

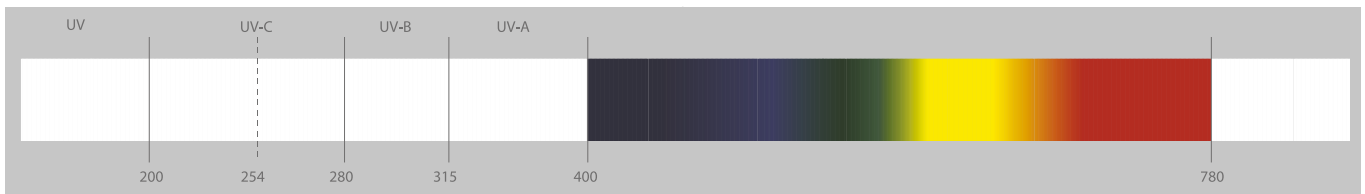


Technical Information Data

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Light

Light is a special form of energy affecting the eye and it's considered to spread in forms of waves or photons. If electromagnetic waves are ordered according to their wavelength, the electromagnetic spectrum is obtained. The section of this spectrum which lies between 380 nm and 780 nms of wavelength is the visible part which is referred to as light.



Wavelength, in terms of Nanometers (nm)

Luminous flux is a term related to the total amount of light emitted by a light source per unit time. It is denoted by Φ . Its unit is lumens. Luminous flux describes the energy flux emitted by a light source which is assessed according to the spectral sensitivity curve of a healthy eye's day vision.

$$\Phi = K_o F V_\lambda$$

K_o : photometric equivalent of energy flux (683 lm/W)

F: energy flux (W)

V_λ : spectral sensitivity of the eye or visibility factor of radiations.

Luminous efficacy: Denoted by e , unit's lm/W.

Luminous efficacy is the ratio of the total luminous flux emitted from a light source or luminaire to the total power of the source or luminaire. In other words, it's the amount of luminous flux emitted by a light source or luminaire corresponding to 1W of power consumed from the grid.

$$e = \frac{\Phi}{P}$$

Luminous intensity:

Luminous intensity is related to the intensity of light emitted in a certain direction per unit time. It is defined for point light sources and it's a direction dependent quantity, its symbol is I and its unit is candela. The average luminous intensity of a point source in any direction γ , I_γ is the amount of luminous flux coming out of the unit solid angle in the same direction.

Illuminance level

Average illuminance level is the ratio of the vertical component of incident luminous flux to the area of unit surface. Its unit is $\text{lm}/\text{m}^2 = \text{lux}$ and is denoted by lx .

Luminance:

Luminance, in general, is related to a particular point on a surface and the direction of view. Luminance is denoted by the letter L . Its unit is cd/m^2 . It is a term related to the luminous intensity travelling in a specific direction from a unit area of a surface. The surface that emits light can be a primary light source such as a lamp that produces light itself or a translucent luminaire surface as well as a secondary light source that reflects the light coming from another source. The luminance of a point on a surface in the direction of γ is the luminous intensity emitted from the apparent unit surface in that direction.

Technical Information Data

Light Generation

Light generation

Light generation in lamps generally occurs in three different groups as thermal, luminescent and electroluminescent.

Thermal Light Generation

When liquids or solids reach a superheated state at high temperatures, they become incandescent and emit light. Incandescent lamps generate light according to this principle. Incandescent light has a continuous spectrum.

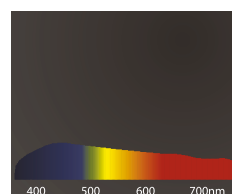
Generation of Luminescent Light

Atoms and molecules release the energy they gain as they pass from the excited state to the ground state, as radiation. This phenomenon takes place by the gas between two solid electrodes which is normally non-conductive, becoming conductive through an electric current and the created electron flow exciting or ionizing the gas atoms. The electrons flowing from one electrode to the other collide with gas atoms on their way. If the speed of electrons is high enough to excite the atoms, the electrons excite the atoms and radiation occurs while the atoms move to their ground state. Unlike the generation of thermal light, the spectrum of light in generation of luminescent light is not continuous. Light is emitted in specific wavelengths according to the type and the partial pressure of the used gases. Lamps operating on this principle are referred to as high pressure or low pressure according to the pressure of the gas within. In discharge lamps used today, mercury or sodium gases are generally used.

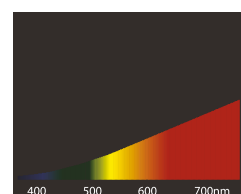
Electroluminescent Light Generation: LED (Light Emitting Diode)

This process is based on the principle of conversion of electrical energy directly to light energy. LEDs are solid-state light sources which allow unidirectional movement of electrons and emit light when an electric current is passed through them. In LED chips which consist of a junction of a P-type semiconductor with an N-type semiconductor, electrons emit photons through combining with holes while passing from the negative side to the positive side (electro-luminescence). LEDs with their efficacy increasing rapidly especially after 1999, stand out for their high efficacy, good color characteristics and long lifetime today. A typical LED chip consists of the following elements.

SPECTRAL RADIATION DISTRIBUTION




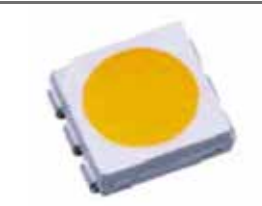
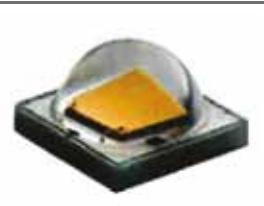
600 mW
100 m 10nm



600 mW
100 m 10nm

Light Generation

Types of LED chips widely used are shown below.

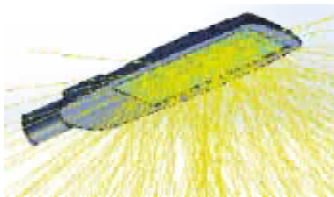
T1	Surface Mount (SMD)	High Power	Multi Chip	COB (Chip on Board)
				

White light can be obtained from LEDs basically in two ways:

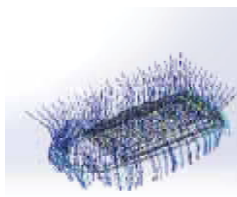
- 1) Obtaining white light using three colored red, green, blue (RGB) LED combinations.
- 2) Obtaining white light through covering short wavelength (blue or ultraviolet) LEDs, with a layer of phosphor.

In designing luminaires using LED chips, optical design being the most notable, thermal and electrical designs of the system should also be taken into consideration. Especially in high-power LEDs, an intense amount of light is released from a very small area. Therefore possible glare problems should be prevented through a good optical design. The luminous efficiency, expressing the ratio of conversion of electrical energy into light energy by LEDs, varies between 10-40 % depending on the type of LED chips. The remaining energy (60-90%) is converted to heat. Heat will accumulate in an LED luminaire without a good thermal design and there will be a temperature rise in the junction point where the light is produced. Increases in the LED junction temperature, will reduce the luminous efficiency of the LED and the luminous efficacy (lumens / watt) value, which indicates the luminous flux amount created per unit power, will be reduced. As the LED chips usually work with direct current, they use a driver in order to draw energy from the existing grid. A secondary task of the drivers is to provide the necessary nominal current to each LED. LED drivers are generally set to give constant current and as a standard, they are produced in current ranges such as 350 mA, 500 mA, 700 mA, 1050 mA etc. The efficiency of LED drivers scale down as the load rate decreases.

An example of the optical design of an LED luminaire



An example of the thermal design of an LED luminaire



Lifetime

Economic lifetime: In a lighting installation consisting of a sufficient sample of lamps for statistical analysis, economic lifetime is the time period which elapses for approximately 30 % depreciation of the total luminous flux due to failure of lamps and reductions in luminous flux.

Average lifetime: In a lighting installation consisting of a sufficient sample of lamps for statistical analysis, average lifetime is in normal conditions the time period which elapses for 50 % of the lamps to fail.

The average lifetime of LED chips varies according to junction temperatures. LEDs driven at high currents have high temperatures and their lifetimes are reduced. LM 80-08 "Approved Method: Measuring Lumen Maintenance of LED Light Sources" tries to define the luminous flux depreciations of LED light sources in time and requires LED light source manufacturers to provide a minimum of 6000 hours of luminous flux (lumens) measurements. It is recommended that the luminous flux measurements are made for minimum 6000 hours, ideally 10,000 hours, collecting the data every 1000 hours. For periods longer than 10000 hours, the standard TM 21-11 "Approved Method: Measuring Lumen Maintenance of LED Light Sources" is used. In TM 21-11, a method is proposed for estimating the data obtained from the measurements according to LM 80-08 in the long run. With the measured values, an attempt at estimating the time that elapses until the luminous flux value drops down to 70%, in other words, economic lifetime, is made. The estimated lifetime of a sample LED chip driven in different current levels are given below.

It is the temperature of a "blackbody" which has the same spectrum with the evaluated light source. Its unit is Kelvin("K). The body which can absorb all of the radiation at different wavelengths falling on it is called as blackbody and the spectral absorption factor of blackbody is assumed as 1 theoretically. When heat energy is given to a blackbody, it will begin to warm up first and then it will emit yellowish, yellow, yellow-and-white and blue-and-white light. The light color of light sources varies depending on the differences in the radiation intensity of their spectrum. The temperature at which a "body with a color temperature", which emits light like a blackbody at a temperature higher than its actual temperature, is referred to as color temperature.

Color Rendering

Color Temperature

It is the temperature of a "blackbody" which has the same spectrum with the evaluated light source. Its unit is Kelvin(°K).

The body which can absorb all of the radiation at different wavelengths falling on it is called as blackbody and the spectral absorption factor of blackbody is assumed as 1 theoretically. When heat energy is given to a blackbody, it will begin to warm up first and then it will emit yellowish, yellow, yellow-and-white and blue-and-white light. The light color of light sources varies depending on the differences in the radiation intensity of their spectrum. The temperature at which a "body with a color temperature", which emits light like a blackbody at a temperature higher than its actual temperature, is referred to as color temperature.

Color Rendering Index

Light sources' ability to distinguish the colors of objects that they illuminate is called the color rendering index. Color Rendering Index - CRI is used to compare the color characteristics of different light sources. These characteristics of various light sources can be measured using a reference source. In these measurements, daylight, with its continuous spectrum is used as the reference. The color rendering index is denoted with R_a and it has no unit. Its value is between 0 and 100. If the color rendering index of a light source has the maximum value of 100 ($R_a = 100$), this means that the spectrum of that source is identical to the reference source.



Luminaries

Luminaries are used to control the distribution of light emitted from light sources and to shape it as desired, to protect the lamp and electric circuits against physical effects, to limit glare and to respond to aesthetic feelings and the need for comfort. For the anticipation and control of the lighting design to be realized, luminaires are the most important data sets necessary to conduct the "lighting calculations". The photometric data of the luminaires signify the luminous intensity distribution surfaces or curves, luminaire efficiencies and luminance and therefore glare.

Luminous Intensity Distribution Surfaces and Curves

The geometric position of the end points of luminous intensities of a luminaire in a variety of directions in the space constitute a surface. This surface is referred to as the luminous intensity distribution surface of a luminaire. To obtain these surfaces, measurements should be conducted in an infinite number of directions. As a more practical means of application, the luminous intensity distribution curves which are cross-sections of different planes passing through the luminaire axis and the luminous intensity distribution surface of the luminaire, or luminous intensity tables are provided instead. In order to perform lighting calculations accurately, luminous intensity tables of luminaires are necessary. Luminous intensity distribution curves and luminous intensity tables are scaled down to correspond to 1000 lm (cd/klm). According to CIE, the luminous intensity distribution curves of luminaires can be given for three different planes of A, B and C.

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Color Temperature (°K)	Color of Light
< 3300	Warm (reddish white)
3300-5300	Medium warm (white)
> 5300	Cold (bluish white)

Luminous Intensity

A Planes

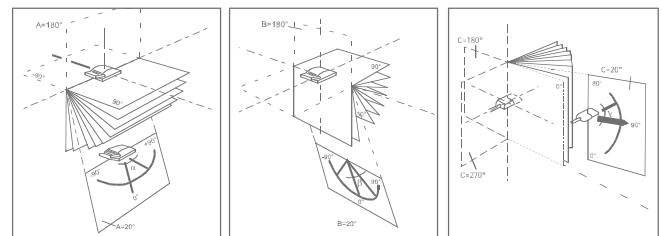
A planes are placed around the rotational axis passing through the luminaire and perpendicular to the luminaire axis. Luminous intensity distribution curves are given by luminous intensity vectors which make α angles with the vertical axis in these planes.

B Planes

The luminaire axis is also considered as the rotational axis. Luminous intensity distribution curves are the geometric locus of the end points of luminous intensities which make β angles with the vertical axis in this plane.

C Planes

Luminous intensity distribution curves in C planes, where the vertical axis passing through the luminaire is taken as the rotational axis, are given with luminous intensity vectors which make γ angles with the vertical axis in these planes.



In order to render an opinion to the users, luminous intensity distribution curves of interior lighting luminaires are given at least for the planes of $C_0^\circ - 180^\circ$ and $C_{90}^\circ - 270^\circ$. For road lighting luminaires, the curves should be given in minimum for $C_0^\circ - 180^\circ$

$C_{90}^\circ - 270^\circ$ and I_{max} planes in which the maximum luminous intensity is obtained. Luminous intensity distribution curves for projectors can be given in B or C planes.

Interior lighting luminaires

Interior lighting luminaires are divided into 6 groups according to the ratio of light they send to the lower and upper half spaces.

Luminaire type	% Upward flux distribution	% Downward flux distribution
Direct	0-10	90-100
Semi-direct	10-40	60-90
Direct-indirect	40-60	40-60
General diffuse	40-60	40-60
Semi-indirect	60-90	10-40
Indirect	90-100	0-10

Luminous Intensity

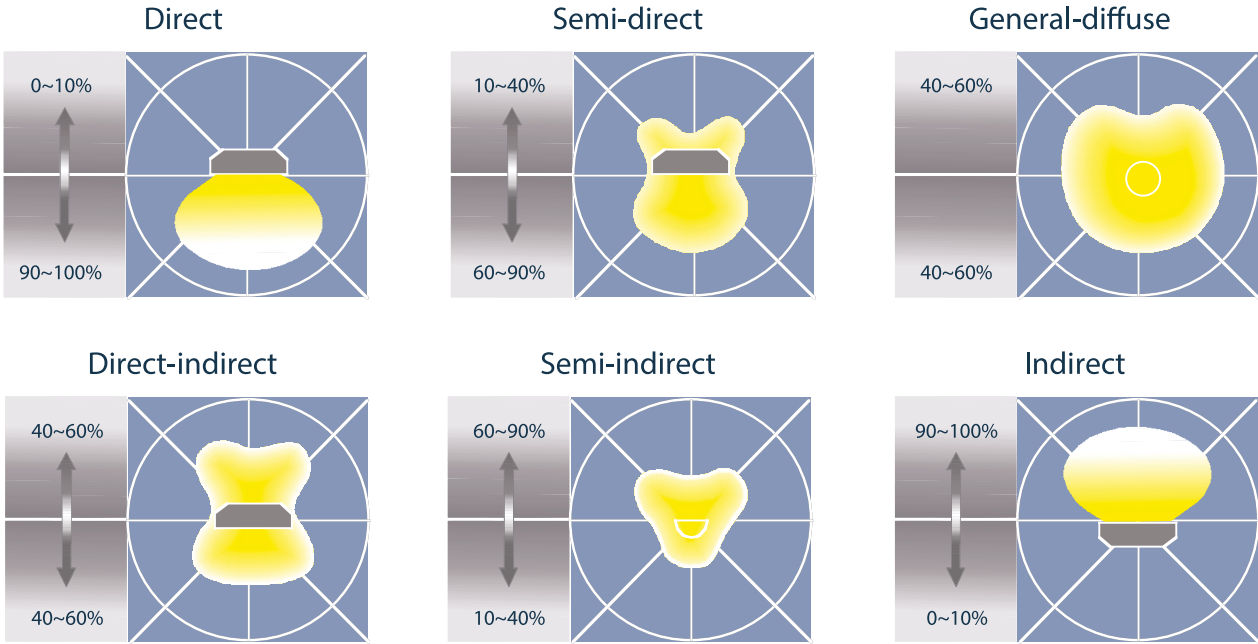


Chart 1. Luminaire classification according to radiation of luminous flux.

Road lighting luminaires
Road lighting luminaires are divided into 3 groups according to CIE;
The classification of luminaires according to CIE

Type of luminaire	I_{80°	I_{90°	The direction of I_{max} (angle of θ_{max})
Screened	30 cd	10 cd	0-65°
Semi Screened	100 cd	50 cd	0-75°
Unscreened	*100 cd		

* Maximum luminous intensity can be 1000 cd.

I_{80} : the maximum luminous intensity value for the angle of $\theta = 80^\circ$ with respect to the vertical axis in $C=0^\circ$ and $C=20^\circ$ planes (in terms of cd/1000 lm),
 I_{90} : the maximum luminous intensity value for the angle of $\theta = 90^\circ$ angle with respect to the vertical axis in $C=0^\circ$ and $C=20^\circ$ planes (in terms of cd/1000 lm),
 θ_{max} : The angular value at which the maximum luminous intensity (I_{max}) occurs.

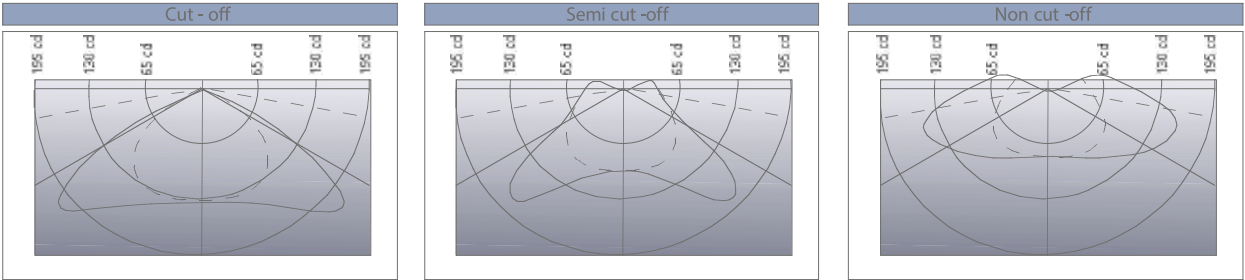


Figure 5. Examples of photometric curves accompanied by their classification.

Protection Against Dust And Water

IP table

Luminaire protection classes are given as IPXY. Here, X (1st Number) shows protection against solid objects, Y (2nd Number) shows protection against liquids.

1st Figure Degree of protection against solid objects	Degree of protection against water								
	0	1	2	3	4	5	6	7	8
	Non protected	Protected against dripping water	Protected against dripping water of 15° angle	Protected against dripping water of 60° angle	Protected against splashing water	Protected against water jets	Protected against heavy seas	Protected against immersion	Protected against submersion
Non protected	0	IP 00	IP 01	IP 02					
Protected against solid objects larger than 50 mm	1	IP 10	IP 11	IP 12	IP 13				
Protected against solid objects larger than 12 mm	2	IP 20	IP 21	IP 22	IP 23				
Protected against solid objects larger than 2,5 mm	3	IP 30	IP 31	IP 32	IP 33	IP 34			
Protected against solid objects larger than 1 mm	4	IP 40	IP 41	IP 42	IP 43	IP 44	IP 45	IP 46	
Dust protected	5				IP 54	IP 55	IP 56		
Completely dust proof	6						IP 65	IP 66	IP 67 IP 68

Reason for Protection Classification: Providing life safety during manwork by protecting the gear and the components from dust and water.

Protection Against Electric Shock

Class	Symbol	Description
0		No earthing protection
I		Earthing protection foreseen
II		Supplementary-insulation, but no earthing protection
III		Foreseen for low-voltage safety power supply

Protection against Mechanical Impact

No Number	Measure of protection Impact energy	Test
IK 00	No protection to this standard	
IK 01	0.15	0.20kg impact
IK 02	0.20	0.20kg impact
IK 03	0.35	0.20kg impact
IK 04	0.50	0.20kg impact
IK 05	0.70	0.20kg impact
IK 06	1.00	0.50kg impact from 10 Rmm
IK 07	2.00	0.50kg impact from 25 Rmm
IK 08	5.00	1.70kg impact from 25 Rmm
IK 09	10.00	5.00kg impact from 50 Rmm
IK 10	20.00	5.00kg impact from 50 Rmm

Minimum Illuminance Levels

	LUX
CHEMICAL INDUSTRY, PLASTIC AND RUBBER	
Remote Control Process Factories	50
Process Factories Where Manpower Labour is Necessary	100
Factories with Continuous Manpower	200
Control and Observation Manpower	300
Laboratories and Packaging Areas	300
Work Requiring Visual Concentration	500
Colour Controls	1000
CEMENT INDUSTRY, CERAMIC and GLASS	
Ovens Mixers	200
Enamelling, Rolling, Pressing, Casting, Simple Parts	300
Grinding, Polishing, Art Work	500
Lens Cutting, Glass Cutting, Manual Cutting	750
Very Fine Works	1000
STEEL PRODUCTION, ROLLING MILES, OVENS	
Automatic Production Process	50
Production Process Requiring Manpower	100
Work Station With Continuous Manpower	200
Control and Observation Points	300
Rest Points and Control	500
METAL WORK	
Hammering of Small Parts	200
Welding, Lathing	300
Fine Lathing Works	500
Marking and Control	750
Cold Rolling	200
Wire Erosion Factories, Cold Strip Profile	300
Thick Sheet Processing	200
Fine Sheet Processing	300
Tool Production	500
Hard Assembly	200
Medium Assembly	300
Fine Assembly	500

Technical Information Data

	LUX
HOUSES, HOTELS, RESTAURANTS	
Bedrooms	50
Headboards	200
Bathrooms	100
Bathrooms (Mirror Fronts)	500
Kithchens	300
Kithchens (On Washing Stands)	500
Living Rooms	100
Living Rooms (Local)	500
Stairs	100
Canteens	200
Warehouses	50
Dressing Rooms, Toilets	100
Gymnasium Rooms, Wardrobes, Laundry	100
OFFICES, SHOPPING CENTERS	
General Office Areas	500
Drawing Rooms	1000
Waiting Lounges	200
IT centers	300
Shops	300
Supermarkets	750
Shops and Showrooms	500
Printer Rooms	300
Computer and Data Preparation Rooms	500
CULTURE, ART, EDUCATION	
Concert Hall, Cinema, Theaters (General)	100
Concert Hall, Cinema, Theaters (Foyer)	200
Exhibition of light sensitive objects	150
Exhibition of light insensitive objects	300
Classes	500
Conference Halls	300
Laboratories, Libraries	500
HOSPITALS	
Night	50

Minimum Illuminance Levels

	LUX
HOSPITALS	
Day	200
Consultation Rooms	500
Stuff Rooms	100
Laboratories	500
AMBARLAR WAREHOUSES	
Warehouses Corridors and Passages	50
Warehouses for Bulk or same type goods	50
Warehouses for Different type goods	100
Warehouses where there should paths	200
AUTOMATION CONTROLLED AND HIGH STACKING WAREHOUSES	
Corridors	20
Operator Places	200
Distribution Places	200
TOILET, CLEANING AND FIRST AID DEPARTMENTS	
Canteens	200
Smoking and Resting Areas	100
Recreation Rooms	300
Showers, Toilets, Dressing Rooms	100
Infirmery and First Aid Rooms	500
INDOOR SERVICE ROOMS	
Machine Rooms, Energy Connection and Distribution Areas	100
Telex Rooms, Mail Centers	500
Central Rooms	300
INDOOR WALKING AREAS	
For Stuff	50
For Stuff and Vehides	100
Stairs, Ramps, and Movable Stairs	100
Loading Ramps, Automatic Conveyors	100
Conveyors in Traffic Area	100
DRAWING ROOMS	
General Office	50
Drawing Tables	750
CAD Stations	300-500

Technical Information Data

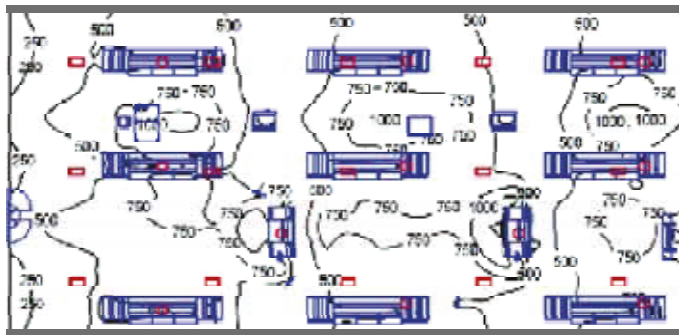
	LUX
WOOD PROCESSING	
Coating, Brightening, Cutting	500
Quality Control	750
PAPER MANUFACTURING, GRAPHICS	
Paper Pulp Stations	200
Cartoon Machines, Binding	300
Cutting, Pressing	500
Seperation of Papers	750
Covering	1000
Colour Controls	1500
Steel and Copper Carving	2000
TEXTILE INDUSTRY	
Work Stations, Baths	200
Washing, Ironing, Knitting, Drawing, Painting	300
Dressing, Spinning, Winding, Knitting	500
Fine Scanning Maintenance, Hat Production	750
Cleaning, Quality Control, Colour Control	1000
Invisible Maintenance	1500
FOOD AND TOBACOO INDUSTRY	
Washing, Cleaning, Brushing in Beer Factories	200
Separation, Packing, Dairy Production	300
FOOD AND TOBACCO INDUSTRY	
Washing, Cleaning, Brushing in Beer Factories	200
Separation, Packing, Dairy Production	300
Separation and Cutting of Fruits and Vegetables	300
Kitchens, Cigar, Cigarette Production	500
Jar and bottle Control, Quality Control, Separation	500
Colour Controls, Laboratories	1000
SERVICE SECTORS	
Hotels and Food Stuff	200
Receptions	500
Restaurants	200
Buffets	300
Confrence Halls	300

Color Rendering

Industrial Area Lighting

- * In the lighting of industrial spaces, tools that perform tasks of their own require a special lighting.
 - * This type of lighting should primarily provide physical security.
 - * The stroboscopic effect which results in incorrect detection of the motion of objects should be eliminated.
 - * Extreme illuminance levels should be avoided.
 - * In the lighting of industrial spaces, the comfort of people working in these areas should be taken into consideration.
 - * The formation of excessive reflections and shadows should be taken care of.
 - * As these types of places are constantly in operation, attention should be paid to energy savings in lighting.
 - * As the industrial plants are usually spaces with high ceilings, light sources with long lifetimes should be preferred.
 - * The replacement of lamps in the luminaires used in these spaces should be easy.
 - * Exproof luminaires should be used in places where flammable and explosive materials exist -such as gas stations
- Luminaire: 2x54W TL5 Highbay -89W LED Highbay
Location: Industrial Areas

Luminaire Arrangement and Light Distribution (Plant Top View)



Energy Saving

Energy Savings in Lighting

The concept is to obtain energy savings through reducing the energy input by increasing the efficiency of lighting without compromising from visual performance and comfort. Against false knowledge, these savings can not be obtained through insufficient lighting. The reason to this is that while insufficient lighting can lower the energy consumption, as it affects the efficiency of the workers of the lit space, it does not provide real savings at the end. Furthermore, as it increases the accident rate at work, it may lead to an unexpected result. These savings may be possible with the improvement of the following lighting components:

- *Use of high efficiency light sources
- *Use of high efficiency luminaires
- *Use of components with lower power loss (for example: lower-loss ballast)
- *Use of lighting controls
- *Convenient lighting design
- *Use of alternative lighting components

Use of High Efficiency Luminaires

*Use of High Efficiency Light Sources

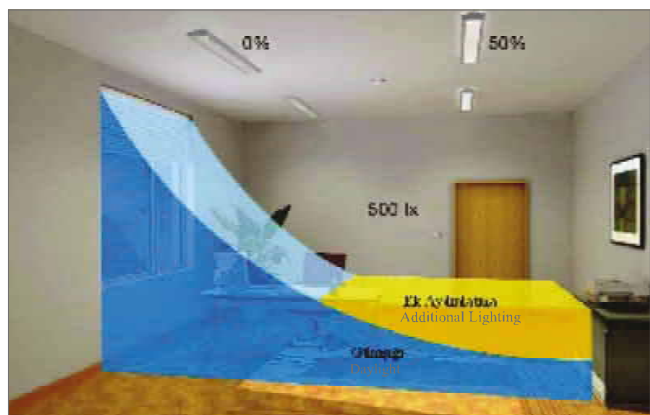
The first requirement of energy-savings in lighting is to provide the necessary light for illumination from light sources with high luminous efficacy. Light sources with a high luminous efficacy emit more luminous flux per unit power. Therefore, in illumination with sources having high efficacies, a lower number of light sources are needed and less energy is used for maintaining the same illuminance level. For example, use of fluorescent lamps for the interior lighting of a plant, where high-pressure mercury vapor lamps have been used, can provide savings up to 43%. Efficacy factors of light sources can be obtained from the comparative table of lamps.

*Use of High Efficiency Luminaires

Luminaires can not efficiently distribute all the light beams radiating from the light sources inside the luminaire. Some of the light beams are absorbed by the reflecting surfaces or when these surfaces are not positioned correctly, the beams can not be reflected to the target surfaces. In order to overcome this situation, high efficiency luminaires with reflectors of high quality and proper design should be used.

*Use of Components with Lower Power Loss

Today, one of the key elements of efficient interior and exterior lighting, discharge lamps, generally need auxiliary components such as ballasts, starters, igniters, etc.. Active power loss caused by auxiliary components, especially the ones which are continuously operating such as the ballast, can significantly affect the efficiency of the system. For example, system efficiency can be improved with ballasts with lower active power loss (lower loss magnetic or electronic ballasts) or using busbar trunks instead of classic installations.



Dimming based on daylight dimming (Luxmate)

Comparison of Light Sources

	INCANDESCENT BULBS	HALOGEN LAMPS	COMPACT FLUORESCENT LAMPS	FLUORESCENT LAMP	LED
Efficacy (lm/W)	6-16	16-25	46-80	70-104	80-160
CRI (Ra)	100	100	75-90	70-95	65-99
Lifetime (hours)	1000	1000-4000	6000-15000	10000-40000	50000
CCT (K)	2700	2700-3500	2700-7000	2700-12000	2700-8000
Electronic Ballast	No	In General No	Needed or Build-in	Needed	Needed
Application	Indoor-Outdoor	Indoor-Outdoor	Indoor	Indoor	Indoor-Outdoor
Dimmable	Yes	Yes	Yes	Yes	Yes
Stroboscopic Effects	No	No	Yes *	Yes *	Yes


* This effect is eliminated if an electronic ballast is used

	MERCURY VAPOUR LAMPS	METAL HALIDE LAMPS	L.P SODIUM VAPOUR LAMPS	H.P SODIUM VAPOUR LAMPS	LED
Efficacy (lm/W)	40-60	72-110	100-192	88-130	80-160
CRI (Ra)	40-60	70-95	0-15	25-70	65-99
Lifetime (hours)	15000-24000	6000-20000	16000-20000	160000-32000	500000
CCT (K)	3200-4200	3000-7000	-	2000-3000	2700-8000
Electronic Ballast	Needed	Needed	Needed	Needed	Needed
Application	Indoor-Outdoor	Indoor-Outdoor	Outdoor	Indoor-Outdoor	Indoor-Outdoor
Dimmable	No	Yes	No	Yes	Yes
Stroboscopic Effects	Yes	No	Yes	No	No


Usage Areas of Fluorescent


	Cold White			Notr White			Warm White			NATURA	
General	54	860	950	33	840	940	29	830	940	827	79
Philips	54	865	950	33	840	940	29	830	940	827	79
General Foods											
Bakery Products											
Freezer Showcase											
Grocery											
Fish											
Butcher											
Textile											
Furniture											
Toys, Stainery											
Fotograph, Jewellery											
Hair Dresser											
Flower											
Supermarkets											
Workshop											
Textile Factories											
Color Test											
Warehouse											
Wood Works											
Graphical Arts											
Conference Halls											
Classrooms											
Kindergartens											
Libraries											
Executive Room											
Meeting Room											
Restaurant											
Museum											
Hospital											


Light Sources


Energy-Saving Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
PL-E 9		9	E14	400 lm
PL-E 9		9	E27	400 lm
PL-E 11		11	E14	630 lm
PL-E 11		11	E27	600 lm
PL-E 20		20	E27	1200 lm
PL-E 24		24	E27	1800 lm




Light Sources

High pressure SON-H Sodium Vapour Lamps(Working Without Ignitor)				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
SON-H 110 SON-H 210 SON-H 350		110	E27	8000 lm
		210	E40	18000 lm
		350	E40	34000 lm


High Pressure Sodium Vapour Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
SON 35 SON 50 SON 70 SON 100 SON 150 SON 250 SON 400 SON 1000		35	E27	2300 lm
		50	E27	3500 lm
		70	E27	5500 lm
		100	E40	9500 lm
		150	E40	15500 lm
		250	E40	30000 lm
		400	E40	54000 lm
		1000	E40	128000 lm


High Pressure Sodium Vapour Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	İfrik Akısı Luminous Flux
SON-T 50 SON-T 70 SON-T 100 SON-T 150 SON-T 250 SON-T 450 SON-T 600 SON-T 1000		50	E27	4000 lm
		70	E27	6500 lm
		100	E40	10000 lm
		150	E40	14500 lm
		250	E40	27000 lm
		400	E40	48000 lm
		600	E40	90000 lm
		1000	E40	130000 lm



Low Pressure Sodium Vapour Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
SOX 18 SOX 35 SOX 55 SOX 90 SOX 135 SOX 180		18	BY22d	1800 lm
		35	BY22d	4600 lm
		55	BY22d	8100 lm
		90	BY22d	13500 lm
		135	BY22d	22500 lm
		180	BY22d	32000 lm




Incandescent Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
		60	E27	730 lm
		100	E27	1380 lm
		25	E14	200 lm
		40	E14	400 lm
		40	E14	430 cd
		60	E27	960 cd
		100	E27	2600 cd


Light Sources







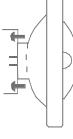
High Pressure Metal Halide Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
HPI-BU 70		70	E27	4000 lm
HPI-BU 100		100	E27	7000 lm
HPI-BU 150		150	E27	10500 lm
HPI-BU 250		250	E40	19000 lm
HPI-BU 400		400	E40	32000 lm
HPI-BU 1000		1000	E40	90000 lm




High Pressure Metal Halide Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
HPI-T 250		250	E40	20000 lm
HPI-T 400		400	E40	32000 lm
HPI-T 1000		1000	E40	80000 lm
HPI-T 2000		2000	E40	180000 lm
HPI-T 3500		3500	E40	320000 lm


Metal Halide Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
CDM-T 70		70	G12	5500 lm NDL 5200 lm WDL
CDM-T 150		150	G12	12500 lm NDL 12000 lm WDL
CDM-TD 70		70	RX7s	5000 lm D 5500 lm NDL 5000 lm WDL
MHN-TD 150		150	RX7s	11000 lm D 11250 lm NDL 11000 lm WDL
MHN-TD 250		250	FC2	20000 lm D 20000 lm NDL 20000 lm WDL

Fluorescent Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
TL 6		6	G5	220 lm
TL 8		8	G5	300 lm
TL13		13	G5	1030 lm
TL-D 15		15	G13	650 lm
TL-D 18		18	G13	1300 lm
TL-D 30		30	G13	3250 lm
TL-D 36		36	G13	3250 lm
TL-D 58		58	G13	5000 lm
TL5 14		14	G5	1220 lm
TL5 28		28	G5	2580 lm
TL-C 22		22	G10q	1000 lm
TL-C 32		32	G10q	1750 lm
TL-C 40		40	G10q	2500 lm

Ballastless Mercury Vapor Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
ML 160		160	E27	3100 lm
ML 250		250	E40	5600 lm
ML 500		500	E40	14000 lm

Halogen Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
Halogen Reflector 12 V		20	GU5,3	3400 cd 10°
		20	GU5,3	550 cd 38°
		35	GU5,3	6000 cd 10°
		35	GU5,3	1000 cd 38°
		50	GU5,3	8800 cd 10°
		50	GU5,3	1600 cd 38°
Halogen Pin End 12 V		10	G4	130 lm
		20	G4	320 lm
		35	GY6,35	600 lm
		50	GY6,35	930 lm
Halogen Bar 220 V		100	R7s	1650 lm
		150	R7s	2200 lm
		200	R7s	3000 lm
		300	R7s	5000 lm
		500	R7s	9500 lm
		1000	R7s	24200 lm
		1500	R7s	33000 lm
2000	R7s	44000 lm		
Halopar 16 220 V		50	GU10	800 cd 40°
50		E27	750 cd 40°	
Halopar 20 220 V		50	E27	3000 cd 10° 1000 cd 38°
Halopar 30 220 V		75	E27	6900 cd 10° 2200 cd 30°
Spotpar 38 220 V		60	E27	3400 cd 12° 1200 cd 30°
		80	E27	5400 cd 12° 1800 cd 30°
		120	E27	9300 cd 12° 3100 cd 30°
Halospot 111 12 V		35	G53	45000 cd 4°
		35	G53	9000 cd 8°
		35	G53	2500 cd 12°
		50	G53	50000 cd 4°
		50	G53	20000 cd 8°
		50	G53	3500 cd 12°
		75	G53	30000 cd 8°
		75	G53	5300 cd 24°
		75	G53	1700 cd 45°
		100	G53	48000 cd 8°
100	G53	8500 cd 24°		
100	G53	2800 cd 45°		

Compact Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
PL 9		9	G23	600 lm
PL 11		11	G23	900 lm
PL-C 10		10	G24	600 lm
PL-C 13		13	G24	900 lm
PL-C 18		18	G24	1200 lm
PL-C 26		26	G24	1800 lm
PL-L 18		18	2G11	1200 lm
PL-L 24		24	2G11	1800 lm
PL-L 36		36	2G11	2900 lm
PL-L 40		40	2G11	3500 lm
PL-L 55		55	2G11	4800 lm

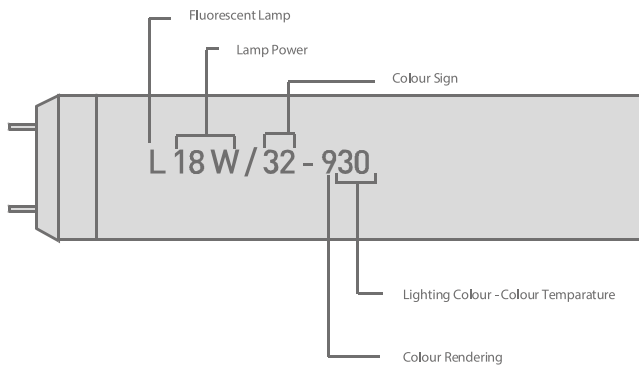
High Pressure Mercury Vapor Lamps				
Type of Lamp	Shape	Watt (W)	Lamp Holder	Luminous Flux
HPL 50		50	E27	1800 lm
HPL 80		80	E27	3800 lm
HPL 125		125	E27	6300 lm
HPL 250		250	E40	13000 lm
HPL 400		400	E40	22000 lm
HPL 700		700	E40	38500 lm
HPL 1000		1000	E40	58500 lm

Technical Information Data

Fluorescent Lamp Codes

Colour temperature and colour rendering standard presentation which is found on fluorescent lamps is given below.

Fluorescent Lamp Codes



9	Colour rendering index	1A	(Ra 90.....100)
8	Colour rendering index	1B	(Ra 80.....89)
7	Colour rendering index	2A	(Ra 70.....79)
6	Colour rendering index	2B	(Ra 60.....69)
5	Colour rendering index	3	(Ra 50.....59)
4	Colour rendering index	3	(Ra 40.....49)

Code Descriptions

International Color Code

First number is for color rendering

30	Warm White	3000 K
40	Cold White	4000 K
50	Daylight	5400 K
60	Daylight	6000 K

The following numbers refer to the color temperature.

Technical Symbols

	Products manufactured in accordance with European standards		2 Class of protection, reinforced insulation is made, no grounding
CELMA	Energy Classification System EEI = A1		3 rd Class of protection, low voltage, ungrounded
	European Norms Electrical Certification		Protected against dripping water IPx1
	Can be mounted to flammable surfaces		Protected against rain IPx3
	1 Class of protection the, body is grounded		Protected against water jets IPx4
	Dustproof		Protected against water jets IPx5
	Size of holes		Waterproof, sinkable and removable to the water IPx7
			Pressurized water proof Submersible IPx8
			Dust-resistant

Technical Information Data

Fields of Application



MIRROR TOPS



MAKE UP ROOMS



PAINTINGS



DECORATIVE OBJECTS



BED HEADS



SHOWCASES



STORES



BOUTIQUES



OFFICES



HOTELS



SCHOOLS



HOSPITALS



MEETING HALLS



OPERATION ROOMS



CONSTRUCTION SITES



SHIPS



HIGHWAYS



STADIUMS



OPEN WAREHOUSES



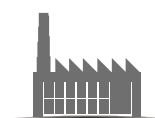
CLOSED WAREHOUSES



SHOPPING CENTERS



INDUSTRIAL KITCHENS



PLANTS WORKSHOPS



LABORATORIES



CLOSED SPORT COMPLEXES



URBAN ROADS



FACADES



RESTAURANTS AND CAFES



AISLES



BALCONIES



SHOWERS



CLOSED CARPARKS



INDUSTRIAL PLANTS



OPEN CARPARKS



MARKETS



OPEN SPORT COMPLEXES



TUNNELS



BUILDING SURROUNDINGS



PARKS



SQUARES



AIRPORTS



POOLS



STAIRS

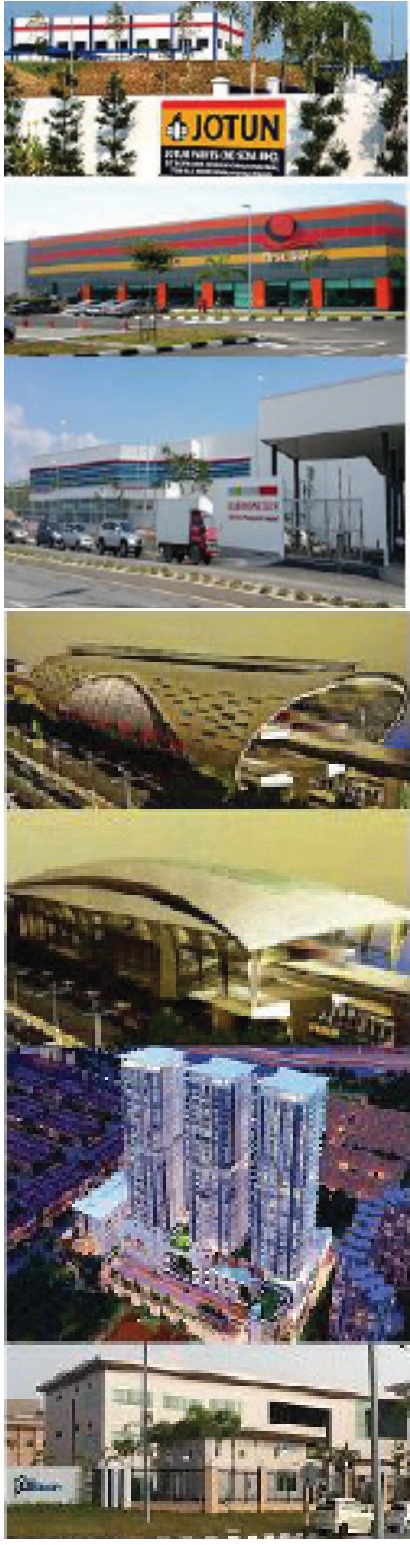


HOUSES



GAS STATIONS

Project Information



Project Information

