

TECHNICAL DATA

LIGHTING MAGNITUDES

Luminous intensity

Symbol : I
Unit : Candela (cd)

Luminous intensity is the luminous flux emitted over a three-dimensional angle, divided by the magnitude of such angle. The distribution of luminous flux are normally shown in polar coordinate graphics. Joining the endpoints of the light intensities provides the geometric shape of the distribution of the intensities. The light distribution graph shows the distribution of the light on a plane, that is, a cross-section of the three dimensional figure of intensity distribution.

Luminous Flux (also "luminous flux", and "light output")

Symbol : f
Unit : Lumen (lm)

The luminous flux is the radiated power emitted by a light source, perceived and evaluated according to the internationally-established value for the sensitivity of the human eye. The luminous flux of lamps are stated in the manufactures technical documentation and are also summarized in this catalogue. One magnitude derived from the luminous flux is the lighting efficiency in lumens/Watts.

Luminance

Symbol : L
Unit: candela per square metre (cd/m²)

Luminance is the magnitude that determines the impression of greater or less brightness produced by a surface. It is calculated using the illuminance E on the surface and the degree of the surface's reflection (r) using the formula:

$$L = \frac{r}{p} \cdot E$$

(This formula does not apply to very bright surfaces.) The degree of reflection can be determined using the tables included in many technical publications. As an example of one of the most common, we can state the Degree of Reflection Table.

Illuminance

Symbol : E
Unit : Lux (lux)

Illuminance is the luminous flux falling on a surface, divided by the area of the surface. Illuminance is the magnitude expressing the level of lighting on a surface or spatial area. Minimum illuminance values are recommended for different visual tasks.

Light output ratio

Symbol : h

The output of spotlights and illuminaires is the result of dividing the luminous flux they emit by the luminous flux of the lamp operating without any obstacle, thus in spotlights and illuminaires with reflector lamps the output is h

Colour rendering index

Symbol: CRI or Ra

Colour rendering indicates the effect of the radiation from a light source on the colour appearance of the objects it

Degrees of reflection			
Colour	Factor	Material	Factor
White	0.7 - 0.8	Maple	0.6
Cream	0.7 - 0.8	Birch	0.6
Yellow	0.55 - 0.65	Red brick	0.05-0.25
Light green	0.45 - 0.5	Concrete	0.15-0.4
Pink	0.45 - 0.5	Light oak	0.4
Blue	0.4 - 0.45	Dark oak	0.15-0.20
Light grey	0.4 - 0.45	White lacquer	0.65-0.75
Beige	0.25 - 0.35	Clear glass	0.06 - 0.08
Ochre yellow	0.25 - 0.35	Cream wood	
Light chestnut	0.25 - 0.35	fibre plates	
Olive green	0.25 - 0.35	Tiles, white	0.5 - 0.6
Orange	0.2 - 0.25	Dark chestnut	0.6 - 0.75
Red	0.2 - 0.25	Whitewash	0.15 - 0.20
Medium grey	0.2 - 0.25	(plaster)	0.8
Dark green	0.1 - 0.15		
Dark blue	0.1 - 0.15		
Dark red	0.1 - 0.15		
Dark grey0.	1 - 0.15	For comparison	
Sea blue	0.05 - 0.1	soot or black	
Black	0.04	velvet	0.02 - 10

Luminance Values (cd/m2)	
Sun at Noon	16x10 ⁹
Sun at sunset	6x10 ⁶
Clear Sky	8.000
Cloudy sky	2.000
Incandescent Lamp 60W clear Bulb	5x10 ⁶
Incandescent Lamp 60W Opaque Bulb	5x10 ⁴
Fluorescent Linear Lamp 18W	4.000

illuminates, in comparison with the colour appearance of such objects when lit by a reference source. The maximum value of Ra = 100 means that the colour rendition of the light source at hand is completely equal to that of the reference source. As can be seen in Colour Rendering table, the colour rendition requirements depend on the visual task.

Colour temperature

The colour temperature depends on the spectral energy distribution in the visible field. Light sources with a predominance of red are said to be 'warm'. When blue predominates, they are said to be 'cold'. For the same agreeable lighting effect, cold colour sources need higher lighting levels than warm ones. The light sources generally used to light interiors can be divided into three colour temperature groups.

Colour rendition index			
Output group	Range of CRI	Colour Appearance	Examples of potential use
1A	Ra>90	Warm,neutral,cold	Colour discrimination medical examination
1B	80<Ra<90	Warm, neutral, cold	Offices, hospitals,shops and schools,paint textile&printing industries.
2B 3 2	60<Ra<80 40<Ra<60 20<Ra<40	Warm,neutral, cold	Industries and stores Heavy industries Roads

Colour temperature			
Colour appearance Group	colour appearance	colour temperature	suitable locations
1,WW	Warm	Below 3,300 K	Residential areas
2nW	Neutral	Between 3,300 & 5,000 K	Work areas
3tW	cold	Above 5,000 K	Highlevels(lux).Special tasks Dry climates.

AN APPROACH TO ILLUMINATION DESIGN

Illumination design calls for creative and engineering abilities of the designer. It is now a matter of common knowledge that a well designed interior adds to the productivity of its occupant, creates congenial atmosphere and reduces fatigue. The scope of interior lighting design can vary widely from installation to installation. Here, an attempt is being made to furnish, step by step preparation of lighting design by lumen method for a simple interior. However, more complex designs involving numerous variables and demanding critical evaluation of photometric results, should be dealt with by professional lighting engineers. In such cases, please approach our nearest branch office or our LAB at Bombay.

CALCULATION STEPS

STEP- 1:

Study the plan and evaluation of installation where the visual task is to be performed.

From standards, and if required thru interaction with user, determine lighting needs viz. illuminance, uniformity, glare limitation, colour quality, etc.

STEP - 2

Select light source and luminaire appropriate to the installation geometry, nature of visual tasks and energy criteria.

Recommended illumination levels

TYPE OF ROOM, TASK OR ACTIVITY	RANGE OF ILLUMINANCE IN SERVICE (lux)		
GENERAL AREAS IN BUILDINGS			
– Aisles and corridors	50 -	100 -	150
– Stairs and lifts	100 -	150 -	200
– Cloakrooms & services	100 -	150 -	200
– Stores	100 -	150-	200
HEAVY INDUSTRIES			
– Production plants without manual work	50 -	100 -	150
– Production plants with occasional manual work	100 -	150 -	200
– Production plants & permanently attended posts	200 -	300 -	500
– Control and Inspection platforms	300 -	500 -	750
TEXTILE INDUSTRIES			
– Design and cutting	200 -	300 -	500
– Sewing and inspection	750 -	1000 -	1500
OFFICES			
General offices, Computer rooms	300 -	500 -	750
Plan offices	500 -	750 -	1000
Technical offices(drawing)	500 -	750 -	1000
Meeting rooms	300 -	500 -	750
SCHOOLS			
CLASSROOMS			
– General lighting	300 -	500 -	750
– Blackboards	300 -	500 -	750
– Drawing classrooms	500 -	750 -	1000
ART ROOMS	300 -	500 -	750
CRAFT WORK CLASSROOMS	300 -	500 -	750
MEETING ROOMS	150 -	200 -	300

STEP - 3

Arrive at Room Index (R.I) using the following formula :

$$R.I = \frac{\text{Length} \times \text{Breadth}}{(\text{Length} + \text{Breadth}) \text{ Mounting Ht.}}$$

STEP - 4

Read co-efficient of utilization (C.O.U.) from COU table for selected luminaire. These values are based on R.I. and room surface reflectance which are generally 70% for light colours, 50% for average and 30% for dark walls and 50%, 30% and 10% for corresponding ceilings.

STEP - 5

Select the Maintenance Factor (M.F.) A general guideline is given below:

AREA:	M.F
A.C rooms, clean rooms, offices, or any other Commercial interior	0.80
Industrial environment, indoor area except control Rooms and outdoor areas.	0.70
Dusty areas eg. Cement Plants, Coal handling areas Foundry etc.	0.60

STEP - 6

Use the following formula to arrive at the quantity of luminarie.

$$\text{Quantity of Luminaire} = \frac{\text{Area} \times \text{Illuminance}}{\text{C.O.U.} \times \text{M.F.} \times \text{No. of lamps per Lumen} \times \text{Lumen per lamp.}}$$

STEP - 7:

Disposition of luminarie should be in general symmetrical. Due consideration should be given to ceiling details for minimizing mounting cost. The mounting to spacing ratio of the selected luminaire should also be kept in mind while working out disposition to achieve desired uniformity of illumination.

OUTDOOR LIGHTING







As the sun goes down, the safety and comfort of road user also goes down particularly on roads which are not well lighted. The primary purpose of street lighting is to provide safety. Studies in many developed countries reveal that proper road lighting can help to reduce accidents at night by more than 30 per cent.

















The objective of street lighting design is not only to find out optimum spacing for a given width of road but also to arrive at appropriate installation parameters like mounting height, overhang and angle of tilt. This calls for constant juggling of numerous variables till optimum lighting solution is obtained. This can be achieved by a computer with speed and accuracy.









Flood lighting design is more complex as it also involves numerous calculations which cannot be performed with speed and accuracy without the help of a computer. It also requires an understanding of the site, application, environment etc.

TYPE OF ROOM, TASK OR ACTIVITY	RANGE OF ILLUMINANCE IN SERVICE (lux)		
HOSPITALS			
Rooms			
- General lighting	50-	100-	150
- Examination	200-	300-	500
- Reading	150-	200-	300
- Night movement	3-	5-	10-
EXAMINATION ROOMS			
- General lighting	300-	500-	750-
- Localised Inspection	750-	1000-	1500-
INTENSIVE CARE			
- Heads of beds	30-	50-	100
- Observation	200-	300-	500
NURSES' ROOMS			
	200-	300-	500
OPERATING THEATRES			
- General lighting	500-	750-	1000
- Local	10000-	30000-	100000
Autopsy rooms			
- General lighting	500-	750-	1000
- Local	5000-	10000-	15000
SURGERIES			
- General lighting	300-	500-	750
- Local	500-	750-	1000
LABORATORIES & PHARMACIES			
- General lighting	300-	500-	750
- Local	500-	750-	1000
SHOPS			
- General lighting in shopping malls	500-	750-	
- In any place	300-	500-	
- In supermarkets	500-	750-	

Luminaire are classified according to the type of protection against electric shock provided as classII, class III

CLASS I		Luminaire provided with an earth connection. Under any fault.
CLASS II		Double insulation with no grounding required.
CLASS III		Luminaire design for operation on safety of extra low voltage. Incase of failure of an insulation no admissibly high touch voltage can develop either between conductors or between a conductor and earth.
MARKING		
		Luminaire for use high pressure sodium lamps that require an extra ignitor(to the lamp)
		Luminaire for use high pressure sodium lamps having an internal starting device
		Luminaire suitable for direct mounting on flammable surface


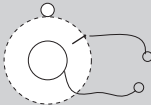
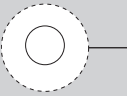
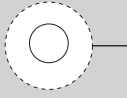


Symbol	Type (W)	Wattage (V)	Voltage	Base intensity(cd)	Luminous (lm)	Light out put (hr)	Average life (mm)	Diameter (mm)	Length	
	GLS	25-100	220-240	E27	-	220-1380	100	60	105	
	P45	40	-	E27	400	-	-	-	-	
	MR 16	50	12	GX/GU 5.3	3100(24)	-	3500	50	46	
	a4	50	12	G53	45000	-	3000	111	46	
	a8				20000				44	
	a24				4000				49	
	a8	30000			44					
	a24	75			5300				-	49
	a45	100			1700				-	48
	a8	48000			-				44	44
a24	8500	-	49	49						
a45	2800	-	48	48						
	SPa10	50	220-240	E27	3000	-	2000	65	65	
	PAR 20				1000					
	FLa 30				1000					
	SPa 10	75	220-240	E27	5500	-	2000	81	81	
	PAR25				1100					
	FLa 30				1100					
	FLa 30	75	220-240	E27	2200	-	2000	97	91	
	PAR 30 SPa10	100			6900		2500			
	FLa 30	3500								
	PAR 38	100W 10°	220-240	E27	10000	-	-	-	-	
		100W 30°		E27	3000					
	HID Elliptical shape	75	220-240	E27	-	5500	15000	54	138	
		100				8500				
		150				13000				
	HCI-T	35	220-240	G12	-	3400	2000	25	84	
		70				6600				
		150				14000				5000
	HCI-TS	75	220-240	RX7S	-	55000	4000	21	114	
		150				13500				24
  	QT32	60	220-240	E27	-	840	-	-	-	
	QT32	100		E27		1550				
	QT-DE12	150		R7s		2600				
 	QT9	10	220-240	G4	-	140	-	-	-	
	QT12	50		GY6.35		950				

Symbol	Type	Wattage (W)	Voltage (V)	Base	Luminous	Light out put intensity(cd)	Average life (lm)	Diameter (hr)	Length
	TC-S	5	220-240	G23	-	250	8000	12	108
		7				400			137
		9				600			137
		11				900			237
	TC-D	10	220-240	G24d-1	-	600	8000	12	110
		13				900			138
		18				1200			153
		26				1800			172
	TC-TEL	18	220-240	G24q-2	-	1200	8000	56/61	123/118
		26				1800			138/133
		32				2400			153
		42				3200			
	TC-L	18	220-240	2G-11	-	1200	10000	17	225
		24				1800			320
		36				2900			415
		18				1140			225
		24				1750			320
		36				2800			145
		40				3500			535
55	4800	535							
	PLE-U	11	220-240	E27	-	540	12000	49	126
		15				900			149
		20				1200			149
		23				1500			170
	PLE-T	23	220-240	E27	-	1500	15000	58	173
	T-5	14	220-240	G5	-	1270	16000	16	549
		28				2720			1149
	T-8	18	220-240	tG-13	-	1000	T10000	26	590
		36				2350			1200







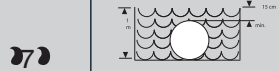
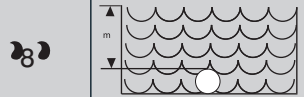
INGRESS PROTECTION

The IP (level of protection) is a two digit number which indicates the protection level provided by the housing of the lighting appliance. The first digit indicates the protection level against dust and the second against water.

1st digit protection against solid bodies

IP	tests	
0		Unprotected
1		Protected from solid bodies more than 50mm (eg. accidental contact with a hand)
2		Protected from solid bodies more than 12mm (eg.fingers)
3		Protected from solid bodies more than 2.5 mm (eg. tools,wires or similar)
4		Protected from solid bodies more than 1mm (eg.small tools, fine wires...)
5		Protected from dust (without harmful deposits)
6		Total protection from dust

2nd digit protection against liquids

IP	Tests	
0		Unprotected
1		Protected from vertically falling drops of water (condensation)
2		protected from water falling at an angle up to 15° from the vertical
3		Protected from rain water falling at an angle upto 60° from the vertical
4		Protected from water sprayed in all directions
5		Protected from water getting in all directions
6		Protected from heaving water similar to heavy seas
7		Protected from immersion in water
8		Protected from prolonged immersion in water at a specified pressure.

The two first digits are defined by the norms UTE C 20 010, IEC 144 and 525 and DIN 40 050

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