

# Lighting Terminology Guide

## GENERAL GUIDE



**GENLUX LIGHTING**

a lighting technology company

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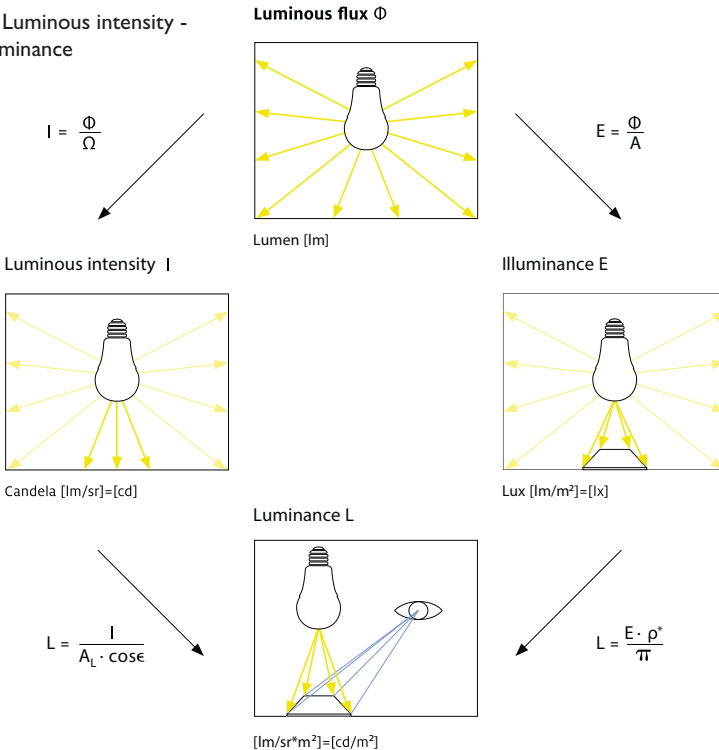
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# Basics of Lighting

## Basic Lighting Terminology

Luminous flux - Luminous intensity -  
Illuminance - Luminance



- $\Omega$  = solid angle into which luminous flux is emitted
- A = area hit by luminous flux
- $A_L \cdot \cos \epsilon$  = visible areas of light source
- $\rho$  = reflectance of area
- $\pi$  = 3.14
- \* = for diffuse surface areas

### Luminous flux

The luminous flux describes the quantity of light emitted by a light source. The luminous efficiency is the ratio of the luminous flux to the electrical power consumed (lm/W). It is a measure of a light source's economic efficiency.

**Abbreviation:  $\Phi$  Unit: lm Lumen**

### Luminous intensity

The luminous intensity describes the quantity of light that is radiated in a particular direction. This is a useful measurement for directive lighting elements such as reflectors. It is represented by the luminous intensity distribution curve (LDC).

**Abbreviation: I Unit: cd Candela**

### Illuminance

Illuminance describes the quantity of luminous flux falling on a surface. Relevant standards specify the required illuminance (e.g. SANS 10114-1:2005 "Interior Lighting").

**Abbreviation: E Unit: lx Lux**

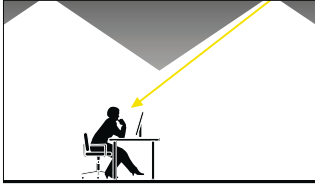
### Luminance

Luminance is the only basic lighting parameter that is perceived by the eye. It describes on the one hand a light source's impression of brightness, and on the other, a surface and therefore depends to a large extent on the degree of reflection (colour and surface).

**Abbreviation: L Unit: cd/m<sup>2</sup>**

# Understanding Glare

## Direct glare



### Cause

- Luminaires without glare control
- Very bright surfaces

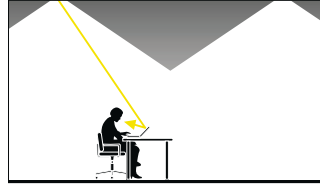
### Effect

- Loss of concentration
- More frequent mistakes
- Fatigue

### Remedy

- Luminaires with limited luminance levels
- Blinds on windows

## Reflected glare



### Cause

- Reflective surfaces
- Incorrect luminaire arrangement
- Incorrect workstation position

### Effect

- Loss of concentration
- More frequent mistakes
- Fatigue

### Remedy

- Matching luminaire to workstation (layout)
- Indirect lighting
- Matt surfaces

## The evaluation of glare

The glare of all luminaires that are in the room regularly can be evaluated with the UGR method, as specified in the standard SANS 10114-1:2005 "Interior Lighting".

However LED luminaires with very bright light points, which can be perceived individually, are crucial.

## The UGR method

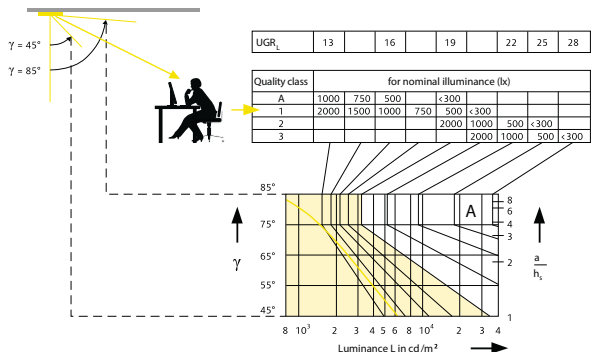
The standardized UGR method (unified glare rating) is used to assess (psychological) glare.

The UGR value is calculated with a formula. This takes into account all of the luminaires in the system that contribute to the impression of glare.

The UGR method takes account of the brightness of walls and ceilings (1) as well as all luminaires in the system that contribute to the sensation of glare (2). The result is a UGR index.

## UGR limits (UGRL) that must not be exceeded:

- ≤ 16 Technical drawing
- ≤ 19 Reading, writing, training, meetings, computer-based work
- ≤ 22 Craft and light industries
- ≤ 25 Heavy industry
- ≤ 28 Railway platforms, foyers



# Light Colour

	Colour Temperature	Appearance	Association
ww (warm white)	up to 3300K	reddish	warm
nw (neutral white)	3300 - 5300K	white	neutral
cw (cool white)	from 5300K	bluish	cool

The light colour describes the colour appearance of the light.

## Colour rendering

Colour rendering is the ability of a light source to reproduce surface colours (test colours R1 to R14) as faithfully as possible compared to a reference light source. It is identified by the colour rendering index (CRI). The best colour rendering is  $R_a = 100$ .

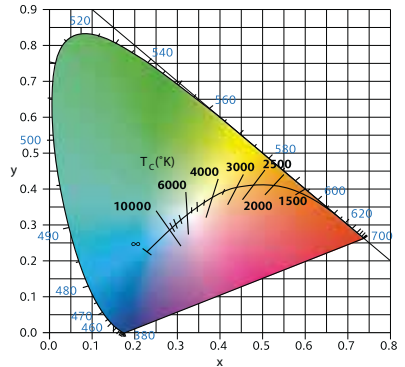
Light sources are divided up into colour rendering levels:

$R_a > 90$  very good colour rendering

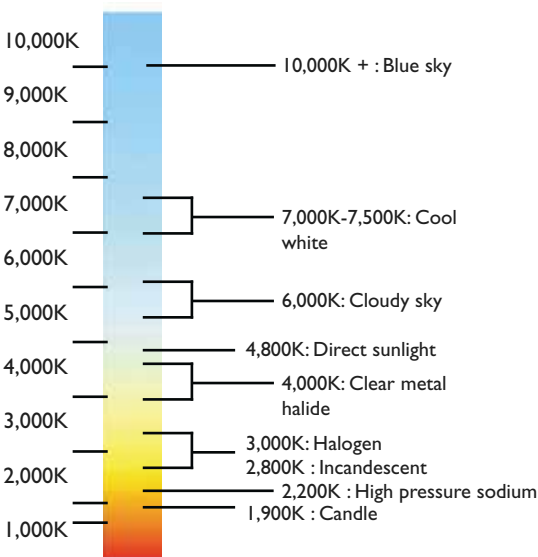
$R_a > 80$  good colour rendering

Colour rendering of less than 80 should not be selected at workplaces.

If light sources with a colour rendering index below 80 are used in exceptional cases, it has to be ensured that safety colours can be recognized without any problems.



## Kelvin colour temperature scale



## Colour rendering comparison



**CRI < 60**







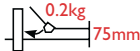


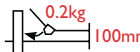


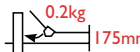


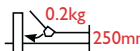


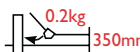






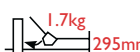
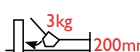

**CRI > 80**



**CRI > 90**

# Luminaire Ingress Protection Ratings

## Ingress protection

IP	1st Figure solid particle protection	IP	2nd Figure liquid particle protection	IK	Mechanical impact resistance IK
0	 No protection.	0	 No protection.	00	0.0J No protection.
1	 Any large surface of the body > 50mm, such as the back of a hand.	1	 Dripping water (vertically falling drops).	01	0.15J 
2	 Fingers or similar objects >12.5mm.	2	 Water dripping at any angle up to 15° from the vertical.	02	0.20J 
3	 Tools, thick wires, etc. >2.5mm.	3	 Water falling as a spray at any angle up to 60° from the vertical.	03	0.35J 
4	 Most wires, screws, etc. >1mm.	4	 Water splashing from any direction.	04	0.50J 
5	 Protected against dust.	5	 Water projected by a nozzle from any direction.	05	0.70J 
6	 No ingress of dust (dust tight).	6	 Water projected in powerful jets from any direction.	06	1.00J 
		7	 Immersion in water.	07	2.00J 
		8	 Continuous and prolonged immersion in water.	08	5.00J 
				09	10.00J 
				10	20.00J 

## Explosion Proof Terminology

### Flammable gases, vapours and mists

#### Zone 0

A hazardous explosive atmosphere is present continuously or long term.

#### Zone 1

A hazardous explosive atmosphere can be expected to occur occasionally.

#### Zone 2

A hazardous explosive atmosphere can be expected to occur only rarely and, if any, short term.

### Combustible dusts

#### Zone 20

Includes areas in which there is a permanent, long-term or frequent explosive atmosphere consisting of dust-air mixtures.

#### Zone 21

Includes areas in which an explosive atmosphere consisting of dust-air mixtures can be expected to occur occasionally and short term.

#### Zone 22

Includes areas in which an explosive atmosphere cannot be expected to occur due to disturbance of deposited dust. If an explosive atmosphere should nevertheless occur, this will most probably happen only rarely and short term.

# Maintenance Factors

## Maintenance factor

The maintenance value of the illuminance for a room must define the obligatory entries according to SANS code of practices over the entire period of usage. The maintenance factor for a room or space is determined based on the selected lighting system, room conditions and other factors.

## LLMF - Lamp Lumen Maintenance Factor (LED's)

LLMF		
Type	30 000 Hrs	50 000 Hrs
Type A (L82 B50)	0.89	0.82
Type B (L80 B50)	0.88	0.80
Type C (L77 B50)	0.86	0.77

## LMF - Luminaire Maintenance Factor

LMF		
Environment	6 Monthly Cleaning	Yearly Cleaning
Very Clean	0.94	0.96
Clean	0.96	0.94
Normal	0.93	0.90
Dirty	0.91	0.86

## RSMF - Room Surface Maintenance Factor

RSMF				
Environment	Yearly Cleaning		3 Year Cleaning	
	Direct Luminaires	Indirect Luminaires	Direct Luminaires	Indirect Luminaires
Very Clean	0.97	0.96	0.97	0.95
Clean	0.95	0.91	0.94	0.91
Normal	0.91	0.84	0.90	0.83
Dirty	0.86	0.75	0.86	0.75

Maintenance factor calculation = MF : LLMF x LMF x RSMF

## Recommended Average Minimum Maintained Illuminance Values

### Classes of play:

#### Class I:

Top-level competition, both national and international level. There are usually a large number of spectators and their viewing takes place from long distances.

#### Class II:

Mid-level competition, matches at regional or local club level with medium-sized spectator groups and average viewing distances.

#### Class III:

Lower-level competition and recreational sport. This normally involves small numbers of spectators at short viewing distance.

### Level of competition:

- International and national: Class I
- Regional: Class I and II
- Local: Class I, II and III
- Training: Class II and III
- Recreational: Class III

These Classes do not take television coverage into account, this is dealt with separately in recommendations for televised events.

Class	Lux - Horizontal illuminance average		Uniformity minimum average		Colour rendering	Glare rating
<b>Aerobics (Indoor)</b>						
I	500		0.7		>60	<50
II	300		0.7		>60	<50
III	200		0.7		>60	<50
<b>Athletics</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	500	0.7	0.7	>60	<50
II	200	300	0.6	0.7	>60	<50
III	75	200	0.5	0.5	>20	<55
<b>Archery</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I, II, III	200	200	0.5	0.5	>60	-
	At target	At target				
I, II, III	750		0.8		>60	-
I, II, III (25m)		1000		0.8		-
I, II, III (50m)		2000		0.8		-
<b>Badminton (Indoor)</b>						
I	750		0.7		>60	n/a
II	500		0.7		>60	n/a
III	300		0.7		>20	n/a
<b>Basketball</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	750	0.7	0.7	>60	<50
II	200	500	0.6	0.7	>60	<50
III	75	200	0.5	0.5	>20	<55



Class	Lux - Horizontal illuminance average		Uniformity minimum average		Colour rendering	Glare rating
<b>Bowls / Boules</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	300	500	0.7	0.8	>60	<50
II	200	500	0.7	0.8	>60	<50
III	100	300	0.5	0.5	>60	<55
<b>Bowling (Indoor)</b>						
I	200		0.5		>60	-
II	200		0.5		>60	-
III	200		0.5		>60	-
<b>Cricket</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	750	750	0.7	0.7	>60	<50
II	500	500	0.7	0.7	>60	<50
III	300	300	0.7	0.7	>20	<55
	Outfield					
I	500		0.5		>60	<50
II	300		0.5		>60	<50
III	200		0.3		>20	<55
<b>Cricket Nets (Indoor)</b>						
I	1500		0.8		>60	n/a
II	1000		0.8		>60	n/a
III	750		0.8		>20	n/a
<b>Dancing (Indoor)</b>						
I	500		0.7		>60	n/a
II	300		0.6		>60	n/a
III	200		0.5		>20	n/a
<b>Equestrian</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	500	0.7	0.7	>60	<50
II	200	300	0.6	0.6	>60	<50
III	75	200	0.5	0.5	>20	<55
<b>Fencing (Indoor)</b>						
	Horiz.	Vert.				
I	750	500	0.7		>60	n/a
II	500	300	0.7		>60	n/a
III	300	200	0.7		>20	n/a
<b>Football</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	750	0.7	0.7	>60	<50
II	200	500	0.6	0.7	>60	<50
III	75	200	0.5	0.5	>20	<55

Class	Lux - Horizontal illuminance average		Uniformity minimum average		Colour rendering	Glare rating
<b>Gymnastics (Indoor)</b>						
I	500		0.7		>60	n/a
II	300		0.6		>60	n/a
III	200		0.5		>20	n/a
<b>Handball</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	750	0.7	0.7	>60	<50
II	200	500	0.6	0.7	>60	<50
III	75	200	0.5	0.5	>20	<55
<b>Hockey</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	750	750	0.7	0.7	>60	<50
II	500	500	0.7	0.7	>60	<50
III	300	300	0.7	0.7	>60	<55
<b>Ice-skating (Indoor)</b>						
I	750		0.7		>60	n/a
II	500		0.7		>60	n/a
III	300		0.7		>20	n/a
<b>Judo (Indoor)</b>						
I	750		0.7		>60	n/a
II	500		0.7		>60	n/a
III	300		0.7		>20	n/a
<b>Karate (Indoor)</b>						
I	750		0.7		>60	<50
II	500		0.7		>60	<50
III	300		0.7		>20	<55
<b>Korfball (Indoor)</b>						
I	750		0.7		>60	<50
II	500		0.7		>60	<50
III	300		0.7		>20	<55
<b>Netball</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	400	0.7	0.7	>60	<50
II	200	400	0.6	0.6	>60	<50
III	75	200	0.5	0.6	>20	<55
<b>Rugby (Outdoor)</b>						
I	Eh: 800 Eave.: 500		0.7		>60	<50
II	200		0.6		>60	<50
III	75		0.5		>20	<55
<b>School Sports</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	750	0.7	0.7	>60	
II	300	500	0.7	0.7	>60	
III	200	200	0.5	0.5	>20	

Class	Lux - Horizontal illuminance average		Uniformity minimum average		Colour rendering	Glare rating
<b>Shooting</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	200 / 750	200	0.5	0.5 / 0.8	>60	n/a
II	200 / 750	200	0.5	0.5 / 0.8	>60	n/a
III	200 / 750	200	0.5	0.5 / 0.8	>60	n/a
<b>Squash (Indoor)</b>						
I	750		0.7		>60	n/a
II	500		0.7		>60	n/a
III	300		0.7		>20	n/a
<b>Swimming (Aquatic Sports)</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	500	0.7	0.7	>60	<50
II	300	300	0.7	0.7	>60	<50
III	200	200	0.5	0.5	>20	<55
<b>Tennis</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	750	0.7	0.7	>60	<50
II	300	500	0.7	0.7	>60	<50
III	200	300	0.6	0.5	>20	<55
<b>Volleyball</b>						
	Outdoor	Indoor	Outdoor	Indoor		
I	500	750	0.7	0.7	>60	<50
II	200	500	0.6	0.7	>60	<50
III	75	200	0.5	0.5	>20	<55
<b>Wall Climbing (Indoor)</b>						
I	500		0.7		>60	n/a
II	300		0.6		>60	n/a
III	200		0.5		>20	n/a
<b>Weight Lifting (Indoor)</b>						
I	750		0.7		>60	n/a
II	500		0.7		>60	n/a
II	300		0.7		>20	n/a
<b>Wrestling (Indoor)</b>						
I	750		0.7		>50	n/a
II	500		0.7		>50	n/a
III	200		0.5		>20	n/a

### Classes of play:

#### Class I:

Top-level competition

#### Class II:

Mid-level competition

#### Class III:

Lower-level competition  
and recreational sport

# Interior Lighting (SANS 10114-1)

## Recommended Average Minimum Maintained Illuminance Values

Type of interior, area, task or activity	Em, min. lx	UGR, max.	Ra, min.	Remarks
<b>General building areas</b>				
Entrance halls	100	22	60	
Lounges	200	22	80	
Circulation areas & corridors	100	28	40	
Stairs, escalators & travelators	150	25	40	
Loading ramps/ bays	150	25	40	
Canteens	200	22	80	
Rest Rooms	100	22	80	
Rooms for physical exercise	300	22	80	
Cloakrooms, washrooms, bathrooms, toilets	200	25	80	
Sick bays	500	19	80	
Rooms for medical attention	500	16	90	
Plant rooms, switch-gear rooms	200	25	60	
Post rooms, switchboards	500	19	80	
Stores, stockrooms, cold stores	100	25	60	200 lx if continuously occupied
Dispatch packing & handling areas	300	25	60	
Control stations	150	22	60	200 lx if continuously occupied
<b>Abattoirs</b>				
Cold store, casting & stunning pen	150	25	60	IP protection
Bleeding area	200	25	60	IP protection
Dressing, evisceration, washing tripery & skin sorting	300	25	80	IP protection
Inspection & grading	500	25	80	
By-products manufacturing, e.g. digesters, grinding, etc.	200	25	80	IP protection
<b>Agriculture</b>				
Loading & operating of goods-handling equipment & machinery	200	25	80	
Feed preparation, utensil washing	200	25	80	
Cutting & sorting of fruit & vegetables	300	25	80	
<b>Dairies</b>				
General work areas	200	25	80	
Bottle inspection	500	22	80	
Bottle filling	500	25	80	
Dispatching	150	25	60	

Type of interior, area, task or activity	E <sub>m</sub> , min. lx	UGR, max.	R <sub>a</sub> , min.	Remarks
<b>Airports</b>				
Arrival & departure halls, baggage claim areas	200	22	80	
Connecting areas, escalators, travelators	150	22	80	
Information desks, check-in desks	500	19	80	
Customs & passport control desks	500	19	80	
Waiting areas	200	22	80	
Luggage store rooms	200	28	60	
Security check areas	300	19	80	
Air traffic control tower	500	16	80	Dimmable lighting
Air traffic rooms	500	16	80	Dimmable lighting
Radar type & other control tower type screens				Specialist advice required
Ticket hall & concourse	200	28	40	
Ticket & luggage offices & counters	300	19	80	
Platforms & passenger subways, underpasses	50	28	40	
Testing & repair hangars	500	22	80	
Engine test areas	500	22	80	
Measuring areas in hangars	500	22	80	
<b>Bakeries</b>				
Preparation & backing	300	22	80	
Finishing, glazing & decorating	500	19	80	
<b>Banks</b>				
Counters (also see offices)	500	19	80	
General work areas	500	22	80	
<b>Brewing &amp; distilling</b>				
General work areas	200	25	60	
Brewhouse, bottling & canning plants	300	22	80	
Bottle inspection	500	22	80	
<b>Car parks (indoor)</b>				
In/ out ramps (day)	300	25	40	
In/ out ramps (night)	75	25	40	
Traffic lanes	75	25	40	
Parking areas	75	28	40	
Ticket office (manned)	300	19	80	
Ticket vending machine	150	25	40	
<b>Cement, concrete &amp; brick industries</b>				
Drying	50	28	20	
Preparation of materials, work on kilns & mixers	200	28	40	
General machine work	300	25	80	
Rough forms	300	25	80	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Cement, concrete &amp; brick industries (continued)</b>				
Fibrizing, mixing, shredding, agitating, manufacturing of flat sheets, & corrugated sheets & moulded goods	300	25	80	Applies also to gypsum, chalk & similar products
Pipe & pole manufacturing: mixing, spinning, reinforcing, stripping	200	25	80	
<b>Ceramics &amp; glass industry</b>				
Drying	50	28	20	
Furnace rooms, mixing, bending, annealing ovens, forming	200	28	60	
Enamelling, rolling, pressing, shaping simple parts, glazing, glass blowing	300	25	80	
Preparation, general machine work	300	25	80	
Grinding, engraving, glass polishing, shaping precision parts, manufacture of glass instruments	750	19	80	
Decorative work	500	19	80	
Grinding of optical glass, crystal hand grinding & engraving, work on average goods	750	16	80	
Precision work, e.g. decorative grinding, hand painting	1000	16	90	Colour temperature > 4000K
Manufacture of synthetic precious stones	1500	16	90	Colour temperature > 4000K
Finishing, bevelling, etching, silvering	500	22	80	
Brilliant cutting	800	19	90	
Inspection - General	300	19	90	Use optical aids as required
Inspection - Fine	800	19	90	Use optical aids as required
<b>Clay &amp; pottery</b>				
Grinding, filter pressing, kiln rooms, mounding, pressing, cleaning, trimming, firing	400	25	80	
Enamelling, colouring, decorating	600	19	80	
<b>Chemical, plastics &amp; rubber industries</b>				
Remote-operated processing installations	50		20	Safety colours shall be recognizable
Processing installations with limited manual intervention	150	28	40	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Chemical</b>				
Hand furnaces, boiling tanks, stationary driers, or gravity crystallizers	150	22	60	IP, corrosive, flammable or vibration protection
Mechanical driers	150	22	60	
Evaporators, filtration plants	150	22	60	
Mechanical crystallizing, bleaching	200	22	60	
Extractors, percolators, nitrators, electrolytic cells	200	22	60	
Controls, gauges, valves, etc.	100	22	60	Local lighting if required
Control rooms: vertical control panel face, (vertical illuminance)	400	19	60	
Control desks	400	19	60	
General work area	150	22	60	
Inspection	1000	19	80	
<b>Plastics</b>				
Processing: calendering, extruding	300	25	60	
Moulding: compression, injection	300	25	60	
Sheet: shaping,	300	25	60	
Trimming, machining, polishing	400	25	80	
Colour matching & inspection	1000	19	80	
<b>Rubber</b>				
Fabric preparation creels	200	25	60	
Dipping, moulding, compounding calendars	500	25	60	
Tyre & tube making	400	25	60	
Curing	400	25	60	
Inspection	1000	19	60	
<b>Churches, mosques, synagogues &amp; temples</b>				
General interior	150	25	80	
Pulpit & lectern areas, chancel, choir	200	22	80	
Altar, communion table	200	22	80	
Vestries	200	22	80	
<b>Courtrooms</b>				
Seating	200	22	80	
Court	500	25	80	
<b>Dye works</b>				
Reception, "grey" perching	600	25	80	Suitable IP protection & supplementary local lighting if required
Wet processes	300	22	80	
Dry processes	300	22	80	
Dyers office	800	19	80	
Final perching	2000	16	90	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Educational buildings</b>				
Playschool room	300	19	80	
Nursery class	300	19	80	
Nursery craft room	300	19	80	
Classrooms, tutorial rooms	300	19	80	Lighting should be controllable
Classroom for evening classes & adult education	500	19	80	
Lecture hall	500	19	80	Lighting should be controllable
Chalk board (vertical illuminance)	500	19	80	Avoid specular reflections
Demonstration table	500	19	80	In lecture halls = 750 lx
Art & craft rooms	500	19	90	
Art rooms in art schools	750	19	90	Colour temperature > 5000K
Technical drawing rooms	750	16	80	
Practical rooms & laboratories	500	19	80	
Teaching workshops	500	19	80	
Music practice rooms	500	19	80	
Computer practice rooms	500	19	80	
Language laboratories	300	19	80	
Preparation rooms & workshops	500	22	80	
Student common rooms & assembly halls	200	22	80	
Assembly hall for exams	500	22	80	
Teachers' rooms	300	22	80	
Library shelves, stacks	300	22	80	Vertical illuminance
Reading tables	400	19	80	
Dormitories	100	25	80	
Corridors & stairs	150	28	80	
<b>Electrical manufacturing</b>				
Cable & wire manufacturing	300	25	80	
Coil winding - large coils	300	25	80	
Coil winding - medium coils	500	22	80	
Coil winding - small coils	750	19	80	
Coil impregnating	300	25	80	
Coil & armature processes, general	400	25	80	
Galvanizing	300	25	80	
Assembly - rough, e.g. large transformers	300	25	80	
Assembly - medium, e.g. switchboards	500	22	80	



Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Electrical manufacturing (continued)</b>				
Assembly - fine, e.g. telephones	750	19	80	
Precision, e.g. measuring equipment	1000	16	80	
Electronic workshops, testing, adjusting	1500	16	80	
<b>Electricity generating stations</b>				
Turbine halls (operating floor)	300	25	20	Safety colours shall be recognizable
Blowers, auxiliary generators	150	25	20	
Cable, screens, & transformer chambers	100	25	60	
Cable tunnel, covered walkways, storage tanks	50	25	20	Safety colours shall be recognizable
Battery & charging equipment rooms	150	25	60	
Coal & ash handling	100	28	20	Safety colours shall be recognizable
Boiler rooms	100	28	20	
Boiler front (operating floor)	150	25	20	
Between boilers (operating floor), stairs, galleries, operating platforms, & precipitator high-voltage chamber	150	25	20	
Pulverizers, feeders, ash-plants, conveyors, (tunnel, junction tower)	100	25	20	Safety colours shall be recognizable
Overland conveyor housing walkways	100	25	20	
Boiler house & turbine house basements	150	25	20	
Pump houses & rooms, water treatment plant	150	25	20	Safety colours shall be recognizable
Control rooms, control panel face (vertical illuminance)	300	19	80	
Control desks with VDUs	400	19	80	See clause 11 in SANS 10114-1
Rear of control panels	150	22	80	
Computer rooms	500	19	80	See clause 11 in SANS 10114-1
Switch houses & rooms	200	22	60	
Relay & telecommunications rooms	300	25	60	
Nuclear reactors, steam raising plant, reactor areas, boilers, galleries	200	25	20	Safety colours shall be recognizable
Gas circulator bays	200	25	60	
Reactor charge/ discharge face	200	25	60	
High-voltage substations (indoor)	200	25	60	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Entertainment</b>				
<b>Cinemas</b>				
Projection room	200	22	60	
Corridors, stairs	150	22	80	
Foyers	100	25	80	
Auditoriums (other than during performances)	100	22	80	
Booking area	300	25	80	
<b>Concert halls</b>				
Foyers	100	25	80	
Auditoriums (other than during performances)	100	25	80	
Platforms	200		80	
Stairs & corridors	150	22	80	
Booking offices	300	25	80	
<b>Multi-purpose halls</b>				
General	300	22	80	
<b>Theatres</b>				
Foyers	150	25	80	
Auditoriums (other than during performances)	100	25	80	
Corridors, stairs	150	22	80	
<b>Fire stations</b>				
Appliance rooms	150	25	80	
External apron	50		60	
<b>Food industry</b>				
Workplaces & zones in breweries, malting floor, area for washing, barrel filling, clearing, sieving, peeling, cooking in preserve & chocolate factories, fermentation cellars	200	25	80	
Sorting & washing of products, milling, mixing, packing	300	25	80	
Workplaces & zones in slaughter houses, butcheries, dairies, mills, filtering floors	500	25	80	
Cutting & sorting of fruit & vegetables	300	25	80	
Manufacturing of delicatessen foods, kitchens	500	22	80	
Inspection of glasses & bottles, product control, trimming, sorting, decoration	500	22	80	
Laboratories	500	19	80	
Colour inspection	1000	16	90	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Canning &amp; preserving</b>				
Inspection of produce	500	22	90	
Preparation, kettle areas, mechanical cleaning, dicing, trimming	400	25	80	
Retorts for canned & bottle goods	200	25	80	
High-speed labelling lines	400	25	60	
Can inspection	400	22	80	
Automatic processes	200	25	60	
<b>Sugar refinery</b>				
General workplaces & zones	200	25	80	
Crushing, settling, evaporating, boiling, curing, drying, packing	200	25	80	
Centrifuging, metering, filtering, condensing	200	25	80	
Panning, mixing, drying	300	25	80	
<b>Foundries &amp; metal casting</b>				
Man-size underground tunnels, cellars	50	28	20	Safety colours shall be recognizable
Platforms	100	25	40	
Sand preparation	200	25	80	
Dressing rooms	200	25	80	
Workplaces at cupola & mixer	200	25	80	
Casting bay	200	25	80	
Shake out areas	200	25	80	
Machine moulding	200	25	80	
Hand & core moulding	300	25	80	
Die casting	300	25	80	
Model building	500	22	80	
<b>Furniture industry</b>				
Raw material store	100	25	60	
Finished goods store	100	25	60	
Wood machining & assembly	300	22	80	IP dust/ flammable protection
Rough sawing & cutting	200	25	60	Prevent stroboscopic effects
Machining, sundry & assembly of components	350	22	80	
<b>Cabinet making</b>				
Veneer sorting & preparation	500	22	90	
Veneer pressing	400	22	80	
Marquetry, inlay work	750	22	90	Colour temperature >4000K
Components store	100	25	60	
Fitting, final inspection	500	22	80	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Upholstery</b>				
Cloth inspection	800	22	90	
Filling, covering	500	22	80	
Slipping	500	22	80	
Cutting, sewing	500	22	80	
<b>Mattress making</b>				
Assembly	400	22	80	
Tape edging	500	22	80	
<b>Tool rooms</b>				
General	300	25	60	
Benches	400	22	60	
<b>Spray booth</b>				
Colour finishing	600	22	90	Explosive hazard protection
Clear finishing	400	22	80	
<b>Joinery</b>				
Bench gluing, assembly	300	25	80	
Machine turning, fluting, dressing, rebating, grooving, cutting, sawing, sinking	500	19	80	Prevent stroboscopic effects
Quality control	1000	19	90	
<b>Gas works</b>				
Retort houses, oil gas plants, water gas plants, purifiers, coke screening & coke handling plants	50	28	20	Safety colours shall be recognizable IP/ explosion hazard protection
Governor, meter, compressor, booster, exhauster houses	250	25	60	
<b>Hat making</b>				
Stiffening, braiding, cleaning, refining, forming, pouncing	300	22	80	
Flanging, finishing, ironing	400	22	80	
Inspection	1000	19	90	
General work area	400	22	60	
<b>Health care premises</b>				
Waiting rooms	200	22	80	Illuminance at floor level
Stairs & corridors during the day	200	22	80	
Stairs & corridors at night	50	22	80	
Day rooms	200	22	80	
Casualty & outpatient departments	200	19	80	
Staff office	500	19	80	
Staff rooms	300	19	80	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Wards</b>				
General lighting	100	19	80	Illuminance at floor level
Reading lighting	300	19	80	
Simple examination	300	19	80	
Examination & treatment	1000	19	90	
Night lighting, observation lighting	5	19	80	
Bathrooms & toilets for patients	200	22	80	
Examination room general	500	19	90	
Ear & eye examination	1000		90	Local examination luminaire
Reading & colour vision test with vision charts	500	16	90	
Scanners with image enhancers & television systems	50	19	80	See clause 11 in SANS 10114-1
Dialysis rooms	500	19	80	
Dermatology rooms	500	19	90	
Dispensaries	400	19	80	
Endoscopy rooms	300	19	80	
Plaster rooms	500	19	80	
Medical baths	300	19	80	
Massage & radiotherapy rooms	300	19	80	
Pre-op & recovery rooms	500	19	90	
Operating theatre	1000	19	90	
Operating cavity	Special			$E_m + 10\ 000\ lx$ to $100\ 000\ lx$
<b>Intensive care</b>				
General lighting	100	19	90	At floor level
Simple examination	300	19	90	At bed level
Examination & treatment	1000	19	90	At bed level
Night watch	20	19	90	
Sterilization rooms	300	22	80	
Disinfection rooms	300	22	80	
Autopsy rooms & mortuaries	500	19	90	
Autopsy table & dissecting table	5000		90	Values higher than 5000 lx might be required
<b>Dentistry</b>				
General lighting	500	19	90	Lighting should be glare-free for the patient
At the patient	1000		90	Local examination luminaire
Operating cavity	5000		90	Values higher than 5000 lx might be required

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Dentistry (continued)</b>				
White teeth matching	5000		90	Colour temperature > 6000K
Colour inspection (laboratories)	1000	19	90	Colour temperature > 5000K
<b>Hosiery &amp; knitwear</b>				
Circular & flat knitting machines, universal winders, cutting out, folding & pressing	400	22	80	
Lock-stitch & overlocking machines	500	22	80	
Mending - light goods	1000	19	80	
Mending - dark goods	1500	19	80	
Examining & hand-finishing light goods	600	19	80	
Examining & hand-finishing dark goods	1000	19	80	
Linking or running on	500	19	80	
<b>Iron &amp; steel works</b>				
Production plants without manual intervention	50	28	20	Safety colours shall be recognizable
Production plants with occasional manual intervention	150	28	40	
Production plants with continual manual intervention	200	25	80	
Slab store	50	28	20	Safety colours shall be recognizable
Furnaces	200	25	20	
Mill train, coiler, shear line	300	25	40	
Control platforms, control panels	300	22	80	
Testing, measurement & inspection	500	22	80	
Underground man-sized tunnels, belt sections, cellars, etc.	50	28	20	Safety colours shall be recognizable
Slab yards, melting shops, ingot stripping, soaking pits, blast furnaces, work areas, pickling & cleaning lines, mechanical pump houses, slabbing & large section rolling mills	100	28	40	
Mould preparation, light section wire & cold strip mills, mill motor rooms, slab & bloom inspection & conditioning, sheet & plate finishing, tinning, galvanizing & roll shops	100	28	40	
Inspection	300	25	40	
Tin plate inspection & pulpits (control rooms)	500	22	60	
General work areas	200	25	40	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Inspection areas</b>				
Rough work, e.g. counting, rough checking of stocks parts, etc.	300	25	40	
Medium work, e.g. "go" and "no-go" gauges	400	22	40	
Subassemblies	400	22	40	
Fine work, e.g. radio & telecommunication equipment, calibrated scales, precision mechanisms, instruments	600	19	60	
Very fine work, e.g. gauging & inspection of small intricate parts	1200 or 1600	19	60	Local lighting or optical aids (or both)
Minute work	1200 or 1600	19	60	
<b>Jewellery manufacturing</b>				
Working with precious stones	1500	16	90	Colour temperature > 4000K
Manufacturing of jewellery	1000	16	90	
Watchmaking (manual)	1500	16	80	
Watchmaking (automatic)	500	19	80	
Fine processes	800	19	80	
Minute processes	4000	10	90	Local lighting, if required
Gem cutting, polishing	1500	19	90	
<b>Laboratories &amp; test rooms</b>				
General laboratories, balance rooms	500	19	80	
Electrical & electronic instrument laboratories	500	19	80	
Calibration scales, precision mechanical instruments	700	19	80	
<b>Laundries &amp; dry cleaning</b>				
Goods receiving, marking & sorting	300	25	80	
Washing & dry cleaning	300	25	80	
Ironing, pressing	300	25	80	
Inspection & repairs	750	19	80	
<b>Leather industry</b>				
Work on vats, barrels, pits	200	25	40	
Fleshing, skiving, rubbing, tumbling of skins	300	25	80	
Saddlery work, shoe manufacture, sewing, polishing, shaping, cutting, punching	500	22	80	
Sorting & grading	1000	19	90	Colour temperature > 4000K
Leather dyeing (machine)	500	22	80	
Glove making	500	22	80	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Leather industry (continued)</b>				
Clicking & closing, preparation operations	800	22	80	
Cutting tables & presses, stitching	1000	22	80	
Bottom stock preparation, lasting & bottom finishing	800	22	80	
Shoe rooms	800	22	80	
Quality control	1000	19	80	
Inspection	1000	16	90	
<b>Libraries</b>				
Shelves & stacks	300	22	80	Vertical illuminance
Carrels, reading rooms, newspapers & magazines, reading tables, counters	500	19	80	
Binding	500	22	80	
Cataloguing, sorting, stock rooms	300	22	80	
General work areas	300	22	80	
<b>Lifts</b>				
Car interior	100		60	
Motor room	500	25	60	
<b>Material handling premises</b>				
Wrapping, packing & labelling	200	28	80	
Sorting stock	200		80	
<b>Metal working &amp; processing</b>				
Open die forging	200	25	60	
Drop forging, welding, cold forming	300	25	60	
Rough & average machining, tolerances > 0.1mm	300	22	60	
Precision machining, grinding, tolerances < 0.1mm	500	19	60	
Scribing, inspection	750	19	60	
Wire & pipe drawing, shapes	300	25	60	
Plate machining > 5mm	200	25	60	
Sheet metal-work < 5mm	300	25	60	
Tool making, cutting equipment manufacture	750	19	60	
<b>Assembly</b>				
Rough	200	25	60	
Medium	300	25	60	
Fine	500	22	80	
Precision	750	19	80	
Galvanizing	300	25	60	
Surface preparation & painting	750	25	60	
Template & jig making, precision mechanics, micro-mechanics	1000	19	80	



Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Blacksmith</b>				
General work areas	250	28	60	
Tempering	200	25	80	
<b>Machining &amp; fitting</b>				
Rough bench & machine work	200	28	60	IP protection
Medium bench & machine work, ordinary automatic machines, rough grinding, medium buffing & polishing	400	25	60	
<b>Plating</b>				
Vats & baths	400	22	60	IP protection
Final buffing & polishing	600	22	80	
<b>Sheet metal</b>				
Bench work, pressing, punching, shearing, stamping, spinning	300	25	60	
Sheet inspection	500	25	60	
<b>Structural steel fabrication</b>				
General	200	28	60	
Marking off	400	28	60	
<b>Welding &amp; soldering</b>				
Gas & arc welding	250	28	60	
Medium soldering, brazing & spot welding, e.g. domestic hardware	350	25	60	
Fine soldering & spot welding, e.g. instruments, radio set assembly	800	22	60	
Very fine soldering & spot welding, e.g. printed circuits	1500	19	60	
<b>Mining (surface buildings)</b>				
Preparation plants, work areas	200	25	20	Safety colours shall be recognizable
Picking belts	300	25	60	IP/ flammable protection
Winding houses	200	28	60	
Lamp rooms, weighing cabins, fan houses	200	28	60	
<b>Museums &amp; art galleries</b>				
General	200	16		
Displays & paintings				Specialist guidance necessary
<b>Offices</b>				
Entrance halls & reception areas	200	22	80	
Corridors & passages	200	22	80	
Conference rooms, general offices, typing & filing	500	19	80	
Computer & business machine operation	500	19	80	See VDU section

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Offices (continued)</b>				
Copying, circulation, etc.	300	19	80	
Reception desk	300	22	80	
Archives	200	25	80	
Writing, reading, data processing	500	19	80	
Technical drawing	750	16	80	
CAD workstation	500	19	80	See VDU section
<b>Paint industry</b>				
General automatic processes	200	25	80	IP/ flammable protection
Special batch mixing	400	22	80	
Colour matching	600	19	90	
<b>Paint shops &amp; spray booths</b>				
Rubbing, dipping, ordinary painting, spraying & finishing	400	22	80	IP/ flammable protection
Fine painting, spraying & finishing	700	22	80	
Re-touching & matching	1000	22	90	
<b>Paper industry</b>				
Pulp mills, edge runners	200	25	80	
Paper manufacturing & processing, paper & corrugating machines, cardboard manufacturing	300	25	80	
Paper & board making, machine houses, calendaring, preparation plants, cutting, trimming, finishing	300	25	80	
Inspection & sorting (overhauling)	400	25	80	IP/ flammable protection
Paper converting process, general	300	25	60	
Associated printing	300	22	80	
<b>Paper bag, carton &amp; box making</b>				
Corrugated boards, cartons, containers & paper box manufacturing	200	25	60	
Coating & laminating process	300	22	60	
Associated printing	300	22	90	
<b>Pharmaceutical &amp; fine chemical</b>				
Raw material storage	200	28	60	IP/ flammable protection
Control laboratories & testing	500	19	80	
Pharmaceuticals manufacturing, grinding, granulating, mixing & drying, tableting, sterilizing & washing	500	25	80	
Preparation of solutions & filling, labelling, capping, inspection	400	25	80	
Fine chemical plant processing	200	25	80	
Fine chemical finishing	500	25	80	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Photographic</b>				
Safety-light darkrooms	10		40	
<b>Post offices</b>				
Circulation	200	22	60	
Counters	500	22	60	
Sorting of mail	500	25	60	
<b>Printing industry</b>				
Cutting, gilding, embossing, block engraving, work on stones & platens, printing machines, matrix making	500	19	80	
Paper sorting & hand printing	500	19	80	
Type setting, re-touching, lithography	1000	19	80	
Colour inspection in multi-coloured printing	1500	16	90	Colour temperature 5000K
Steel & copper engraving	2000	16	90	Localized lighting
Standard bookbinding work, e.g. folding, sorting, gluing, cutting, embossing, sewing	500	22	60	
Type foundries: dressing type, hand & machine casting	300	25	60	
Front assembly, sorting	500	22	80	
Printing plants: machine composition, imposing stones	300	25	60	
Presses	400	25	60	
Composition room	400	19	60	
Proofreading casting	500	19	80	
Electrotyping: block making, electroplating, washing, backing	500	25	60	
Moulding, finishing, routing	400	25	60	
Photoengraving: Block making, etching, masking	400	25	60	
Finishing, routing	500	25	60	
Colour printing: inspection area	1000	19	90	
<b>Refrigeration</b>				
Chilling & cold rooms, ice-making	200	25	60	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Restaurants &amp; hotels</b>				
Reception/ cashier desk, porter's desk	300	22	80	
Kitchen	500	22	80	
Restaurant, dining room, function room, bars	200	22	80	Design for intimate atmosphere
Self-service restaurant	200	22	80	
Buffet	300	22	80	
Conference rooms	500	19	80	Lighting should be controllable
Corridors	100	25	80	At floor level, at night, lower illuminance levels are acceptable
Stairs	150	25	80	
Entrance halls	200		80	
Lounges	150	19	80	
Bedrooms: general	100		80	
Dressing table, headboards, etc.	200		80	
Billiard rooms: general	200		80	
Billiard tables				Special lighting
Card rooms	300	22	80	
Laundries	300	22	80	
Goods & passenger lifts	100			
Cloakrooms & toilets	150			
Bathrooms	100			
Self-service counters	300	22	80	
General work areas	300	22	80	
<b>Retailing</b>				
Sales areas (small)	300	22	80	
Sales areas (large)	500	22	80	
Till area, wrapper table	500	19	80	
General work areas	300	22	80	
Stairs & corridors	200	22	80	At floor level
Stockrooms	200	25	80	
<b>Soap manufacturing</b>				
All processes e.g. kettle houses & ancillaries, batch or continuous soap rooting, soap stamping, etc.	300	25	80	
General areas	300	25	60	
Auto processes	200	25	60	
Control panel face	200	25	60	Vertical illuminance
Product processing & packing	200	25	60	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Telephony</b>				
Manual exchange rooms (on desk)	300	22	60	
Main distribution frame rooms in automatic exchanges	300	25	60	
Battery rooms	150	25	60	Corrosive/ flammable protection
<b>Textile industry</b>				
Workplace & zones in baths, bale opening	200	25	60	
Carding, washing, ironing, drawing, combing, sizing, card cutting, pre-spinning	300	22	80	
Spinning, plying, reeling, winding, wrapping, weaving, braiding, knitting	500	22	80	Prevent stroboscopic effects
Sewing, fine knitting, taking up stitches	750	22	90	
Manual design, drawing patterns	750	22	90	Colour temperature > 4000K
Finishing, dyeing	500	22	80	
Drying room	100	28	60	
Automatic fabric printing	500	25	80	
Burling, picking, trimming	1000	19	80	
Colour inspection, fabric control	1000	16	90	Colour temperature > 4000K
Invisible mending	1500	19	90	
Hand tailoring	1000	19	90	
<b>Cotton or linen</b>				
Bale breaking, blowing, carding	300	25	60	
Roving, slubbing, spinning (ordinary counts), winding, hackling, spreading, cabling	300	22	60	
Warping, slashing, dressing & dyeing, doubling (fancy), spinning (fine counts)	300	25	80	
Healding (drawing in)	800	19	80	
Weaving: patterned cloths	800	19	90	
Weaving: plain "grey" clothes	800	19	80	
Cloth inspection	1000	19	90	
<b>Jute</b>				
Weaving, spinning flat, Jacquard carpet looms, cop winding	300	25	60	
Yarn calendar	400	25	60	

Type of interior, area, task or activity	E <sub>m</sub> , min. lx	UGR, max.	R <sub>a</sub> , min.	Remarks
<b>Silk or synthetics</b>				
Soaking, fugitive tinting, conditioning or setting of twist	500	25	80	IP/ flammable protection
Spinning	500	25	80	
Winding, twisting, rewinding & coning, quilling, slashing	350	25	80	
Warping	400	25	80	
Healding (drawing in)	800	19	80	
Weaving	800	19	80	
Inspection	1000	19	90	
<b>Woollens</b>				
Preparing, raising, brushing, pressing, backwashing, gilling, grabbing & blowing	300	25	60	IP/ flammable protection
Blending, carding, combing (white), tentering, drying, cropping	300	25	80	
Spinning, roving, winding, warping, combing (coloured), twisting	500	25	80	
Healding (drawing in)	800	19	80	
Weaving: fine worsteds	800	19	80	
Weaving: medium worsteds, fine woollens	500	19	80	
Weaving: heavy woollens	400	19	80	
Weaving: burling & mending	800	19	80	
Perching: "Grey"	800	19	80	
Finals	2000	19	90	
<b>Tobacco</b>				
Primary manufacturing: weighing, blending, conditioning, threshing, cutting	250	22	80	IP protection
Cigarette making machines, filter plug makers	500	22	80	
Catcher (inspection)	1000	22	90	
Hand processes	750		90	
Cigarette or tobacco packing	600	22	80	
<b>Transport terminals, bus, rail, sea</b>				
Radar type & other control tower type screens				Specialist advice required
Reception areas (desks), customs & immigration halls, lounges, luggage collection, security check	300	22	60	
Check-in counters, customs & passport control	500	22	80	
Circulation, platforms, dispatch	150	25	60	

Type of interior, area, task or activity	$E_m$ , min. lx	UGR, max.	$R_a$ , min.	Remarks
<b>Vehicle construction/ servicing</b>				
Body work & assembly	500	22	80	
Painting, spraying chamber, polishing chamber	750	22	90	IP/ flammable protection
Painting: touch-up, inspection	1000	16	90	Colour temperature > 4000K
Upholstery manufacture	1000	19	80	
Final inspection	1000	19	80	
General assemblies, chassis assemblies, car assembly, trim shops, body subassemblies	400	25	60	
Final inspection	500	22	80	
<b>Servicing</b>				
Parking areas (indoors)	50	28	40	
Washing, polishing, greasing	200	25	60	Local lighting if required
Servicing pits	200	22	60	Illumination on underside of vehicle
Repairs	350	22	60	
Workbenches	400	22	60	
Fuel pumps	200	28	40	
<b>Warehousing</b>				
Small material, racks, packing & dispatch	200	25	60	Vertical illuminance on racks
Issue counters	300	25	60	
Loading bays, large material	100	28	60	
Inactive storage & automatic stores	50	28	60	
<b>Woodworking &amp; sawmilling</b>				
Rough sawing & bench work, sizing, planning, rough sanding	250	25	60	Prevent stroboscopic effects
Medium machine & bench work, gluing, cooperage	300	25	60	
Fine bench & machine work, fine sanding & finishing	500	22	60	
Automatic processing, e.g. drying, plywood manufacturing	50	28	40	
Steam pits	150	28	40	
Saw frame	300	25	60	Prevent stroboscopic effects

# Exterior Lighting (SANS 10389-1)

## Recommended Average Minimum Maintained Illuminance Values

1	2	3	4	5	6
Areas to be lit, operation performed	Minimum maintained average illuminance (in lux)		Minimum uniformity ratio $E_{hmin}/E_{hav}$	Minimum uniformity ratio $E_{hmin}/E_{hmax}$	Maximum glare rating $GR_{max}$ .
	Horizontal $E_{hav}$	Vertical $E_{hav}$			
<b>Airports</b>					
Apron parking areas	20	20	0.25	0.2	50
Areas adjacent to apron	10		0.25	0.2	50
Taxiway between aprons	5	15	0.25	0.2	50
<b>Building sites</b>					
<b>Work areas or task</b>					
Very rough work e.g. clearance, excavation & loading ground	20		0.25	0.125	55
Rough work e.g. drain pipes mounting, transport, auxiliary & storage tasks	50		0.40	0.2	50
Accurate work e.g. framework element mounting, light reinforcement work, wooden mould & framework mounting, electric piping & cabling	100		0.40	0.2	45
Fine work e.g. element jointing, demanding electricity, machine & pipe mountings	200		0.50	0.2	45
<b>Traffic areas</b>					
Pedestrian passages, vehicle turning, loading & unloading points	50		0.40	0.2	50
<b>Safety &amp; security</b>					
General lighting on building site, element mould, timber & steel storage, building foundation hole & working areas on sides of the hole	50		0.40	0.2	50
<b>Canals &amp; locks</b>					
Outport embankment ballasting		1 - 10			
Waiting quays	10		0.25	0.125	50
Locking chamber walls: wall height below 10m		2			
Locking chamber walls: wall height over 10m		5			



1	2	3	4	5	6
Areas to be lit, operation performed	Minimum maintained average illuminance (in lux)		Minimum uniformity ratio $E_{hmin}/E_{hav}$	Minimum uniformity ratio $E_{hmin}/E_{hmax}$	Maximum glare rating $GR_{max}$ .
	Horizontal $E_{hav}$	Vertical $E_{hav}$			
<b>Filling &amp; service stations</b>					
Entry & exit drive ways: light environment (cities)	50 - 100		0.40	0.2	45
Entry & exit drive ways: dark environment	20 - 50		0.40	0.2	45
Meter reading area: light environment (cities)	300 - 500		0.50	0.333	45
Meter reading area: dark environment	150 - 300		0.50	0.333	45
Air pressure & water checking points & other service areas	75 - 150		0.40	0.2	45
Vehicle parking & storage area (see also parking areas)	5		0.25	0.1	50
<b>Harbours</b>					
<b>Work areas or task</b>					
Cargo handling, loading & unloading	20		0.25	0.125	55
Coupling of hoses & pipes	50			0.167	50
<b>Traffic areas</b>					
Walking passages exclusively for pedestrians	10		0.25	0.125	50
Passengers areas in passenger harbours	50		0.40	0.2	50
Vehicle traffic areas	20		0.40	0.167	45
Dangerous part of walkways & driveways (see also parking areas)	50		0.40	0.2	45
<b>Safety &amp; security</b>					
General lighting	10		0.25	0.125	50
Medium risk areas e.g. vehicle storage areas & container terminals with frequent traffic	20		0.40	0.167	50
High risk areas e.g. fire, explosion, poison	50		0.40	0.2	45
<b>Industrial yards &amp; storage areas</b>					
<b>Work areas or task</b>					
Very rough work e.g. short term handling of large units & raw materials, loading & unloading of solid bulk goods	20		0.25	0.125	55

1	2	3	4	5	6
Areas to be lit, operation performed	Minimum maintained average illuminance (in lux)		Minimum uniformity ratio $E_{hmin}/E_{hav}$	Minimum uniformity ratio $E_{hmin}/E_{hmax}$	Maximum glare rating $GR_{max}$ .
	Horizontal $E_{hav}$	Vertical $E_{hav}$			
<b>Work areas or task (continued)</b>					
Rough work e.g. continuous handling of large units & raw materials, loading & unloading of freight, lifting & descending location for cranes, open loading platforms	50		0.40	0.2	50
Accurate work e.g. reading of addresses, covered loading platforms, use of tools, ordinary reinforcement & casting tasks in concrete plants	100		0.50	0.33	45
Fine work e.g. demanding electrical, machine & piping installations, inspection	200		0.50	0.33	45
<b>Traffic areas</b>					
Walkways exclusively for pedestrians	5		0.25	0.1	50
Traffic areas for slowly moving (max. 10 km/h) vehicles, e.g. bicycles & trucks	10		0.40	0.2	50
Regular vehicle (max. 40 km/h), priority roads of parking areas	20		0.40	0.2	45
<b>Safety &amp; security</b>					
Low risk areas e.g. storage with occasional traffic	5		0.25	0.125	55
Medium risk areas e.g. vehicle storage areas & container terminals with frequent traffic	20		0.40	0.167	50
High risk areas e.g. fire, poison areas & radiation risk areas	50		0.40	0.2	45
<b>Parking lots</b>					
<b>Parking lots &amp; pedestrian areas</b>					
Light traffic e.g. parking lots of shops, schools, churches, terraced & apartment houses	5		0.25	0.1	55
Medium traffic e.g. parking lots of department stores, office buildings, plants, sports & multi-purpose building complexes	10		0.25	0.125	50
Heavy traffic e.g. parking lots of major shopping centres, major sports & multi-purpose building complexes	20		0.25	0.125	55

1	2	3	4	5	6
Areas to be lit, operation performed	Minimum maintained average illuminance (in lux)		Minimum uniformity ratio $E_{hmin}/E_{hav}$	Minimum uniformity ratio $E_{hmin}/E_{hmax}$	Maximum glare rating $GR_{max}$ .
	Horizontal $E_{hav}$	Vertical $E_{hav}$			
<b>Vehicle driveways</b>					
Light traffic	5		0.25	0.1	50
Medium traffic	10		0.40	0.167	50
Heavy traffic	20		0.40	0.2	55
<b>Petrochemical industries &amp; other hazardous industries</b>					
<b>Work areas or task</b>					
Very rough work e.g. handling of servicing of tools, utilization of manually regulated valves, starting & stopping motors, lighting of burners	20		0.25	0.125	55
Rough work e.g. filling & emptying of container trucks & wagons with risk free substances, inspection of leakage, piping & packing	50		0.40	0.2	50
Accurate work e.g. filing & emptying of container trucks & wagons with dangerous substances, replacements of pump packing, general servicing work, reading of instruments	100		0.40	0.2	45
Fine work e.g. repair of machines & electric devices	200		0.50	0.33	45
<b>Traffic areas</b>					
Walkways exclusively for pedestrians	5		0.25	0.1	50
Traffic areas for slow moving vehicle traffic (max. 10 km/h), e.g. bicycles & trucks	10		0.40	0.167	50
Regular vehicle traffic (max. 40 km/h)	20		0.40	0.2	45
<b>Safety &amp; security</b>					
Low risk areas e.g. areas of risk free process & occasionally used platforms & stairs	10		0.40	0.167	50
Medium risk areas e.g. vehicle storage areas & conveyors	20		0.40	0.167	50
High risk areas e.g. oil stores, cooling towers, boilers, compressors, pumping plants, valves, manifolds, operating platforms, regularly used stairs, crossing points of conveyors, electric switch-yards	50		0.40	0.2	45

1	2	3	4	5	6
Areas to be lit, operation performed	Minimum maintained average illuminance (in lux)		Minimum uniformity ratio $E_{hmin}/E_{hav}$	Minimum uniformity ratio $E_{hmin}/E_{hmax}$	Maximum glare rating $GR_{max}$ .
	Horizontal $E_{hav}$	Vertical $E_{hav}$			
<b>Safety &amp; security (continued)</b>					
Fuel loading & unloading sites	100		0.40	0.2	45
<b>Power, electricity, gas &amp; heat plants</b>					
<b>Work areas or task</b>					
Very rough work e.g. handling of servicing tools, handling of coal	20		0.25	0.125	55
Rough work e.g. overall inspection	50		0.40	0.2	50
Accurate work e.g. general servicing work & reading of instruments	100		0.40	0.2	45
Fine work e.g. repair of electric devices	200		0.50	0.33	45
<b>Traffic areas</b>					
Pedestrian movements within electrically safe areas	5		0.25	0.1	50
Traffic areas for slowly moving vehicles traffic (max. 10 km/h) e.g. bicycles, trucks & excavators	10		0.40	0.167	50
Regular vehicle traffic (max. 40 km/h)	20		0.40	0.2	45
<b>Safety &amp; security</b>					
Low risk areas e.g. coal fields	5		0.25	0.1	55
Medium risk areas e.g. oil stores	20		0.40	0.167	50
High risk areas e.g. switch yards	50	50	0.40	0.2	45
<b>Railway areas</b>					
<b>Passenger areas</b>					
Open platforms, small stations	10		0.25	0.125	50
Open platforms, medium-size stations	20		0.40	0.33	45
Open platforms, large stations	50		0.40	0.33	45
Covered platforms, small stations	50		0.40	0.33	45
Covered platforms, large stations	100		0.50	0.33	45
Stairs, small & medium-size stations	50		0.40	0.33	45
Stairs, large stations	100		0.50	0.33	45
Walkways, small & medium-size stations	20		0.40	0.167	50
Walkways, big stations	50		0.40	0.2	45

1	2	3	4	5	6
Areas to be lit, operation performed	Minimum maintained average illuminance (in lux)		Minimum uniformity ratio $E_{hmin}/E_{hav}$	Minimum uniformity ratio $E_{hmin}/E_{hmax}$	Maximum glare rating $GR_{max}$ .
	Horizontal $E_{hav}$	Vertical $E_{hav}$			
<b>Freight areas</b>					
Freight track, temporary, or quick operation	10		0.25	0.125	50
Freight track, continuous operation	20		0.40	0.167	50
Open platforms	20		0.40	0.167	50
Covered platforms, temporary or quick operation	50		0.40	0.33	45
Covered platforms, continuous operation	100		0.50	0.33	45
Traffic areas for mobile cranes & cars	20		0.40	0.167	50
Container handling areas	20		0.50	0.167	50
Container storage areas	10		0.25	0.125	50
Track for trailer loading on wagon	20		0.40	0.167	50
<b>Railway yards</b>					
<b>Flat marshalling yards</b>					
- switching area	10		0.25	0.125	50
- central area of yard, temporary or quick	10		0.40	0.167	50
- central area of yard, continuous operation	15		0.40	0.2	45
- turn-out track, uncoupling area	10		0.50	0.33	50
<b>Hump area</b>					
- wagon inspection pit		100			
- uncoupling area	50	20	0.40	0.33	45
- hump crest, wagon numbering reading	20	50	0.40	0.33	45
<b>Classification yards</b>					
a) Hard operated wagon rolling, switching & braking -braking rail with brake shoe	20		0.40	0.33	45
- switching area, head end	15				
- brake area with brake shoe	15		0.40	0.2	45
b) Automatic wagon rolling & switching -retarders		50		0.33	45
- continuous retarders	15		0.40	0.2	45
- switching area, head end	15		0.40	0.2	45
- central area of classification yard	15		0.40	0.2	45
Switching area, central area of yard	10		0.25	0.125	50

1	2	3	4	5	6
Areas to be lit, operation performed	Minimum maintained average illuminance (in lux)		Minimum uniformity ratio $E_{hmin}/E_{hav}$	Minimum uniformity ratio $E_{hmin}/E_{hmax}$	Maximum glare rating $GR_{max}$ .
	Horizontal $E_{hav}$	Vertical $E_{hav}$			
<b>Tracks on passenger station areas</b>					
Switching area, central area of yard	10		0.25	0.125	50
<b>Servicing &amp; stabling tracks for cars, trains &amp; locomotives</b>					
- passenger car cleaning area	10		0.25	0.125	50
- passenger car servicing area	20	20	0.40	0.2	45
- passenger car washing area	20	20	0.40	0.2	45
- stabling tracks for wagon & cars	5		0.25	0.125	50
Stabling tracks for locomotives	20		0.40	0.2	50
Level crossings	20		0.40	0.2	45
<b>Saw mills</b>					
<b>Work areas or task</b>					
Very rough work e.g rapid handling of timber on land & in water, sawdust & chip conveyors	20		0.25	0.125	55
Rough work e.g. scattering of & batch places, sorting of timber on land or in water, timber unloading points & sawn timber loading point, mechanical lifting to timber conveyor	50		0.40	0.33	50
Accurate work e.g. reading of addresses & marking of sawn timber	100		0.40	0.2	45
Fine work e.g. tying of timber with belts	200		0.50	0.33	45
Very fine work e.g. feeding into stripping & chopping machines	300		0.50	0.25	45
<b>Traffic areas</b>					
Walkways exclusively for pedestrians	5		0.25	0.1	50
Traffic areas for slowly moving vehicle traffic (max. 10 km/h), e.g. bicycles & tracks	10		0.25	0.125	50
Regular vehicle traffic (max. 40 km/h)	20		0.40	0.2	45
<b>Safety &amp; security</b>					
Small risk areas e.g. timber storage, sawdust & wood chip fields	5		0.25	0.1	55
Medium risk areas e.g. sawn timber storage areas	10		0.40	0.167	50

1	2	3	4	5	6
Areas to be lit, operation performed	Minimum maintained average illuminance (in lux)		Minimum uniformity ratio $E_{hmin}/E_{hav}$	Minimum uniformity ratio $E_{hmin}/E_{hmax}$	Maximum glare rating $GR_{max}$ .
	Horizontal $E_{hav}$	Vertical $E_{hav}$			
<b>Safety &amp; security (continued)</b>					
High risk areas e.g. crossing points of conveyors, fire risk areas	50		0.40	0.2	50
<b>Shipyards &amp; docks</b>					
<b>Work areas or task</b>					
Very rough work e.g. short term handling of large areas	20		0.25	0.125	55
Rough work e.g. cleaning of ship hull	50		0.25	0.2	50
Accurate work e.g. painting & welding of ship hull	100		0.40	0.2	45
Fine work, mounting of electrical & mechanical components	200		0.50	0.33	45
<b>Traffic areas</b>					
Walking passages exclusively for pedestrians	5		0.25	0.125	55
Traffic areas for slow moving (max. 10 km/h) vehicle traffic, e.g. bicycles & trucks	10		0.40	0.2	50
Regular vehicle traffic (max. 40 km/h)	20		0.40	0.167	50
<b>Safety &amp; security</b>					
General lighting on shipyard area, storage areas for prefabricated goods	20		0.25	0.125	55
<b>Water &amp; sewage plants</b>					
<b>Work areas or task</b>					
Very rough work e.g. handling of service tools, utilization of manually operated valves, starting & stopping of motors	20		0.25	0.125	55
Rough work e.g. handling of chemicals, inspection of leakage, piping packing & raking plants	50		0.40	0.2	45
Accurate work e.g. changing of pumps, general servicing work, reading of instruments	100		0.40	0.2	45
Fine work e.g. repair of motors & electric devices	200		0.50	0.33	45

1	2	3	4	5	6
Areas to be lit, operation performed	Minimum maintained average illuminance (in lux)		Minimum uniformity ratio $E_{hmin}/E_{hav}$	Minimum uniformity ratio $E_{hmin}/E_{hmax}$	Maximum glare rating $GR_{max}$ .
	Horizontal $E_{hav}$	Vertical $E_{hav}$			
<b>Traffic areas</b>					
Walkways exclusively for pedestrians	5		0.25	0.1	55
Traffic areas for slow moving vehicle traffic (max. 10 km/h), e.g. bicycles & trucks	10		0.40	0.167	55
Regular vehicle traffic (max. 40 km/h)	20		0.40	0.2	45
<b>Safety &amp; security</b>					
Low risk areas e.g. occasionally used service passages & stairs, waste water cleaning & aeration tanks, filter & sludge digestion tanks	5		0.25	0.1	55
Medium risk areas e.g. regularly used stairs, basins & filters of clean water plants	20		0.40	0.167	50

## Reference to indoor lighting table (pg. 11)

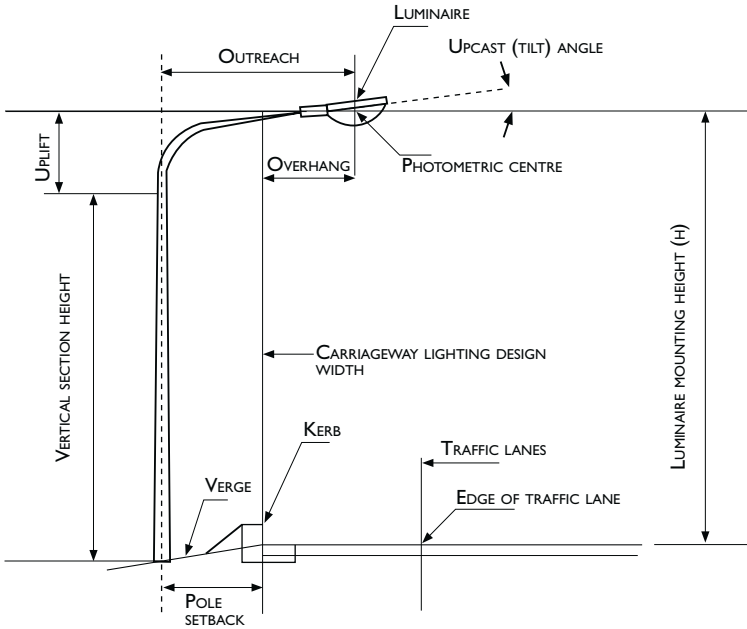
Recommended average maintained illuminance value requirements:

- a.) Column 1: lists specific interiors, areas, tasks or given activities. If a particular location or task is not listed, the values for the closest similar or comparable situation should be used.
- b.) Column 2: gives the minimum average maintained illuminance ( $E_{hav}$ ) on the reference surface of the interior, area, task or activity listed in column 1.
- c.) Column 3: gives the maximum unified glare rating (UGR) applicable to the interior, area, task or activity listed in column 1.
- d.) Column 4: gives the minimum colour-rendering indices ( $R_a$ ) for the interior, area, task or activity listed in column 1.
- e.) Column 5: gives comments and advisory notes for exceptions and special applications.



# Street Lighting (SANS 10098-1)

## Geometry & Street Lighting Terminology



## Street Lighting Terminology & Their Application

Term	Description	Application
Mounting height	The vertical distance from the roadway surface to the photometric centre of the luminaire.	The most suitable standard height at which the luminaire's lighting performance can be most efficiently utilised within construction constraints.
Outreach	Outreach is measured horizontally from the centreline of the pole to the photometric centre of the luminaire.	The most suitable standard horizontal distance that places the luminaire at a lateral point across the road where the luminaire performance can be most efficiently utilized
Pole setback	The horizontal distance between the edge of the kerb (or edge of the traffic lane if no kerb) and the centre-line of the lighting pole, measured normal to the direction of traffic.	The dimension specified by the road controlling authority as being that required reduce the possibility of vehicle impact. It is relative to the road speeds, pole type and whether the road is curved or straight, proximity to intersections.
Carriageway width	The portion (width) of the roadway that is devoted to the use of vehicles	The kerb-to-kerb width of that part of the carriageway which is used for calculation or assessment of road lighting.
Overhang	Overhang is measured horizontally from the edge of the kerb to the photometric centre of the luminaire	This is a critical dimension used in design software applications in determining carriageway luminance and illuminance.

## Street Lighting Terminology & Their Application

Term	Symbol	Description	Application
Luminance	L (cd/m <sup>2</sup> )	The average intensity of light reflected off the surface of the road.	Sections of carriageway between intersections. Group A Roads.
Illuminance	E <sub>h</sub> (lx)	E <sub>h</sub> is the level of illumination arriving at a horizontal plane.	Major road intersections and conflict points. Group B Roads.
	E <sub>v</sub> (lx)	E <sub>v</sub> is the level of illumination arriving at a vertical plane.	External car parks, pathways, stairways, public precincts, cycle ways, pedestrian crossings etc.
Uniformity	U <sub>O</sub>	Overall luminance uniformity. Ratio of minimum carriageway luminance over the average carriageway luminance calculated within a specified area.	Straight sections of carriageway within calculated area..
	U <sub>L</sub>	Longitudinal luminance uniformity. Ratio of minimum carriageway luminance over the maximum carriageway luminance along a line-of-sight down a length of carriageway.	Straight sections of carriageway between lanes of calculated area

### Uniformity

Levels of illumination along the carriageway will vary as a result of luminaire mounting height, luminaire spacing and luminaire output. It is important that the contrast between the illumination levels along the carriageway be minimized. The motorist's eyes should not have to adjust too much for the variations.

Uniformity is measured as a ratio between road surface illumination levels e.g. max. to min. or max to average.

Uniformity values vary for various roadway elements.

Uniformity is as important as providing enough illumination.

## Electrical Data & Light Outputs

Lamp type	Lamp wattage (W)	Corrected line current		Lamp current	
		Starting Amps	Running Amps	Starting Amps	Running Amps
Mercury Vapour	250	2.60	1.35	3.70	2.00
High Pressure Sodium	150	1.30	0.88	2.40	1.80
	250	2.10	1.42	4.00	3.10
	400	3.80	2.20	6.40	4.55
Metal Halide	250	3.00	1.35	4.20	3.00
	400	3.80	2.80	5.80	3.50

## Recommended Lighting Values For Group B & C Streets & Foot Ways (SANS 10098-1)

Lighting category	Type of street	Minimum average horizontal illuminance E	Minimum horizontal illuminance E	Minimum semi-cylindrical illuminance E
B1	Residential streets with medium to high volume traffic	5 lux	1 lux	2 lux
B2	Residential streets with medium volume traffic	3 lux	0,6 lux	1 lux
B3	Residential streets with low volume traffic	2 lux	0,4 lux	0,6 lux
C1	Wholly pedestrian in city centre	10 lux	3 lux	7,5 lux
C2	Wholly pedestrian in local shopping malls	7,5 lux	1,5 lux	3 lux

**Note:**

- Horizontal illuminance values apply across the carriageway on footpaths up to 2 m from the edge of the carriageway.
- For areas requiring higher security, semi-cylindrical illuminance values as stated can be used as a supplementary criterion. They apply on the footways parallel to the kerbs in both directions.

## Inverse Square Law

For calculating illumination at a point P on a plane surface:

$$E = \frac{I_{\theta}}{d^2} \quad \text{for a point directly below the light source}$$

$$E = \frac{I_{\theta}}{d^2} \cos\theta \quad \text{for a point at some angle } \theta \text{ elsewhere on the plane}$$

$$\text{or } E = \frac{I_{\theta}}{h^2} \cos^3\theta$$

Where:

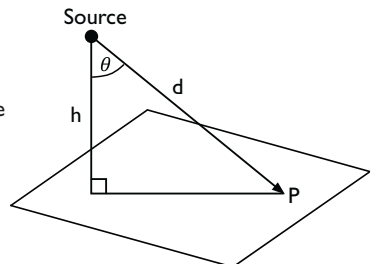
E = Illuminance in lx

d = the distance from the source to the point (m)

$\theta$  = the angle of the light from the normal

$I_{\theta}$  = the intensity of the source in the direction  $\theta$  (cd) as per the I-table

h = the perpendicular distance from the source to the plane (m)



Notice that an inverse square law is evident here. Thus the mounting height of a luminaire were doubled, the illumination levels would fall to one quarter of their original value.

# Recommended Lighting Values For Group A Roads (SANS I0098-I)

LIGHTING CATEGORY		ROAD CROSS-SECTION																											
		WITHOUT MEDIAN						WITH MEDIAN																					
		MAXIMUM TRAFFIC VOLUME DURING DARKNESS (MOTOR VEHICLES PER HOUR PER LANE)																											
TYPE OF ROAD		>600				300				100				>900				600				200							
		Ln	Uo	Ul	Tl	Ln	Uo	Ul	Tl	Ln	Uo	Ul	Tl	Ln	Uo	Ul	Tl	Ln	Uo	Ul	Tl	Ln	Uo	Ul	Tl				
A.1	Freeway and expressway with median free od level crossings; for speed limits exceeding 90 km/h.	2	0.4	0.7	15	1.5	0.4	0.7	20	1	0.4	0.6	20	2	0.4	0.7	15	1.5	0.4	0.7	20	1	0.4	0.6	20	1	0.4	0.6	20
A.2	Major roads, for speed limits not exceeding 90 km/h.	1.5	0.4	0.7	20	1	0.4	0.6	20	0.8	0.4	0.5	20	1.5	0.4	0.7	20	1	0.4	0.6	20	0.8	0.4	0.5	20	0.8	0.4	0.5	20
A.3	Important urban traffic routes, for speed limits not exceeding 60 km/h.	1	0.4	0.6	20	0.6	0.4	0.5	20	0.5	0.4	0.5	20	1	0.4	0.6	20	0.8	0.4	0.5	20	0.5	0.4	0.5	20	0.5	0.4	0.5	20
A.4	Connecting roads, local distributor roads; residential major roads.	0.5	0.4	0.5	20	0.5	0.4	0.5	20	0.3	0.3	0.5	2.5	0.5	0.4	0.5	20	0.5	0.4	0.5	20	0.3	0.3	0.5	20	0.3	0.3	0.5	25

Ln = MINIMUM AVERAGE LUMINANCE, CD/M<sup>2</sup>;  
 Uo = OVERALL LUMINANCE UNIFORMITY, MIN;  
 Ul = LONGITUDINAL LUMINANCE UNIFORMITY, MIN;  
 Tl = THRESHOLD INCREMENT, %, MAX.

Note:  
 a) The values apply to straight sections of the road, and to curves and intersections.  
 b) the luminance values apply to a dry road surface of any material.

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## References

SANS 10114-1 Interior lighting, Part 1:Artificial lighting of interiors.  
SANS 10389-1 Exterior lighting, Part 1:Artificial lighting of exterior areas for work and safety.  
SANS 10098-1 Public lighting, Part 1:The lighting of public thoroughfares.  
Occupational Health and Safety Act & regulations, Act 85 of 1993. (2016). Amended.  
Public Lighting Design Manual. (2018). (Corporation Limited)  
The Lighting Handbook: Reference book. (Zumtobel Lighting GmbH).

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## Disclaimer

Information in this guide is subject to national standards and thus is subject to change without prior notice.  
Genlux Lighting can not be held liable for any changes or alterations in this regard.  
This is a guide only and the SABS Lighting standards should be consulted for the latest values.

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## NOTES:



# GENLUX LIGHTING BRANCHES

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## JOHANNESBURG (Head office)

4 Branch Road,  
Driehoek, Germiston, Gauteng, 1401  
P.O. Box 1183, Germiston, 1400  
Tel: +27 (0) 11 825 3144  
Fax: +27 (0) 86 508 5595  
Email: [genluxsales@actom.co.za](mailto:genluxsales@actom.co.za)

## DURBAN

70 Solomon Mahlangu Drive,  
Rossburgh, Durban, 4094  
P.O. Box 922, Durban, 4000  
Tel: +27 (0) 31 465 4170  
Fax: +27 (0) 31 465 4189  
Email: [genluxKZN@actom.co.za](mailto:genluxKZN@actom.co.za)

## CAPE TOWN

12 Hawkins Avenue,  
Epping Industria No 1, Cape Town, 7460  
P.O. Box 276, Eppindust, Cape Town, 7475  
Tel: +27 (0) 21 532 2000  
Fax: +27 (0) 21 532 2013  
Email: [genluxCT@actom.co.za](mailto:genluxCT@actom.co.za)

## BLOEMFONTEIN

20 Lombard Street,  
Hilton, Bloemfontein, 9300  
P.O. Box 914, Bloemfontein, 9300  
Tel: +27 (0) 51 448 1417  
Fax: +27 (0) 51 448 7104  
Email: [genluxsales@actom.co.za](mailto:genluxsales@actom.co.za)

## PORT ELIZABETH

200 Kempston Road,  
Sidwell, Port Elizabeth, 6001  
P.O. Box 3503, North End, Port Elizabeth, 6056  
Tel: +27 (0) 41 451 5641  
Fax: +27 (0) 41 451 5650  
Email: [genluxPE@actom.co.za](mailto:genluxPE@actom.co.za)

[www.genluxlighting.co.za](http://www.genluxlighting.co.za)

*light creates colour...*

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**E.&O.E. (errors and omissions excepted)**

**Email: [genluxsales@actom.co.za](mailto:genluxsales@actom.co.za)**

**Tel: +27 11 825-3144**

**Website: [www.genluxlighting.co.za](http://www.genluxlighting.co.za)**