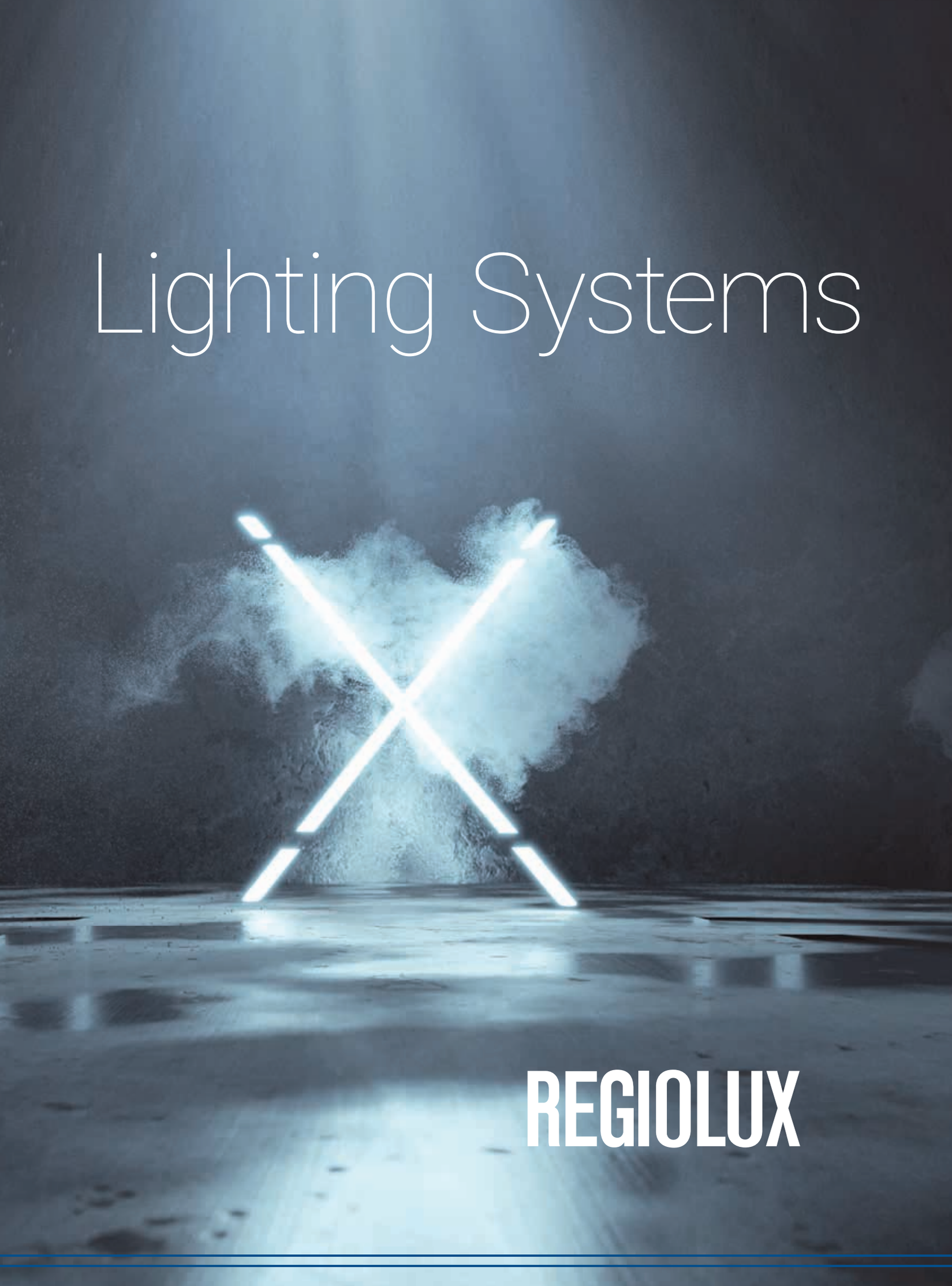
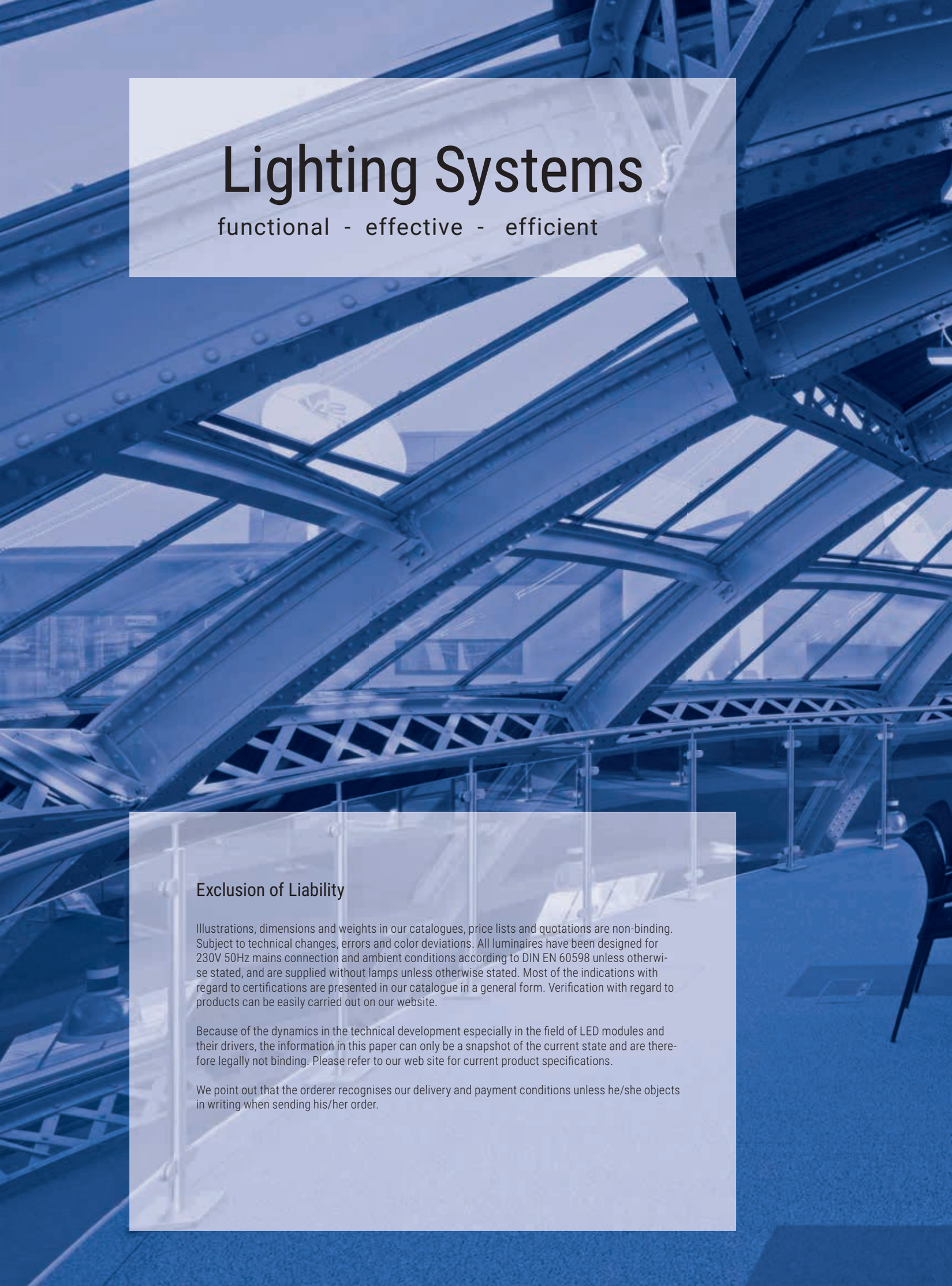
Lighting Systems



REGIOLUX



Lighting Systems

functional - effective - efficient

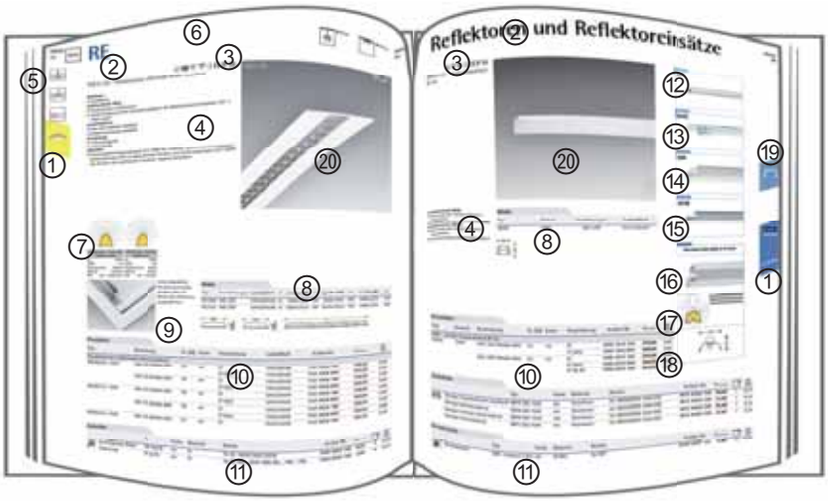
Exclusion of Liability

Illustrations, dimensions and weights in our catalogues, price lists and quotations are non-binding. Subject to technical changes, errors and color deviations. All luminaires have been designed for 230V 50Hz mains connection and ambient conditions according to DIN EN 60598 unless otherwise stated, and are supplied without lamps unless otherwise stated. Most of the indications with regard to certifications are presented in our catalogue in a general form. Verification with regard to products can be easily carried out on our website.

Because of the dynamics in the technical development especially in the field of LED modules and their drivers, the information in this paper can only be a snapshot of the current state and are therefore legally not binding. Please refer to our web site for current product specifications.

We point out that the orderer recognises our delivery and payment conditions unless he/she objects in writing when sending his/her order.

Description of page layout



① Product group

② Luminaire family, type

③ Certification: Overview and explanation in Technical information chapter 8: 8.6 Certification, insulation class and protection rating

④ Description with regard to lighting technology, housing, miscellaneous

⑤ Indications with regard to ceiling systems

⑥ Reference to accessories pages and products in other product groups

⑦ Light distribution curve (LVK) with data with regard to lighting technology of the reference product.
Explanations in the following area Explanations

⑧ Dimensional table and sectional drawings: Explanations of the variables in the following area Explanations

⑨ Detail image with explanation

⑩ Product table: Explanations of the abbreviations in the following area Explanations

⑪ Table with spare parts / accessories (if available): Explanations of the abbreviations in the following area Explanations

⑫ Combination quick-fit mounting system: Component mounting rail

⑬ Combination quick-fit mounting system: Component device mount

⑭ Combination quick-fit mounting system: Component light direction

⑮ Combination quick-fit mounting system: Component light direction insert

⑯ Quick-fit mounting system: Combination

⑰ Quick-fit mounting system: Light distribution curve of the combination, explanations in the following area Explanations

⑱ Quick-fit mounting system: Dimensioned drawing of the combination

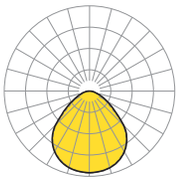
⑲ Indication to the product area mounting rail / device mount / light direction

⑳ Product image with icons and indication for functions and features

Explanations

Explanation of lighting technological data

① PNEMP/625 IP54 LED 4400 lm 840



②	η_{LB}	100 % ③
	lm/W	51 ④
	direct/indirect	100/0 % ⑤
	UGR lat./long	18,3/18,0 ⑥
	VDU	65° < 3000cd/m² ⑦

1. Configuration
Possible deviations of luminous flux between magnetic ballasts (Llb) and electronic ballasts (ECG) are not considered.

2. Luminous intensity distribution
Luminous intensity distribution curves shown in the catalogue are represented according to DIN 5032. Only both primary planes are displayed: 0°/180° planes (at right angles to luminaire axis) as a continuous line and 90°/270° (parallel to luminaire axis) as a dotted line. Curves are scaled to represent 1000 lumens of lamp luminous flux.

3. Light output ratios η_{LB}
Light output ratios specified for each luminaire are calculated from the relation of luminous flux Φ_L (τ_L) emitted from the luminaire with an ambient luminaire temperature τ_L = 25° C and further standardised conditions to the sum of measured luminous flux of the lamps with open distribution transferred individually to the luminaire ballast.
In the case of LED luminaires, the principle of absolute photometry is increasingly applied. In this case, the light output ratio is indicated with 100%. Additionally, the luminous flux is indicated in the form of the measured luminous flux of the luminaire.

4. Luminous efficiency
The luminous efficiency is the luminous flux of a bulb or luminaire related to its electrical power consumption.
In the case of LED luminaires presented according to the principle of absolute photometry (light output ratio 100%), the indication refers to the lumen output of the luminaire which is described by the ratio between luminous flux of the luminaire and system performance of the luminaire.

5. Direct and indirect light components
For evaluating the efficiency and lighting effect of a lighting system within a room, specification of the direct and indirect beam components is helpful.

6. Glare reduction according to UGR method
According to DIN EN 12464-1, not only is reflected glare considered but also direct glare within a specific room. As a standard evaluation system the UGR (Unified Glare Rating) method was introduced in Europe as part of the DIN EN 12464-1 standard. Details concerning the UGR method are described in the CIE 117 publication. The UGR values (lat. and long) of a lighting installation, determined according a table for the position of a standard viewer, are not permitted to exceed the value specified by the standard. In order to compare the direct glare of various luminaires, UGR values of a number of manufacturers are specified with reference to a so-called standard room. Please note that a correct comparison is only possible if all room conditions are identical. In addition it must be noted that UGR values for a real installation may significantly differ to those of the standard room.

Values given are based upon the following definitions.
Room dimensions:
Distance of eye level to luminaire level: H
Room width X = 4H
Room length Y = 8H
Standard reflection factors (0,7 ceiling; 0,5 walls; 0,2 floor)
Luminaire arrangement parallel to Y axis Luminaire distances:
Distance of luminaire to luminaire (spacing) S = 0,25H
Distance of luminaire to wall ½ S = 0,125H

Explanation of lighting technological data

7. Suitability for VDU workstations
Here, the suitability of luminaires for VDU workstations according to DIN EN 12464-1 is specified. The degree number means that the luminance in all luminaire planes beyond that angle does not exceed certain limitation values. Depending on screen quality and screen visualisation, the norm specifies different limitation values. In case of a positive display on screens with an own luminance (< 200 cd/m²), a maximum of 1500 cd/m² and in case of screens with a high luminance (> 200 cd/m²), a maximum of 3000 cd/m² is permissible.

Control gear

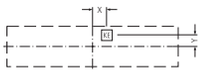
Abbr.	Description
ECG	Electronic ballast
Llb	Low-loss ballast
ind	Inductive, must be compensated on-site
multi	Multiwatt T5
ED	Electronic driver, not dimmable
EDM	Electronic driver Multi, not dimmable (8 or 16 adjustable lighting levels)
DALI	Electronic driver, DALI, dimmable
DALI DT8	Electronic driver, DALI, dimmable, change of light color (Tunable white)
LC.	Device with integrated LC components of special type
M.	Master unit Typ 1-N
S.	Sensor unit Typ 1-N
NL-B1, NL-B3	Emergency light single battery; 1=1h, 3=3h

Explanations

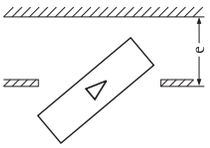
Definition of measurement table variables

Abbr.	Description
A	Distance between the individual luminaires
A1	Fixing distance in case of single mounting
A2	Fixing distance for first or last luminaire in case of light run mounting
A3	Fixing distance for the middle luminaires or between the luminaires in case of light run mounting
A4	Fixing distance (width)
B	Width
D	Diameter
DA	Diameter of cut for recessed luminaires
DA_B	Width of cut for recessed luminaires
DA_L	Length of cut for recessed luminaires
DS min	Minimum ceiling thickness with suspended ceiling
DS max	Maximum ceiling thickness with suspended ceiling
Db	Sensor detection diameter
Dr	Sensor detection diameter ideal movement towards the sensor
Ds	Sensor detection diameter seated activity
Dt	Sensor detection diameter tangential movement parallel towards the sensor
Et	Mounting depth (necessary depth for luminaire mounting)
Et min	Minimum mounting depth (necessary depth for luminaire mounting during celing construction)
FB	Width of luminaire groundplate
FD	Diameter of luminaire groundplate
FL	Length of luminaire groundplate
H	Height
HS	Installation height of sensor
KB	Width of luminaire head or ballast box
KD	Diameter of luminaire head or ballast box
KE	Cable infeed
KH	Hight of luminaire head or ballast box
KL	Length of luminaire head or ballast box
L	Length
L2	Additional length
MB	Modul (axes) width
ML	Modul (axes) length
P	Suspension length
Pmin	Minimum suspension length
Pmax	Maximum suspension length
P_{Sys}	Luminaire system performance
T	Depth
W	Wall distance
X	Distance from middel of the luminaire to the electrical feed in (X direction = length)
Y	Distance from middel of the luminaire to the electrical feed in (Y direction = width)

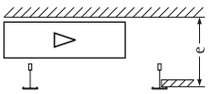
Description of measurement table variables



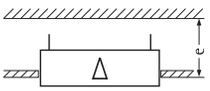
1. Positioning of electrical feed in.



2. Required installation depth "Et" for swivelling of luminaire in visible T rail constructions (lay-in luminaires). Required installation depth "Et" for swivelling luminaire and control gear (if applicable) through ceiling cut-out (clamp mounting).



3. Reduced installation depth "Et min" with aligning of luminaire above T rail construction (during ceiling construction).



4. Required installation depth "Et" for swivelling of mounting bracket (clamp mounting).

Ceiling systems

	Ceilings with visible T-rails
	For concealed symmetrical rail constructions
	For concealed asymmetrical rail constructions
	For recessed ceilings
	For panel ceilings, module 100, 150, 200

Cross references

	Reference accessories
	Reference mounting rail installation
	Reference mounting note
	Reference product groups

Icons / functions features

	Configuraton with sensor available
	Configuraton with emergency light unit available
	Luminaires for HCL (human Centric Lighting)
	Luminaires suitable for Advanced Services
	Luminaires suitable for IoT (Internet of Things)
LED	LED (included)
α	Beam angle

Explanations

Materials

Abbr.	Description
A03S-U	Recognised national cable type: measurement voltage 300 V to 300 V; Silicone rubber isolation material, heat-resistant to +180° C; Single-wire conductor, round
ABS	Acrylonitrile Butadiene Styrene Copolymerisate
Al	Aluminium
AlMgSi	Aluminium magnesium silicon (extruded section)
Cu	Copper
EPDM	Synthetic rubber
Glass	Glass
Glass matt	Matt glass
Glass (ESG)	Tempered single-pane safety glass
H03VV-F	Harmonised cable: measurement voltage 300 V to 300 V; Isolation material PVC, heat-resistant to +70° C; sheathing material PVC, heat-resistant to +70 °C; fine-strand conductor, flexible
H05HH-F	Harmonised cable: measurement voltage 300 V to 500 V; Isolation material flat, divisible cable; sheathing material flat, divisible cable; fine-strand conductor, flexible
H05S-U	Harmonised cable: measurement voltage 300 V to 500 V; silicone rubber isolation material, heat-resistant to +180° C; single-wire conductor, round
H05V2-U	Harmonised cable: measurement voltage 300 V to 500 V; Isolation material PVC, heat-resistant to +90° C; single-wire conductor, round
H05VV-F	Harmonised cable: measurement voltage 300 V to 500 V; isolation material PVC, heat-resistant to +70° C; sheathing material PVC, heat-resistant to +70 °C; fine-strand conductor, flexible
H07V2-U	Harmonised cable: measurement voltage 450 V to 750 V; isolation material PVC, heat-resistant to +90° C; single-wire conductor, round
Inox	Stainless steel
Inox V2A	Stainless steel (alloy type 1.4301 or X5CrNi18-10)
Inox V4A	Stainless steel (alloy type 1.4401 or X5CrNiMo17-12-2)
Mix	Diverse materials
PA	Polyamide
PC	Polycarbonate
PMMA	Polymethylmethacrylate (acrylic glass)
Polymer	plastic (not defined specifically)
Polymer clear	Plastic (crystal clear)
Reinforced polymer	Plastic (with admixture of reinforcing materials)
PS	Polystyrene
PVC	Polyvinyl chloride
St	Steel
StZn	Steel with zinc coating

Colour code

Abbr.	Colour
al	aluminium
aeh	aluminium high gloss
aes	aluminium matt gloss
aen	aluminium natural anodized
ap	aluminium plate finish
am	anthracite metallic
bl	blue
bl/cr	blue chrome
ce	cream
cr	chrome
eg	brushed stainless steel
ge	yellow
ge/cr	yellow chrome
ga	grey
gr	green
hg	light grey
hgl	high gloss
kg	pebble grey, RAL 7032
kgm	pebble grey metallic, RAL 7032
kl	clear
me	metallike
op	opal white
og	orange
ro	red
sw	black, RAL 9005
si	silver
sg	silver-grey, RAL 9006
tz	translucent
tp	transparent
vw	traffic white, RAL 9016
ws	white
wa	white-aluminium, RAL 9006

Technical information

1. The quality of light

Lighting planning today can choose from a wide variety of light sources and therefore instruments that enable lighting adapted to people's needs. The first approaches towards qualitative lighting planning were made as early as the nineteen fifties. The pioneer in the field of new lighting philosophy was Richard Kelly. His systematisation of light effects today still finds praise.

Richard Kelly managed to free himself from the requirement of uniform illuminance, seen until then as a central criterion of lighting planning. He substituted the question of light quantity with the question of the quality of light. He searched for criteria that differentiated between the perceptional priorities of the viewer. From this consideration a systematisation was created within which Kelly differentiated between three fundamental functions of lighting.

Light for looking light for viewing light for looking at

Light for looking

Light for seeing approximately corresponds to the usual quantitative expectation of light. General lighting is created that is sufficient for the perception of the defined viewing tasks. This might be the perception of objects or building structures, orientation in an environment or orientation while moving forwards. But in contrast to quantitative lighting planning, light for viewing is not the aim but rather the basis for extended lighting planning.

Light for viewing

Light for viewing according to Kelly's theory extends beyond general lighting and accommodates the requirements of people in their surroundings. This type of lighting sets priorities for human perception: firstly objects are recognised that are illuminated in the room the brightest, and then the viewer completes this with perception of the darker objects. In contrast to uniform lighting, light for viewing structures the visual environment into bright and dark zones. It can be quickly and unequivocally differentiated and comprehended. The viewer's gaze can be directed onto single objects or zones in the room. This principle not only aids orientation in rooms, it can also be used for the presentation of goods and objects with an aesthetic appeal.

Light for looking at

Light for viewing not only illuminates objects or communicates information, but is itself the object of perception. In this respect the light contributes to the aesthetic effect of the room and creates ambience and atmosphere. Light for viewing can be created by candlelight or a light object. The brilliance of the light itself can also become visible via the illumination of specific materials.

To be able to implement these three basic functions of lighting into lighting planning, the industry offers a wide range of lamps that equip various forms of luminaire housings. The design of luminaires does not only have an aesthetic function, but is also influenced by the light guiding optics that in their turn ensure precise light control and glare elimination. Thus equipped, the lighting planner can then work qualitatively with light.

General lighting, supplying **light for seeing**, can be implemented with direct, wide distribution luminaires for fluorescent or compact fluorescent lamps. These light sources create diffuse light.

Homogeneous light can also be achieved via indirect lighting. But because purely direct or purely indirect light cannot create optimal visual conditions, luminaires with direct-indirect distribution have proven to be highly suitable for general lighting.

For improving general room impressions, illumination of vertical surfaces is recommended. This can be achieved with rectangular or circular luminaires, and with asymmetric reflectors and compact or linear fluorescent lamps.

For improving the general lighting of vertical surfaces, directed light can also be implemented that structures the rooms uniformly and therefore also provides light for viewing.

If **light for viewing** is ensured, a room impression can be emphasised with light for looking at. This in turn gives a significantly more sophisticated quality of light, and primarily improves rendering of the plasticity and surface structures of illuminated objects. Directed light enables differentiated concentration of light and opens the way for more flexibility with the arrangements of luminaires in the room. An interplay of light and shadow is created that determines the succession of perception.

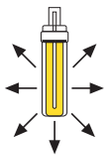
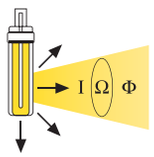
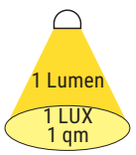
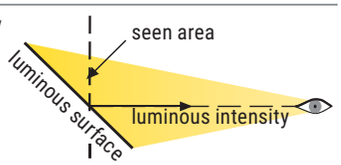
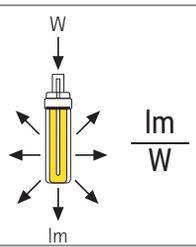
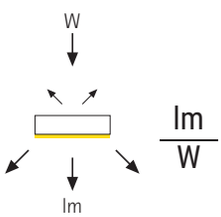
Room depth also becomes experienceable. Surface-mounted spots with reflector lamps are often used for such tasks. Recessed pan-and-tilt luminaires, usually equipped with high pressure discharge lamps and wide distribution reflectors, can also provide directed light.

In order to emphasise **light for viewing** it makes sense to keep the general lighting level low. Modelling effects can then be implemented with supplementary directed light. If general lighting is too high, the planner is forced to work with higher wattages for the adjustable light sources. Often the stray light from accentuated areas is sufficient for ambient lighting.

Light for looking at has greater demands on lamps and luminaires than the light for viewing tasks. This mostly means working with almost point-like light sources. As soon as the light from such lamps falls onto materials having glossy surfaces, light reflections are created that are perceived as being brilliant. When light sources themselves become objects, fibre optics, LED and also halogen pin-base lamps can be used. The luminance level of the lamps is experienced as radiant light. Light guidance and the lighting itself is no longer of primary significance.

Bibliography:
History of Light and Lighting - Correspondence Course Lighting Application/ Vol. 2

2. Lighting technology basic concepts

Basic term	unit	**symbol**	definition	
1. Luminous flux	Lumen (lm)	Φ	The total quantity of light emitted from the light source.	
2. Luminous intensity	Candela (cd)	$I = \frac{\Phi}{\Omega}$	The luminous intensity I evaluates the light radiated in a definite direction. It depends on the luminous flux Φ in this direction and on the radiated solid angle.	
3. Illuminance	Lux (lx)	$E = \frac{\Phi}{A}$	The illuminance E is the luminous flux Φ, on a defined surface A.	
4. Luminance	Candela per m^2 (cd/m^2)	$L = \frac{\Phi}{A \cdot \cos \varepsilon}$	The luminance is the luminous intensity per m^2 of visible surface. The luminance L of an illuminated surface is the measure for the luminosity perceived.	
5. Bulb light output	Lumen per Watt (lm/W)	$\eta = \frac{\Phi}{P}$	The bulb light output is the gross light flux of a bulb relative to its power consumption.	
6. Luminaire light output	Lumen per Watt (lm/W)	$\eta = \frac{\Phi}{P}$	The luminaire light output is the net light flux of a luminaire relative to its power consumption, including the operating equipment.	

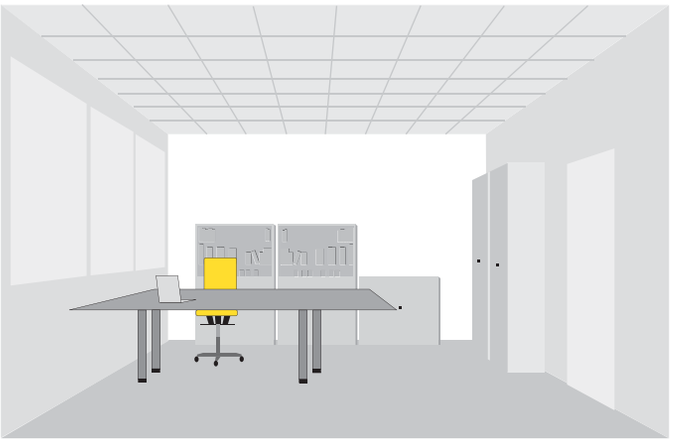
3. Lighting planning

The planning of a lighting system represents a complex task, including the working out of a lighting solution together with the building owner, the architect and the building services planner. This should fulfill valid standards and directives and should also meet the quality attributes for good lighting (see Section 4). And of course, successful lighting design in combination with the interior design also contributes to pleasant spacial environments.

3.1 Prerequisites

The following documents and specifications are necessary for planning a lighting system:

- Floor plan and sections of the rooms, room dimensions
- Ceiling system (type of construction and ceiling axis dimensions)
- Colours, reflection factors of ceiling, walls, floor and furniture
- Furniture or machine layouts
- Room use and visual tasks
- Position of work areas and surrounding areas
- Operating conditions such as temperature, dust and humidity (also see Fig. 3.3)



3.2 Standards

Lighting systems should comply to valid standards and directives. The basis for this is supplied by the European EN 12464 standard, ‚Lighting of workplaces'.

3.2.1 EN 12464 Part 1 ‚Lighting of workplaces in indoor areas'

Extract from DIN EN 12464-1
The indicated maintenance values for the illuminance are mean values above the working zone on the horizontal, vertical or inclined reference area. Independent of age and condition of the lighting system, the mean illuminance may not fall below the indicated value.

The UGR value of a lighting system may not exceed the indicated value.

Type of room, visual task or activity	Em (lux)	UGR
Traffic zones		
Traffic zones and corridors	100	28
Staircases, escalators, moving pavements	100	25
Loading ramps, loading zones	150	25
Break, sanitary and first aid rooms		
Canteens, Coffee kitchen	200	22
Break rooms	100	22
Rooms for compensatory gymnastics	300	22
Cloakrooms, washrooms, bathrooms, toilets	200	25
First aid rooms	500	19
Rooms for medicinary case	500	16
Control rooms		
Rooms for facility installations, Control gear rooms	200	25
Telefax and Post offices, telefon registration	500	19
Cold storages and stock rooms		
Stockrooms	100	25
Shipping and Packing	300	25
(High-bay) racks		
Traffic route without passenger traffic	20	-
Traffic routes with passenger traffic	150	22
Control center	150	22
Front of (high) bay rack	200	-
Agriculture		
Charging and operating of conveyors and machines	200	25
Barns	50	-
Barns for sick animals, calving barns	200	25
Feed preparation, milk rooms, equipment cleaning	200	25
Bakeries		
Preparation and baking rooms	300	22
Final processing, glazing, decoration	500	22
Electrical industry		
Manufacture of cables and wires	300	25
Winding (of large coils)	300	25
Winding (of medium-sized coils)	500	22
Winding (of fine coils)	750	19
Impregnation of coils	300	25
Galvanization	300	25
Assembly works (rough, e.g. large transformers)	300	25
Assembly works (medium-fine, e.g. control panels)	500	22
Assembly works (precision, e.g. telephones)	750	19
Assembly works (high precision, e.g. measuring instruments)	1000	16
Electronic workshops, testing, adjustment	1500	16
Metal working and processing		
Hammer forging	200	25
Drop forging	300	25
Welding	300	25
Rough and medium machine works: Tolerances > = 0.1 mm	300	22
Precision machine works; grinding: Tolerances < = 0.1 mm	500	19
Marking, monitoring	750	19
Wire and tube drawing shops, cold forming	300	25
Processing of heavy sheets: Thickness > = 5 mm	200	25
Processing of light sheets: Thickness < 5 mm	300	22
Production of tools and cutting goods	750	19
Assembly works (rough)	200	25
Assembly works (medium-fine)	300	25
Assembly works (precision)	500	22
Assembly works (high precision)	750	19
Galvanization	300	25
Surface treatment and painting	750	25
Tool, gauge and fixture making, precision mechanics and micromechanics	1000	19

Type of room, visual task or activity	Em (lux)	UGR
Printing offices		
Cutting, gilding, embossing, etching of printing blocks, work on lithographs and platens, printing machines, matrix production	500	19
Paper sorting and manual printing	500	19
Fonts, retouching, lithography	1000	19
Colour checking of multicolour printing	1500	16
Steel and copper engraving	2000	16
Textile manufacture and processing		
Workplaces and zones on baths, bale opening	200	25
Cording, washing, ironing, work on opening machines, drawing, combing, roving, jute and hemps spinning	300	22
Spinning, twisting, spooling, winding	500	22
Warping, weaving, braiding, knitting	500	22
Sewing, fine knitting, picking up stitches	750	22
Designing, pattern drawing	750	22
Finishing, dyeing	500	22
Drying rooms	100	28
Automatic textile printing	500	25
Slabbing, warp tying, cleaning	1000	19
Colour inspection, fabric inspection	1000	16
Invisible mending	1500	19
Hat production	500	22
Automobile industry		
Body construction and assembly	500	22
Paintwork, paint shops, grinding cabins	750	22
Paintwork: Repair, inspection	1000	19
Upholstery shop	1000	19
Final inspection	1000	19
General car service, repair and testing	300	22
Wood processing and machining		
Automatic processing, e.g. drying, laminated wood production	50	28
Vaporization pit	150	28
Reciprocating saws	300	25
Work at the joiner's bench, gluing, assembly	300	25
Grinding, painting, model joinery	750	22
Work on woodworking machines, e.g. turning, straightening, joining, cutting, sewing, milling	500	19
Selection of veneer woods	750	22
Marquetry, wood inlaid works	750	22
Quality control	1000	19
Offices		
Filing, copying etc.	300	19
Writing, typewriting, reading, data processing	500	19
Technical drawing	750	16
CAD workplaces	500	19
Conference and meeting rooms	500	19
Reception desks	300	22
Archives	200	25
Sales rooms		
Sales area	300	22
Counter areas	500	19
Packing tables	500	19
Libraries		
Bookshelves	200	19
Reading areas	500	19
Counters	500	19

Type of room, visual task or activity	Em (lux)	UGR
Parkings		
Entrance and exits (during the day)	300	25
Entrance and exits (during the night)	75	25
Routes	75	25
Parkings / parking spaces	75	-
Counter	300	19
Kindergarten, play schools (pre-schools)		
Playrooms	300	22
Day nursery rooms	300	22
Hobby rooms (handicrafts rooms)	300	19
Training centers		
Classrooms, seminar rooms	300	19
Classrooms for evening classes and adult education	500	19
Lecture halls	500	19
Black, green boards and white boards	500	19
Demonstration table	500	19
Art rooms	500	19
Art rooms in art schools	750	19
Rooms for technical drawings	750	16
Exercise rooms and laboratories	500	19
Handicraft rooms	500	19
Training workshops	500	19
Music exercise rooms	300	19
Computer training rooms (menu controlled)	300	19
Language laboratories	300	19
Preparation rooms and workshops	500	22
Entrance halls	200	22
Traffic zones, corridors	100	25
Staircases	150	25
Common areas for pupils / students and meeting rooms	200	22
Staff room	300	19
Libraries: Bookshelves	200	19
Libraries: Reading area	500	19
Collection of teaching resources	100	25
Sports halls, gymnasiums, swimming pools	300	22
School canteens	200	22
Kitchens	500	22

3.2.2 Further standards and directives

EN 1838	Emergency lighting
EN 12193	Sport hall lighting
EN 15193	Energy-related evaluation of buildings
BSI LG 7	Lighting Guide 7: Office Lighting
DIN 5035	Lighting with artificial light
DIN 67528	Lighting in public car-parks and on public off-street parking spaces
DIN SPEC 67600	Biologically effective lighting - planning recommendations
DIN V 18599	Energy-related evaluation of buildings
ASR 7/3	Workplace directive
BGR 131	Employers' association

Guidelines from specialist associations

3. Lighting planning

3.3 Special requirements

According to the application area, special operating conditions must be taken into account when selecting luminaires. The following represents a selection of frequent requirements.

3.3.1 Higher protection ratings

Some of the most frequent strains on electrical control gear are dust and humidity. In rooms with such conditions, luminaires with higher protection ratings must be used that are designed to prevent the ingress of foreign bodies and/or water (see Fig. 8.6.).

3.3.2 Fire risk facilities

This concerns rooms where a danger exists of flammable materials coming into proximity with electrical operating devices, meaning that fire may result. In situations with danger of fire via dust and/or fibres, luminaires must comply with the minimum protection rating of IP50 and the D designation (see Fig. 8.6.). In such cases the temperatures of the luminaire surfaces where with correct mounting flammable materials may gather must not exceed specified limit values.

3.3.3 High or low ambient temperatures

Luminaires are inspected in laboratory conditions with standardised parameters.Ambient temperature is usually 25°C. If in practice the ambient temperature strongly differs from this (e.g. for cold stores or workshops with process heat) the luminaire manufacturer should be consulted. In some cases special measures must be carried out.

3.3.4 Resistance to aggressive materials

If aggressive materials in the room atmosphere exist for specific application areas, the luminaire manufacturer should be consulted in order to assess the suitability of the luminaires. In this case information concerning the type of materials, their concentrations in the ambient air, ambient temperature and air humidity should be given. With regard to the compatibility of plastics to chemicals see Fig. 8.2.4. In this connection, resistance to chemical cleaning solvents must also be ascertained.

3.3.5 Splinter protection

Both in sensitive production areas and especially in rooms used for foodstuff manufacturing, impurities via glass splinters (e.g. from lamp damage) must be prevented. For this reason lamps with protective tubing or closed luminaires should be used.

3.3.6 Increased safety requirements in the food industry

Particular strict criteria apply for the use of luminaires in rooms of the food and beverage industry. Along with a higher degree of protection, the focus is on shatter protection, mechanical and chemical resistance as well as aspects of cleaning and/or maintenance. Appropriate tests according to DIN 10500 need to be performed to prove that these luminaires satisfy the standard IFS Food (International Featured Standards Food, formerly International Food Standard) and/or the BRC-Global Standard Food (British Retail Consortium) and may therefore be used in companies certified according to these standards.

3.3.7 Protection against flying balls

In sports halls, balls collide with luminaires with a relatively high impact velocity. Here it must be guaranteed that lamps are not destroyed by the impact and that no danger for people occurs from falling pieces. Luminaires for sports halls must therefore be ball-proof (see Fig. 8.6.).

3.3.8 Suitability for computer workstations

In rooms with computer screens, non-computer screen compatible lighting can lead to reflections and therefore glare. Lighting planning must therefore determine the area for luminaire mounting that may lead to disturbances, and the type and arrangement of luminaires must be selected in such a way that no disturbing reflections are created. Computer screen-compatible luminaires are equipped with special lighting technology with which the luminance values in the critical angle areas are reduced (see Fig. 4.3.).

3.3.9 Further demands for colour rendition

Various colour rendering properties of lamps lead to different perception of colours, thus influencing visual performance and well-being. Natural colour rendition is especially important for visual tasks in which colours must be matched and controlled (e.g. dental laboratories, printing works, textile manufacturing and sales). In this regard, suitable lamps with optimal colour rendition should be used.

3.3.10 Clean rooms

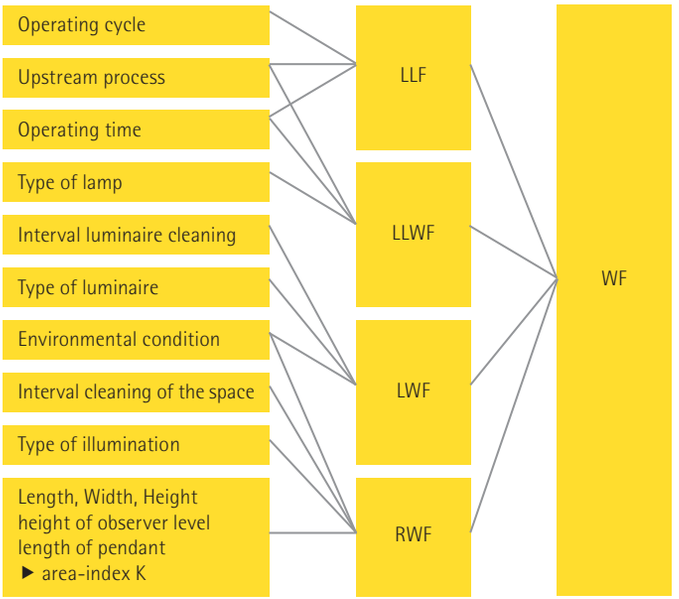
Clean room technology protects products, processes and people from the hazardous effects of contamination. That is why high quality requirements are placed on the operating resources (incl. illuminants), such as a reduction of particle emissions. Clean room applications are, for example, found in hospitals, in the pharmaceutical and foodstuff industries, in microelectronics and in research laboratories.

3.4 Maintenance factor

Illuminance levels specified in EN 12464 are so-called maintenance values and must not be fallen short of. Because in practice the actual illuminance level decreases due to ageing and soilage of the lamps, luminaires and the rooms, this is compensated for with the calculation of a maintenance factor (see Fig. 4.1). It is the duty of the lighting planner to specify or calculate the maintenance factor for the specific room and to draw up a maintenance plan. Mathematically, the maintenance factor represents the product of four part-maintenance factors:

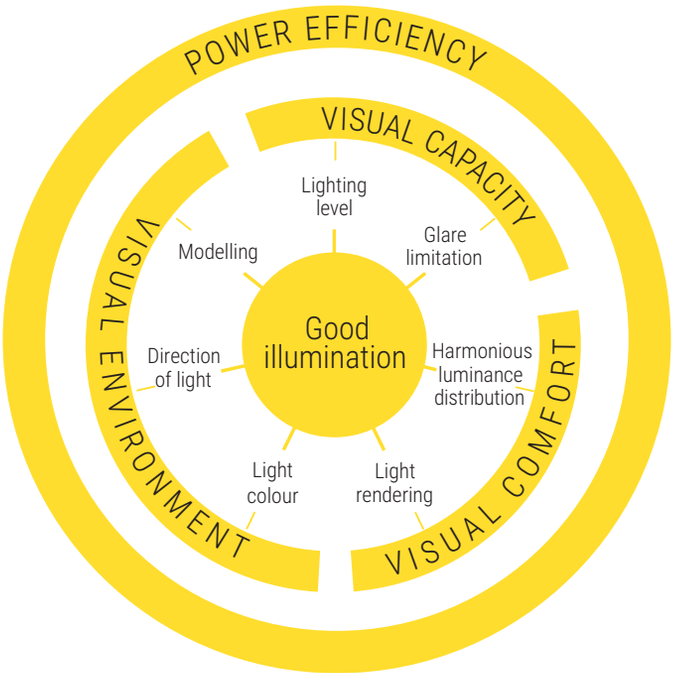
WF=LLWF x LLF x LWF x RWF

LLF	Lamp service life factor (lamp failure during service life)
LLWF	Lamp luminous flux maintenance factor (reduction of luminous flux during service life)
LWF	Luminaire maintenance factor (soiling of luminaires between two cleaning cycles)
RWF	Room maintenance factor (reduction of reflection factors of the room surfaces)
WF	Maintenance factor



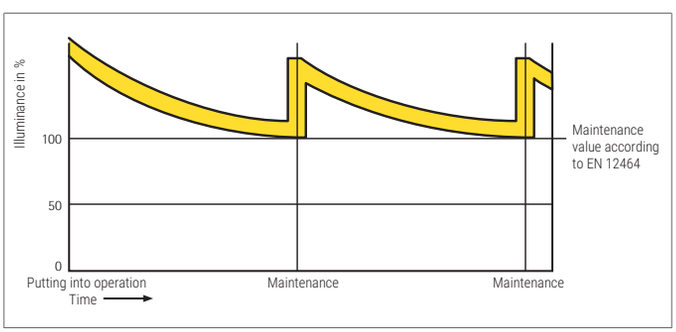
4. Quality criteria for good light

The task of indoor lighting is to supply people with an environment that contributes to their physical and emotional well-being and that also prevents accidents. In addition, lighting should influence the disposition of people according to high levels of performance, and with the intention of preventing premature tiredness and reducing errors. In order to optimally meet such requirements, several quality attributes should be considered during the planning process:



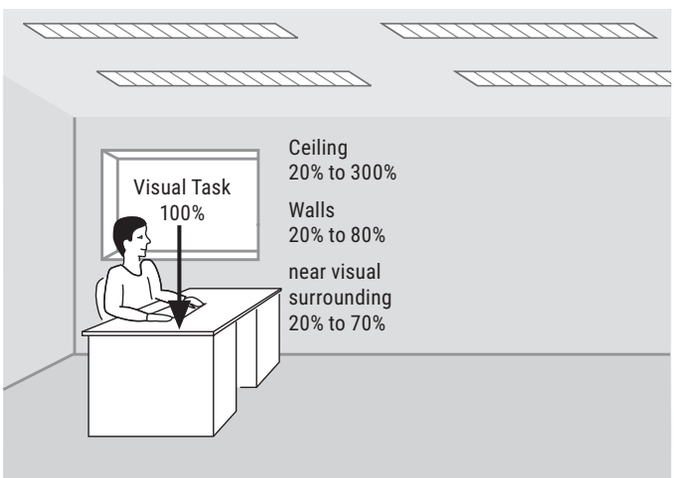
4.1 Lighting level

The lighting level is primarily defined by the level of illuminance. This in turn is dependent upon the visual task, and is oriented to the difficulty of recognising specific contrast and detail as well as the speed at which these must be perceived. The EN 12464 standard defines the required illuminance levels for various types of room and activity. Maintenance values specified for the illuminance levels are mean values for the workzones of the rooms in the specific working planes. Independent of the age and condition of the lighting system, the mean illuminance level must not fall below the specified value. For all lighting systems, illuminance levels decrease with increasing age of the lamps and because of the collection of dust. In addition, the reflecting peripheral surfaces of the room also usually darken with age or become dusty. The lighting system must therefore be planned according to a light loss factor that considers all influences and that was calculated for the intended lighting equipment, the spacial environment and the maintenance plan to be defined.



4.2 Luminance distribution

The illuminance level in a room says little about a balanced and uniform distribution of the luminance on various surfaces. A homogeneous brightness distribution and the lighting level required for this are the prerequisites for well-being with people. Optimal viewing conditions are given when the luminance contrasts between the object viewed and the larger surfaces of its surroundings are kept within specified limits. The recommended luminance ratio between viewing task and the near or far surroundings should not exceed 3:1 and should not be less than 1:3. The luminance of peripheral room surfaces and the viewed object can be established by us with the aid of special programs.



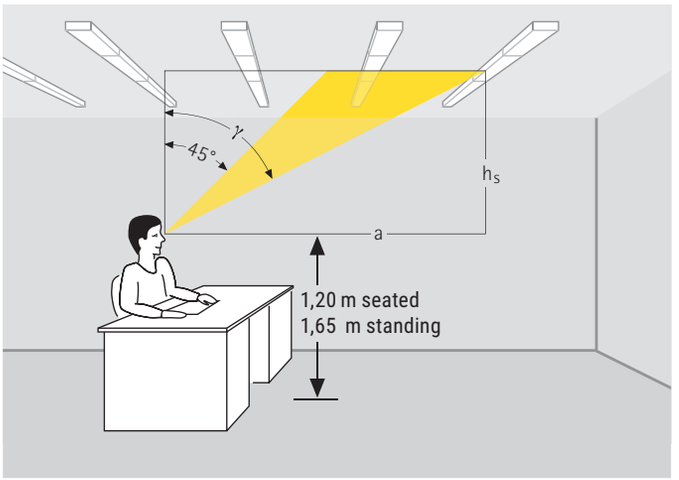
Recommended luminance ratio between visual task and the near or the distant surroundings.

4.3 Glare limitation

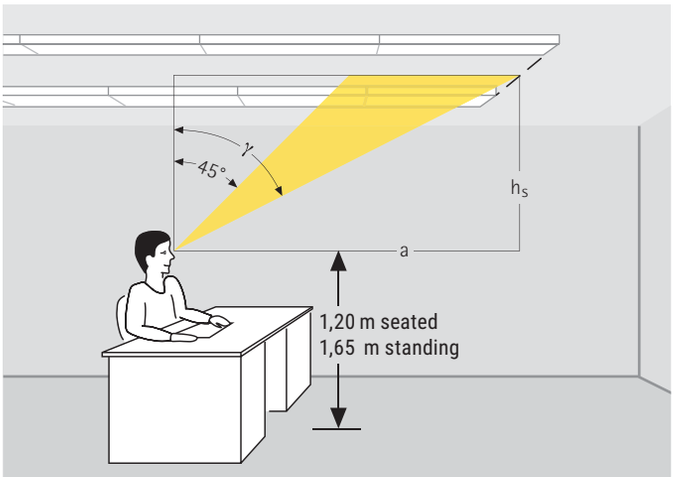
Direct glare is caused by excessive luminance in the field of view. It diminishes visual acuity (physiological glare) and may seriously lessen the sense of well-being (psychological glare). Methods of glare evaluation for indoor luminaires evaluate the limitation of luminance within the critical beam angle. As a standard evaluation system the UGR (Unified Glare Rating) method was introduced in Europe as the DIN EN 12464-1 standard. Details concerning the UGR method are described in the CIE 117 publication. The UGR value of a lighting installation, determined according to a table for the position of a standard viewer, is not permitted to exceed the value specified by the standard.

Reflected glare is caused by disturbing reflections upon blank surfaces. As shown in the illustration, no light from the marked area should fall onto the working plane. According to the physical law ‚angle of incidence = angle of reflection', reflections occurring would lie precisely in the field of view of the person working there. Matt work surfaces help significantly in solving the problem of reflected glare. Reflected glare leads to similar disturbances as direct glare, and impairs mainly contrasts, which are required for disturbance-free seeing. The lighting of computer screen workspaces requires especially careful planning, because strong reflections on the screens often make work impossible.

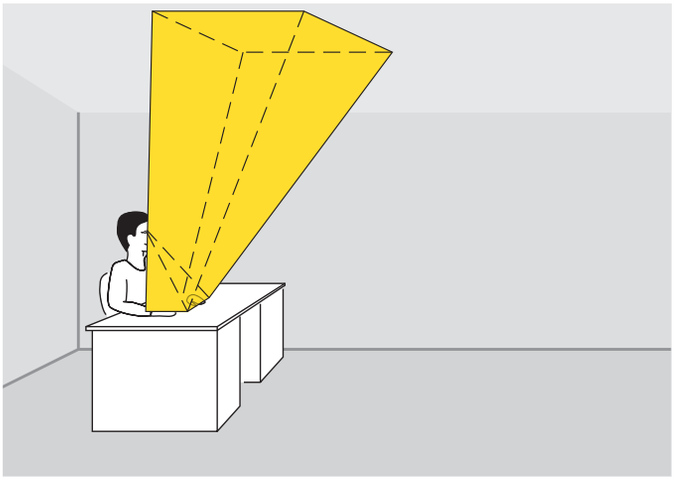
4. Quality criteria for good light



Arrangement of luminaires at right angles.

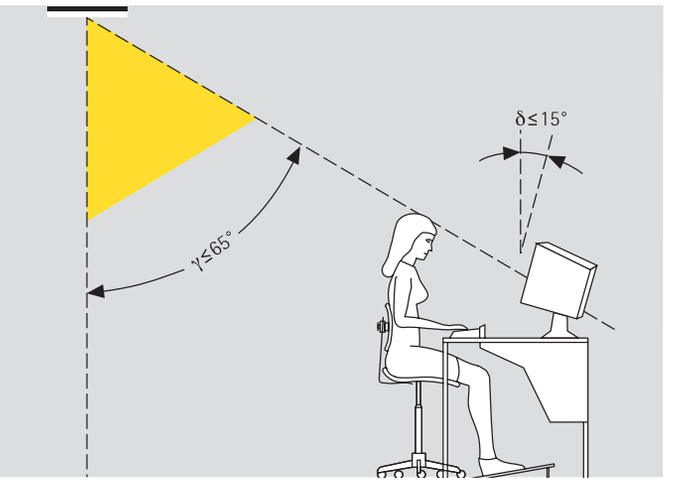


Arrangement parallel to the line of vision.



Reflected glare is caused by disturbing reflections on bright surfaces.

The reflective properties of the screen surfaces, the screen polarity and its curvature in combination with shining surfaces in the room are the decisive factors of influence for the assimilation of information via screens. Disturbing reflections can be lessened with anti-reflection measures for the screen surface. The suitability of luminaires is specified in DIN EN 12464-1. Depending on screen quality and screen polarity, the luminance values of luminaires and shiny surfaces reflected on the screens must not exceed the specified limitation values for mean luminance. Depending on these screen classes and the screen polarity, the luminance values of luminaires and shiny surfaces reflected on the screens must not exceed the specified limitation values for mean luminance. These limitation values are considered for luminaires above an emission angle of 65° all round.

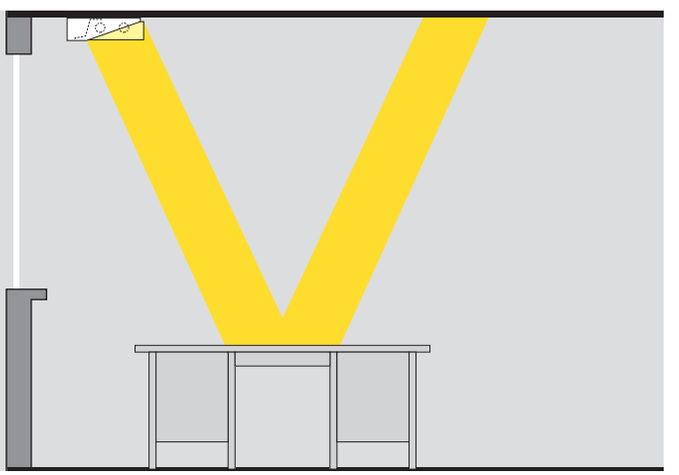


"High state"-luminance of the screen	Screens with high luminance L > 200 cd/m²	Screens with mean luminance L ≤ 200 cd/m²
Case A Positive polarity and usual requirements with regard to colour and details of the presented information, e.g. as available in offices, classes, etc.	≤ 3000 cd/m²	≤ 1500 cd/m²
Case B Negative polarity and/or higher requirements with regard to colour and details of the presented information, e.g. as available in case of CAD, colour verification, etc.	≤ 1500 cd/m²	≤ 1000 cd/m²

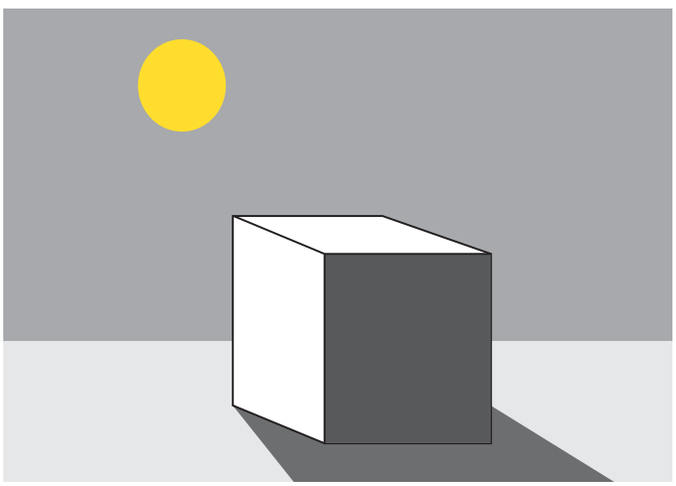
Note: "High state"-luminance of the screen (see EN ISO 9241-302) describes the maximum luminance of the white area of the screen. Manufacturers of screens indicate that value.

4.4 Light direction and shadows

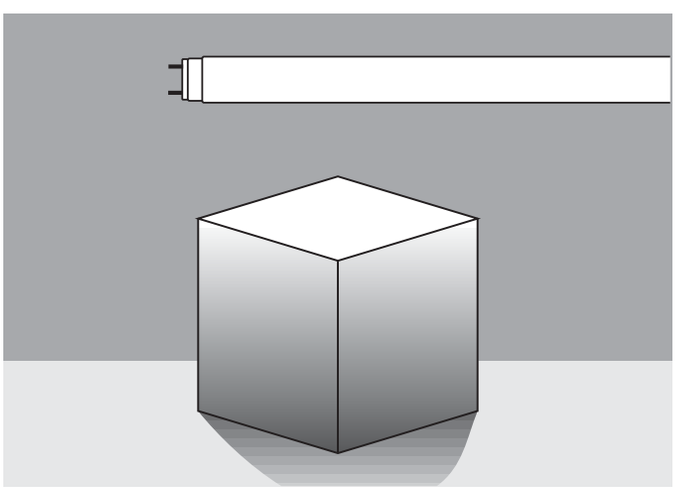
Light direction should fundamentally be oriented to the ingress of daylight. The correct arrangement of luminaires is an important prerequisite for the avoidance of direct glare. Angle-dependent reflected glare can be minimised through advantageous arrangements. (As the illustration shows, lateral light incidence prevents glare of shiny table surfaces. Lateral light with luminaire arrangements parallel to the direction of view is therefore the best solution).



For good recognition of illuminated forms and surface structures, sufficient shadowing must be achieved with aid of the lighting. Strong shadowing in most cases is an advantage for emphasis of sales objects or for making danger spots visible. Balanced shadows with soft edges are desired though for the general lighting of indoor spaces. Directed light and strong shadowing. With general lighting, shadowing can be evaluated with the ratio of cylindrical illuminance EZ to horizontal illuminance E. Overshadowing is avoided when the ratio of E:EZh is not less than 0.3 at a height of 1.2 m above floor level. EZ is the mathematical mean value of the four vertical illuminance levels at the reference level of 1.2 m (see DIN 5031, Sector 3). The figures show shadowing with point-source lighting and with lighting arranged in continuous runs.



Directed light and considerable shadowing.



General lighting and balanced shadows.

4.5 Light colour and colour rendition

These factors contribute to visual perception and the recognition of our environment. Only with the right ‚colour climate' do people feel at ease. This factor is defined via the light source and its colour rendition properties as well as the colour design of the room. Light colour, colour rendition and the colour surroundings of a room must therefore be matched.

4.6 Biologically effective light

Light not only has a visual function but also a biologically effective component. If not enough daylight is available because people spend too much time in closed rooms, artificial light can assume specific functions of daylight and quasi delivers „the right light at the right time". Based on the natural light, the artificial light is given a dynamic structure similar to the course of the day. Thereby, the changes in the level of illumination and in the light colour are of particular importance. This is achieved using luminaires with tunable white technology and a corresponding light control system. A lighting concept based on this goes beyond the standard quality features of a lighting system and focuses on human beings: Human Centric Lighting (HCL) is able to support the human circadian rhythm, stimulates the well-being and supports the stable health of persons.

4.7 Energy efficiency

As well as the above-mentioned classic quality attributes, the energy efficiency of a lighting system is becoming ever more important. With total costs of lighting over the complete utilisation period, costs for electricity amount to approximately 60%. 20% each are to be calculated for the factors of purchase and installation/maintenance. Energy-saving systems significantly minimise costs, relieve the environment and fulfill new legislative framework conditions (see 5.)

Further information

in theme catalogue
„Human Centric Lighting"

5. Energy efficiency

5.1 EnEV

The requirements on the energetic quality of new-builds and modernisation of old-builds are set out in the Energy Saving Ordinance (EnEV). After several revisions since the EnEV came into force, it will be replaced in 2019 by the new Building Energy Act GEG 2019. The last version of the EnEV remains valid until this is finally ratified. The objective is to reduce energy consumption for buildings down to the low-energy standard by 2021, for public buildings already by 2019. EnEV defines DIN V 18599 (see section 5.2) as the calculation procedure for energy assessment.

5.2 DIN V 18599

In the German DIN V 18599 standard, energy-related evaluation of buildings calculation of used, end and primary energy requirements for heating, cooling, ventilation, hot water and lighting', the energy requirements for lighting is considered as a whole together with the complete energy efficiency of buildings. The buildings are zoned according to energy specifications and each zone is assigned a utilisation profile. For calculation methods, the standard defines both simple tables and detailed specialist planning.

5.3 Energy audit

With the introduction of the energy services act (EDL-G) energy audits in accordance with EN 16247-1 are mandatory for all commercial enterprises as of December 2015. Only small and medium-sized enterprises (SME) as well as companies with their own energy management system in accordance with ISO 50001 are exempt from this. At least 90 % of the total energy consumption is determined as part of the audit and possible potential for energy savings are highlighted. Repeat audits are required by law 4 years after the previous audit at the latest.

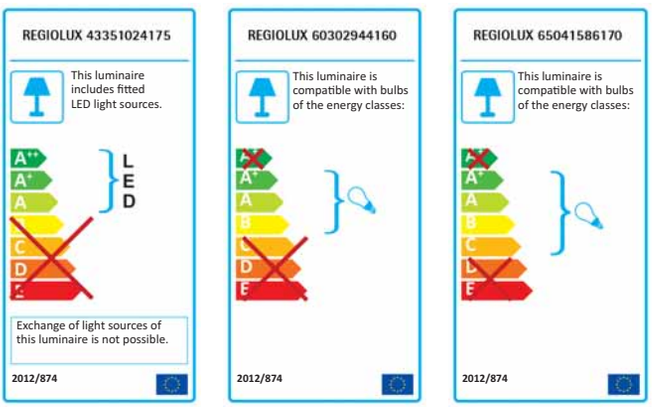
5.4 Modern lighting systems

In order to meet increased needs for energy efficiency, lighting installations should be optimised according to energy-related factors. This applies both to the refurbishment of old systems and lighting systems to be newly installed.

The components to be analysed are:
- Light source (in particular luminous flux)
- Control gear (connected load, start behaviour, standby losses)
- Lighting technology of the luminaire (light output ratio and light distribution)
- Lighting management (lighting control, presence detection)
- Maintenance (long service life, ease of maintenance)

5.5 Energy use designation

According to EU Ordinance 874/2012, lamps and luminaires are classified based on their energy consumption values. On luminaires, this marking relates to the attributes of the lamps with which they can be operated. The energy efficiency class A++ has the highest level of efficiency and Class E has the lowest efficiency. The classes indicated in the catalogue relate to a piece of lighting medium equipment in light colour 840 or 830. On luminaries with replaceable lighting mediums, the efficient classes may vary depending on the light colour used.



Further information

in theme catalogue
„Light · Energy · Environment“

6. Lamps

6.1 LED

The LED technology offered by Regiolux is a sure winner thanks to its high levels of efficiency and low energy consumption. Efficiency here includes low maintenance expense, ruggedness, and a long service life.
Effective temperature management in luminaire construction with LED is important when it comes to meeting all expectations. It ensures the performance characteristics are met and the luminaire has the promised service life.
An effective and passive cooling is the consequence in technical terms. An optimal light control system affects lighting wellbeing, as well as energy efficiency. You are sure to expect high-quality light technology in all our LED luminaires.
As an energy-efficiency option for traditional lighting systems, our LED luminaires also always need to meet basic quality demands on light wellbeing. also performed solid work here too. We have selected specific lumen packages, optimal colour rendition and various colour temperatures for our Regiolux luminaires. Another quality characteristic is our uniformly stable colour locus.
Energy efficiency and service life are not always the crucial factors in LED lighting. LED technology gets further plus points when the lighting system also needs quick and frequent switching, long maintenance intervals or special toughness requirements.
Regiolux LED luminaires ensure you can realise sophisticated lighting concepts and provide perfect illumination for your projects.
Our photometric data are created by us with great care. Due to the high dynamics in the LED and LED-driver field, however, the electrical and photometric data indicated by our suppliers comes with a tolerance of typically ±10%.
Therefore, this tolerance also applies to our figures and it indicated by our suppliers on their data sheets. These data sheets can be provided upon request.

6.1.1 LED benefits

- Lower power consumption
- Long service life
- Unlimited switching capability
- Full light right away
- Continuously dimmable
- No IR and no UV radiation
- High impact- and vibration strength
- Small dimensions
- Mercury free

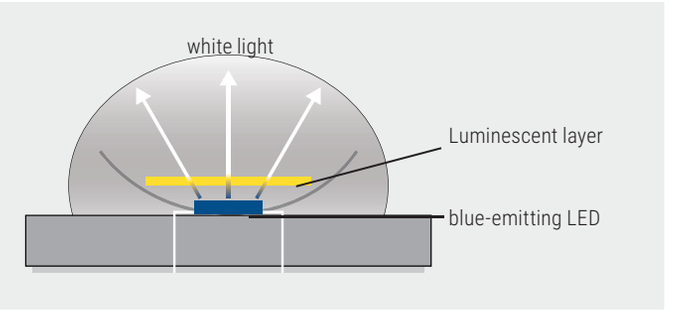
6.1.2 Luminous flux and light yield

Thanks to the rapid development of LED in recent years, they are also able to provide the relatively high quantities of light for general lighting in the technical light area. The amount of light - or Luminous flux (unit: Lumens) - denotes the total amount of light power emitted by a bulb or luminaire. When the Luminous flux in an LED only relates to the LED module (or an LED spot), this is called the gross luminous flux. This information is dependent on the different operating parameters and is defined by the LED manufacturer. If the module is built into a luminaire, the luminous flux will change due to a change in the operating conditions (such as temperature). Losses also come about as a result of technical light measures carried out on the luminaire (e.g. glare reduction), which means that a reduced luminous flux actually exits the luminaire. This is called the net luminous flux.
According to the definition, the light yield denotes the ratio of the emitted luminous flux to the electrical supply and is given in Lumens per Watt. A distinction must be made between gross and net here. For the gross light yield, the yield luminous flux of the module is used, whereby the electrical connecting line can be calculated with or without the operating device. In planning programs such as e.g. Relux however, the net light yield is calculated - this is called the luminaire light yield. This is based on the net luminous flux and the system performance of LED and driver. An identifying characteristic in terms of the net figure is data about the operating efficiency of the LED luminaire at precisely 100%. In light technology, this is called absolute photometry.
In the meantime the market has come to prefer net values, in particular, when comparing different types of LED luminaire. Knowledge of gross and net is essential to avoid comparing apples with pears.

6.1.3 Luminous flux and light colour

In contrast to the colour mix comprising red/green/blue, the efficiency of most white-emitting LED is based on the LED chip initially producing blue radiation. This blue light is deflected by a luminescent layer which is e.g. constructed from yellow phosphorus. According to the principle of luminescence conversion, white light is then produced from blue and yellow.

If wanting to produce a warmer light colour, the admixture of light needs additional red components in the luminescent layer. However, these components work less effectively. This is the reason why the LED luminaires of the same type and rating have a lower luminous flux for a warm white light colour compared to variants with a higher colour temperature.



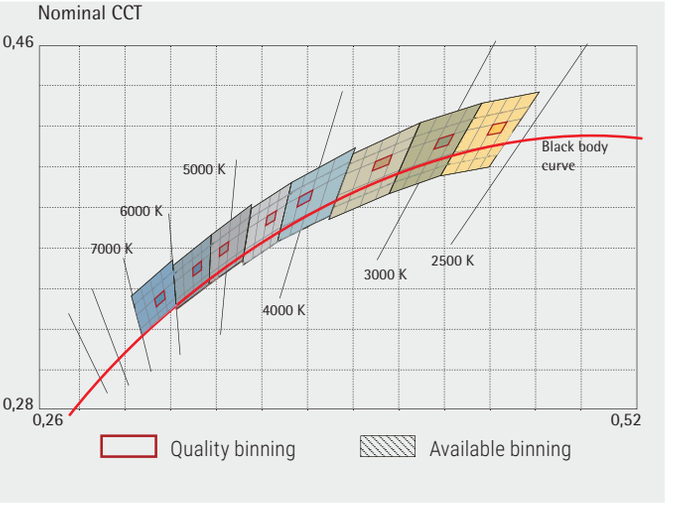
Origin of the light colour in an LED

6.1.4 Binning

Depending on production tolerances of LED, these may vary in their light quantity and colour temperature. However, to achieve a constant light quality with the same level of brightness and light colour, LED are sorted by their values. LED with identical or similar parameters end up in the same bin. The narrower the tolerances, the higher the quality of the "binnings".

The following terms are often used in connection with binning:

Colour consistency — same light colour from lamp to lamp
Colour locus constancy — the light colour does not drift due to ageing or when the luminaires are dimmed



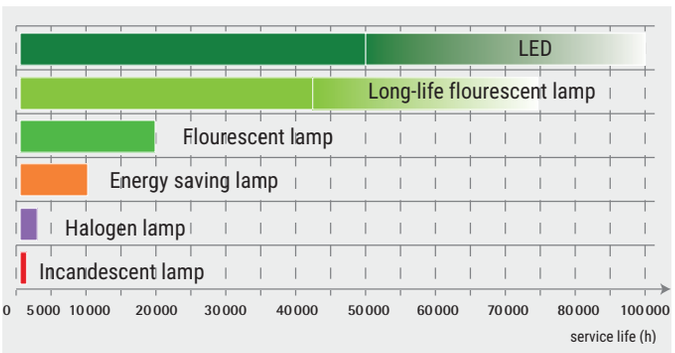
Fine sorting according to colour locus (binning) ensure the quality criteria of the LED technology.

6.1.5 Thermal management

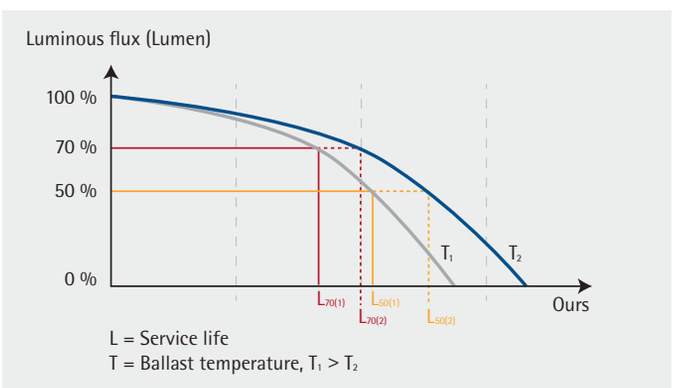
The LED light is free of infrared radiation. This makes the LED ideal for illuminating sensitive objects, such as in museums or shops. A high proportion of heat arises directly in the LED chip during light generation.This is due to high power density on a small surface. This heat will need to be dissipated since the luminous flux falls at high temperatures and the service life decreases. Construction of the luminaire with appropriate heat dissipation measures is thus very important in ensuring that the operating temperature of the LED is optimal.

6.1.6 Service life

LED used in the technical light area usually have a service life of 50,000 hours and above. This makes the LED one of the longest-lasting lighting mediums available today - without question. In practice, this means a considerable reduction in maintenance costs. Service life information is supplemented by values about degradation and mortality. Degradation, given in Lx, is defined as the reduction in the LED's luminous flux due to ageing. Mortality By describes the LED's failure rate.
The service life specifications are determined on the basis of the international standards LM 80 and TM 21. In the case of the measuring procedure LM 80 (Measuring Lumen Maintenance of LED Light Sources), the degradation is measured at 3 different ambient temperatures over a period of at least 6,000 hours. For luminaires which are to be classified with 50,000 hours service life, the test period must be extended to more than 8,300 hours and is thus almost one whole year. The LM 80 values determined are then integrated in the calculation method TM 21 (Projection Long Term Maintenance). This is a mathematical model that calculates the expected further degradation by means of extrapolation.



For example, if an LED luminaire features with L80B10, this means that after 50,000 hours of use, the luminous flux has reduced to 80% of its initial value. Ten per cent of LED are allowed to drop below the 80% level, excluding total failures. An important factor influencing both the Luminous flux and the service life is temperature. If there is too much heat, this has a negative effect on the luminous flux and service life.This means effective thermal management with efficient heat dissipation is especially important for LED luminaires



6.1.7 Flicker

The LED as an electronic source of light can react extremely fast to changes in its supply voltage. If this leads to a temporary variation of the emitted light in terms of its intensity or light colour, this is called flickering. Depending on the frequency, flickering is either visible or invisible to the human eye and can lead to adverse effects on health, such as headaches or neurological problems (epilepsy). Reciprocal effects are also known with technical equipment, e.g. during the use of video cameras or bar code scanners.
The occurrence of flickering in LED luminaires does not depend on the lamp but on the quality of the controller that is used. What is decisive here is whether the DC voltage used to operate the LED is still overlaid with a residual ripple. If DALI controllers are used, the LEDs should not be activated by a pulsating signal. Contact us if you want to illuminate sensitive areas to that effect. We will help you to define the right components.

6.1.8 Photobiological safety

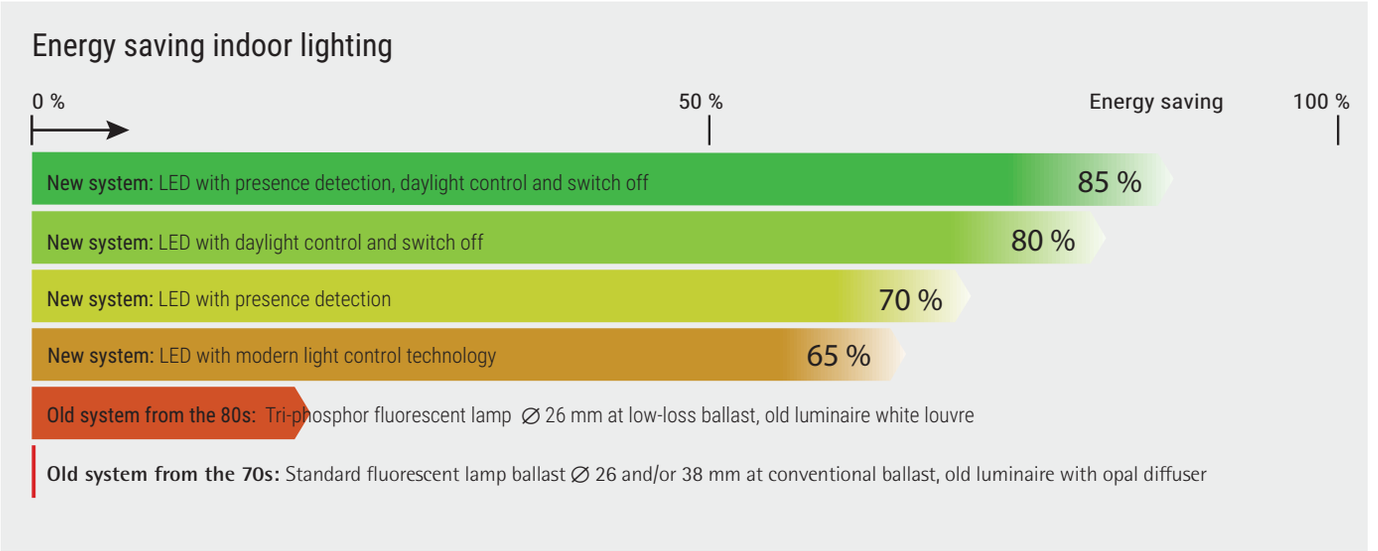
The photobiological safety according to DIN EN 62471 considers the ultraviolet, visible and infrared radiation of lamps and luminaires. LEDs for lighting purposes in technical lighting usually only emit light in the visible range. The potential for damage, e.g. to the eye's retina, depends on the wavelength and is at its highest in the blue spectral range (blue light threat). Other influencing factors include luminance, distance to the light source and the exposure time. Regiolux LED luminaires are equipped with adequate glare suppression measures such as diffusers or lenses so that it is not possible to look directly into open distribution LEDs and the luminance is reduced accordingly. The aforementioned standard classifies the risk from source of radiation into four groups. LED luminaires from Regiolux have been tested and comply with the risk groups RG 0 or RG1. There is no hazard from luminaires in these groups during normal user behaviour.

6. Lamps

6.1.9 Light management with LED

Light management components further increase the energy efficiency of lighting systems. Even basic presence indicator switches improve the efficiency of such systems at relatively little expense. Since frequent switching of the LED does not result in a reduction of the service life, this lighting medium is ideal for such applications. In addition, the LED immediately starts at 100 % light and no follow-up times need be configured.

Daylight-dependent rules with or without a presence function can be realised with components from the „Light Control" catalogue chapter or with the prepared master luminaires such as e.g. alvia LC01. Compared to legacy systems with conventional luminaires and magnetic pre-switching, the savings potential of energy costs can reach up to 85%.



6.1.10 Warranty

We offer warranty periods of up to 5 years on LED module and drivers.
Simply register at www.regiolux.de/en/service/warranty, within 2 months after taking delivery of the product at the latest

6.2 Fluorescent lamps

6.2.1 Burning-in

New fluorescent lamps, especially T5 versions, require a burn-in time of approx. 100 hours for basic stabilisation. With operation of lamps with dimmable electronic control gear, burn-in must take place with dimming set at 100%.

6.2.2 Cool spot

Lamps in T5 design have a so-called ‚cool spot', the coolest point on the stamp side of the lamp. With multi-lamp luminaires care must be taken that the stamped ends are on the same side, so that the cool spot does not overheat. If T5 lamps are arranged vertically, the stamp imprint should be below.

7. Electrics

7.1 Maximum number of luminaires per circuit

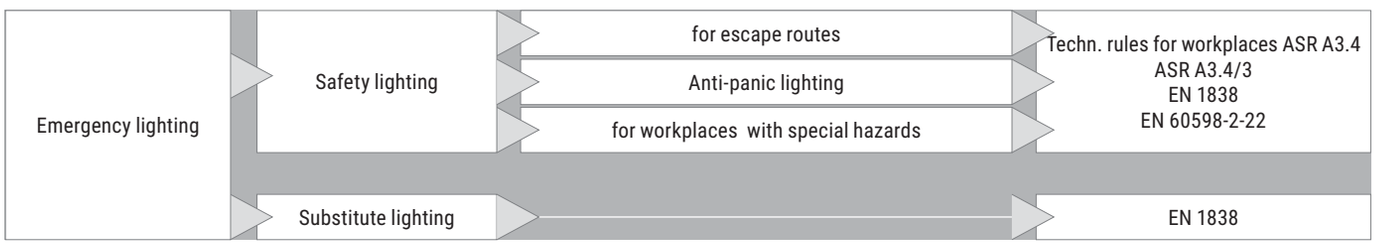
The maximum permissible number of LED luminares differs according to manufacturer and type of electronic driver. The quantity for the specific LED luminaire type is available on request. The number of drivers per luminaire is specified on the respective product page. The corresponding technical data is provided on request. Driver-specific installation instructions, for example for 2 group switching, are documented in the assembly instructions of the luminaire.

7.2 Emergency light

7.2.1 Requirements of emergency power supply systems for emergency lighting

Demands on the safety lighting following EN 60598-2-22

Demands	a) Meetingrooms, business offices	b) Meetingrooms, with max. 20 safety luminaires	c) Hotels and inns, multi-story buildings, schools	d) Escape routes in workplaces	e) Workplaces with special hazards
Minimum illuminance power	1 lux	1 lux	1 lux	1 lux	10 % to En - E min. = 15 lx
Switchover	max. 1 s	max. 1 s	max. 15 s	max. 15 s	max. 0,5 s
Nominal operating duration of the subst. power sources	3 h	3 h	3 h	1 h	> 1/60 h
Permissible substitute power sources	Central battery, group battery with or without inverter rapid/immediate stand by generator	Central battery, group battery with or without inverter rapid/immediate stand by generator, individual batteries	Central battery, group battery with or without inverter rapid/immediate stand by generator, individual batteries, substitute generator	Central battery, group battery with or without inverter rapid/immediate stand by generator, individual batteries, specially secured mains	



7.2.2 Safety luminaires on central battery systems

With the requirement of operation on a central battery, only a correspondingly tested safety luminaire may be used. Even if a number of LED drivers are already suitable for AC and DC voltage, this does not mean that the luminaires may be used as safety luminaires for operation with DC voltage. Correspondingly tested luminaires that are suitable for this kind of use are available on request.

7.2.3 Safety luminaires with switchover device

If safety luminaires are fed from a central battery system in an emergency lighting case, a switching point is needed that can be positioned either outside or inside the luminaire. This immediately switches over to the central battery supply in the event of a mains failure. The luminous flux in emergency operation is 100 percent for standard drivers. If DALI controllers are used, the emergency luminous flux is defined on the basis of the factory settings or can be adjusted by programming.

7.2.4 Safety luminaires with single battery

Luminaires of this design are fitted with emergency lighting modules, a battery and charge display. An additional permanent phase that is not switched is required to charge the battery. Regiolux luminaires with **single** batteries are usually designed for 3 hours of operation, other versions are possible on request. The battery's service life is limited so that the customer has to change the battery if the rated service life is fallen short of. The individual battery luminaire is operated with a reduced quantity of light in a case of emergency lighting. We will be happy to inform you of the exact emergency lighting current for the specific luminaires on request.

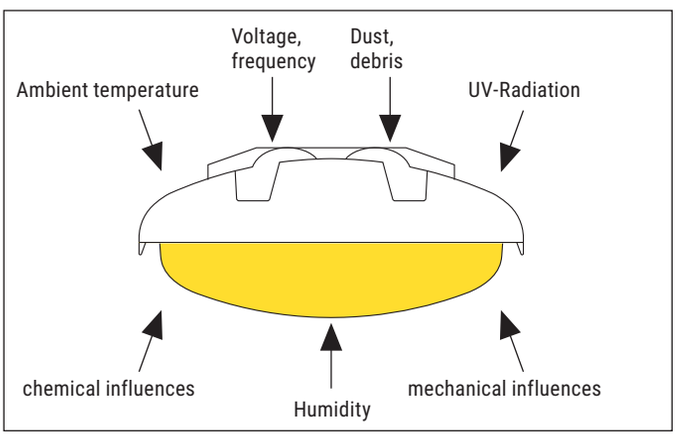
8. Luminaires

8.1 Proper use

Regiolux luminaires may only be equipped with light sources specified on the identification plate and in the approval certificates. Use of other lamps as well as LED and T5 adapters does not constitute proper use according to intentions and may lead to functional impairment and danger. As a part of our legal product monitoring obligation in accordance with Paragraph 6 Section 4 of the German Product Safety Act (ProdSG) we explicitly refer to these dangers. In the event of damage, legal problems can be expected.

8.2 Special operating conditions

Luminaires are subject to a number of external influences. Under certain circumstances, this can mean harsher operating conditions for luminaires which have an effect e.g. on the service life of the luminaires and lamps. Such effects may result in warranty limitations and even loss. The manufacturer should be asked directly about the effects of such special operating conditions on the luminaires. The following represents a short overview with selected examples.



8.2.1 Mains power supply

Regiolux luminaires are designed for a sinusoidal alternating voltage of 230 V and 50 Hz (see fig. 8.6.). In other cases (e.g. foreign countries), ballasts must be adapted to the actual values of the supply voltage. For this reason the existing network construction and its values/tolerances must be regarded. This also applies to network deficiencies. In particular, overvoltage may lead to damage of the components in extreme cases. Sources of interference must be eliminated, if necessary together with the power supply company.

8.2.2 Electromagnetic compatibility

Electromagnetic compatibility (EMC) is defined by both interference immunity of the luminaires against external disturbance factors and emitted interference to external systems. Various standards define corresponding limitation values. Despite conformity to these limitation values, in particular cases disturbances may occasionally occur (e.g. radio transmission). In such cases, interference immunity of the electrical devices should be inspected. Possible actions for avoidance of disturbances are increasing the distance between the luminaire and electrical device or modification of the wave band for signal transmission.

8.2.3 Ambient temperature

Regiolux luminaires are designed for an ambient temperature of 25° C (see fig. 8.6.). If in practice the ambient temperature strongly differs (e.g for cold stores or workshops with process heat), we should be contacted for specifying to what extent the selected luminaires can be approved for the corresponding temperature conditions. In particular, operation under higher ambient temperatures may lead to malfunctioning of e.g. the electronic ballast (see fig. 7.1.2.). In this case special luminaires may be required

8.2.4 Chemical influences

Environments with particular chemical substances in the atmosphere can have a range of effects on lamps, luminaires and lighting systems.

8.2.4.1 Resistances of plastics

The resistance table gives an overview of the chemical stability of the most important plastics used for luminaire construction. Specifications for chemical resistance are related to an ambient temperature of approx. 22° C.

Clearing agents	PMMA	PC
Scouring agent	resistant	resistant
All-purpose glue	resistant	partially resistant
All-purpose cleaning agent	resistant	resistant
Mild detergent	resistant	resistant
Hair setting lotion	resistant	resistant
Nail polish/-remover	not resistant	not resistant
Perchloroethylene	not resistant	not resistant
Detergent	resistant	partially resistant
Cleaning agent for acrylic glass	resistant	resistant
Pril washing-up liquid	resistant	resistant
Cleaning agent for glass	not resistant	resistant
Silicone oil	resistant	resistant
Washing-up liquid	partially resistant	resistant
Special-purpose cleaning agent Tri	not resistant	not resistant

For cleaning of the diffuser/housing it is recommended to use a weak solution of the suitable agent. Limited use of chemical cleaning agents is allowed.

Chemical substance	Polyester	Acrylic glass (diffusor PMMA)	Polycarbonate (diffusor/housing PC)
Acetone	not resistant	not resistant	not resistant
Aliphat. hydrocarbons	partially resistant	partially resistant	resistant
Alcohol up to 30 %	resistant	resistant	resistant
Alcohol concentrated	partially resistant	not resistant	not resistant
Ammonia 25 %	not resistant	resistant	not resistant
Accumulator acid	resistant	resistant	resistant
Aniline	not resistant	not resistant	not resistant
Aromat. hydrocarbons	partially resistant	not resistant	not resistant
Ether	partially resistant	not resistant	not resistant
Ethyl acetate	not resistant	not resistant	not resistant
Benzine	resistant	resistant	resistant
Benzole	not resistant	not resistant	not resistant
Beer	resistant	resistant	resistant
Blood	resistant	resistant	resistant
Bromine acid	not resistant	not resistant	not resistant
Chloroform	not resistant	not resistant	not resistant
Chlorophenol	not resistant	not resistant	not resistant
Diesel oil, crude oil	resistant	resistant	partially resistant
Dioxane	resistant	not resistant	not resistant
Acetic acid up to 5 %	resistant	partially resistant	resistant
Acetic acid up to 30 %	resistant	not resistant	partially resistant
Glycerine	resistant	resistant	partially resistant
Glycol	resistant	resistant	resistant
Glysantine	resistant	resistant	resistant
Carbon dioxide	resistant	resistant	resistant
Carbon monoxide	resistant	resistant	resistant
Lime water	resistant	resistant	partially resistant
Saline	resistant	resistant	resistant
Ketone	not resistant	not resistant	not resistant
Lysol	not resistant	not resistant	not resistant
Sea water	resistant	resistant	resistant
Methylene chloride	not resistant	not resistant	not resistant
Methyl alcohol	not resistant	not resistant	not resistant
Metal salts and their watery solutions	resistant	resistant	resistant
Sodium hydroxide 2 %	partially resistant	resistant	not resistant
Sodium hydroxide 10 %	not resistant	resistant	not resistant
Petroleum ether	resistant	resistant	partially resistant
Pyridine	not resistant	not resistant	not resistant
Phenol	not resistant	not resistant	not resistant
Nitric acid up to 10 %	resistant	resistant	resistant
Nitric acid 10 to 20 %	partially resistant	partially resistant	partially resistant
Nitric acid over 20 %	not resistant	not resistant	not resistant
Hydrochloric acid up to 20 %	resistant	resistant	resistant
Hydrochloric acid over 20 %	resistant	resistant	partially resistant
Sulphuric acid up to 50 %	resistant	resistant	resistant
Sulphuric acid up to 70 %	resistant	partially resistant	partially resistant
Sulphuric acid over 70 %	not resistant	not resistant	not resistant
Sulphurous acid up to 5 %	partially resistant	partially resistant	not resistant
Hydrogen sulphide	resistant	resistant	resistant
Soapsuds	resistant	resistant	resistant
Soda	resistant	resistant	resistant
Synth. suds	resistant	resistant	partially resistant
Oil of turpentine	resistant	partially resistant	partially resistant
Carbon tetrachloride	resistant	not resistant	not resistant
Water up to 60° C	resistant	resistant	resistant
Hydrogene peroxide up to 40 %	not resistant	not resistant	partially resistant
Hydrogene peroxide over 40 %	not resistant	partially resistant	partially resistant
Xylene	not resistant	not resistant	not resistant

8.2.4.2 Resistances of electronic components and LED

Under certain circumstances, chemicals may also have an influence on electronic components, circuit boards and LED. For example, luminaires with electronic components and PCBs can be damaged due to increased concentrations of ammonia in the atmosphere.
LED can also be sensitive to chemical influences. For example, atmospheres with an increased proportion of sulphur compounds or chlorides are considered critical and can result in occlusions, discolorations and reduction of the service life.

8.2.5 Recessed luminaires

A precondition for the installation of our luminaires is that the ceiling construction is able to take up the weight of the luminaires and is also suitable for their accommodation.

8.2.6 Noise

Please note that luminaires can be incited by sound waves to emit resonance. Furthermore, noises caused by lamp and ballast operation can be emitted by luminaires, and in addition thermal expansion until maximal level may cause noise. If luminaires are to be deployed in areas of noise sensibility (recording studios, rehearsal rooms, sacral areas etc.), we request that you contact us in this matter.

8. Luminaires

8.3 Luminaire optics and their applications

8.3.1 Individual.Lens.Optic

In the combination of LED and spot lens, the effective area of the lens is only located over the LED light points themselves and not over the entire circuit board. Spot lenses made of PMMA (acrylic glass) have a special, light technology calculated structure whereby the light is focused, emitted and distributed. Spot lens deliver a particularly efficient form of light control with a high degree of efficiency and optimised all-round glare control. The light distribution can be wide, narrow and extremely narrow (high-bay warehouse aisle lighting). A double asymmetrical light distribution curve is also possible. The latter is preferred in sales rooms such as discount stores or specialist markets and using vertical lighting levels it allows goods to be selectivly illuminated from both sides of the sales aisles. Industrial applications of the symmetrically distributing spot lens luminaires can be found in factory halls and warehouses. The LED is maintained as a visible light point in the appearance of the luminaire.

8.3.2 Linear.Lens.Profil

This type of lens made of PMMA (acrylic glass) is the preference for light technology of linear LED modules. Linear lenses have a special, light technology calculated structure whereby the light is focused, emitted and distributed. Linear lenses deliver a particularly efficient form of light control with a high degree of efficiency. The light distribution can be wide, narrow and extremely narrow (high-bay warehouse aisle lighting). A double asymmetrical light distribution curve is also possible. The latter is preferred in sales rooms such as discount stores or specialist markets and using vertical lighting levels it allows goods to be selectivly illuminated from both sides of the sales aisles. Industrial applications of the symmetrically distributing linear lens luminaires can be found in factory halls and warehouses. The appearance of the linear lens is perceived as a light line.

8.3.3 Fresnel lens

This lens is characterised by a special design with a grooved structure. Developed as a linear lens, the design is reduced to a pane made of PMMA (acrylic glass) calculated by light technology and is used in LED luminaires among other things. The light is bundled and focused via different angles of refraction, whereby asymmetrical distributions are also possible. This is used for example for furniture luminaires for cove lighting or for lighting of vertical areas.

8.3.4 Microprismatic pane

This high quality plastic pane made of PMMA (acrylic glass) has light technology calculated pyramid prisms. This pane is characterised by homogeneous light distribution and excellent glare limitation, and is also appropriate for the illumination of VDU workstations with a light density threshold < 3000 cd/m^2. In combination with LED, the individual LED light spots remain visible and the luminaire is also perceived as LED luminaire when switched on.

8.3.5 Diffusers

Diffusers can be designed either as panes or in a tub shape. PMMA (acrylic glass) or polycarbonate are used as materials; in harsher industrial applications the panes can also be made of single-pane safety glass. The optics are categorised as clear, clear with a prismatic structure, iced (satined) and opal. The light technology of the covers differs in terms of the degree of transmission and also in the efficiency level. Especially iced and opal designs provide a calm and unifying finish to the luminaires. For example, quadratic recessed luminaires have an effect of roof lighting. Angular diffusers have lit side sections and in this way generate an indirect proportion for modest ceiling illumination. Example applications are administration rooms without screens, classrooms, sales rooms and industry.

8.3.6 Louvre

Luminaire louvres are composed of metal components and consist of louvre side sections and transverse lamellars. The side sections influence the light distribution of a luminaire depending on their shape and ensure transverse glare control, while the lamellars are primarily used to control longitudinal glare. High quality louvres are made of parabolic aluminium louvre elements, whereby the surface is anodised as either highly reflective or silk matt. Special designs such as the micro louvre with low transverse lamellars allow very flat luminaires and they have a supplementary reflection enhancing silver coating. The high degree of efficiency that is therefore possible combined with exact glare limitation produces a very comfortable level of lighting for vision, for example for VDU workstations. The luminance above the threshold emission angle of 65° is therefore reduced to <1000 cd/m^2. Disruptive reflections on screens are avoided. Other application areas are representative spaces such as meeting rooms, conference rooms and reception areas. Specular louvre luminaires can also asymmetrically radiate light and illuminate vertical surfaces such as blackboards or presentation surfaces - if necessary with asymmetrically arranged lamp positions.
Simple louvre versions with white surfaces are used in spaces with lower light technology requirements, for example in corridors and waiting areas.

Further information

in theme catalogue
„Light solutions -
for beverage and food industry"

8. Luminaires

8.4 Maintenance

In order to maintain light output ratios, regular cleaning of luminaires is intended and makes sense. Lighting technology often features high-grade optical surfaces and must therefore be handled very carefully. Both mechanical loads (wiping, rubbing etc.) as well as the use of unsuitable cleaning agents must be avoided, as both can lead to impairment or even destruction of the optical characteristics of surfaces (see figure 8.1.7.). Residues of cleaning agents may furthermore cause smudges and streaks that might negatively effect light control. We would be glad to give you detailed information concerning the proper cleaning of luminaires.

8.5 Special luminaires and modifications

Special versions with electrical or mechanical modifications as well as special coatings in accordance with RAL colours can be supplied at extra cost following assessment of feasibility. Customized luminaires undergo the same inspections at Regiolux as standard luminaires.

8.6 Certification, insulation class and protection rating

All Regiolux luminaires are manufactured according to approved technical standards and 100% electrically tested. The luminaires are designed as standard for 230 V, 50 Hz and an ambient temperature of 25° C, and satisfy European norms and directives, including ENEC provisions in relation to safety, electromagnetic compatibility and energy efficiency.

IP degrees of protection according to the first reference number

1rst ref.-No.	Short description	Short details which foreign bodies cannot ingress the housing
0	Unprotected	No special protection.
1	Protected against the ingress of foreign solid bodies larger than 50 mm	Great body surface, e.g. a hand (however no protection against intentional contact), foreign solid bodes.
2	Protected against the ingress of foreign solid bodies larger than 12 mm	Finger or similar up to 80 mm length; foreign solid bodes greater than 12 mm diameter.
3	Protected against the ingress of foreign solid bodies larger than 2.5 mm	Tools, wires etc. with a diameter or a thickness greater than 2.5 mm; foreign solid bodes greater than 2.5 mm diameter.
4	Protected against the ingress of foreign solid bodies larger than 1 mm	Wires or strips thicker than 1 mm; foreign solid bodes greater than 1 mm diameter.
5	Dustproof	Ingress of dust is not completely prevented, however, dust must not penetrate in such quantities that a proper operation of the device is impaired.
6	Dust tight	No penetration of dust.

IP degrees of protection according to the second reference number

2nd ref.-No.	Short description	Details of protective measures through the housing
0	Unprotected	No special protection.
1	Protected against dripping water	Dripping water (vertically falling drops) shall have no harmful effects.
2	Protected against dripping water up to 15	Vertically falling drops shall have no detrimental effect, if the housing is inclined up to 15° from its original operation position.
3	Protected against spraying water	Water falling as a spray at an angle of up to 60° from the vertical shall have no detrimental effect against the vertical position.
4	Protected against splashing water	Water splashed against the housing from any direction shall have no detrimental effect.
5	Protected against water jets	Water projected by a nozzle against the housing from any direction shall have no detrimental effect.
6	Protected against heavy sea	Water from heavy seas or water jet under high pressure shall not penetrate the housing in harmful quantities.
7	Protected against the effects of immersion	Ingress of water in harmful quantities shall not be possible when the housing is immersed in water under defined conditions with regard to pressure and time.
8	Protected against immersion	The device is suitable for permanent immersion in water; the conditions are to be indicated by the manufacturer. Note: In general, this signifies that the device is completely sealed; however, this may signify with specific devices that water penetrates but has no detrimental effects.

Protection classes

	Luminaires with the indoor symbol in accordance with IEC 60417-5957 are suitable and approved for the use in buildings.		Luminaires of protection class I must be connected to a protective conductor.
	Luminaires of protection class II are shock-proof and therefore a PE terminal is not authorized.		Luminaires with insulation class III are approved for operation with safety extra low voltage < 50V (effective).

Test symbols

The information in regard to test symbols in this catalogue can only be a snapshot of the current state.
Please refer to our web site for current product specifications.

The -symbol is the European safety symbol for luminaires. The testing regulations are specified in DIN EN 60598.
The -symbol is issued in combination with the identification number of a European test center (VDE = 10). This documents that the luminaires have been built and tested „in conformity with the standards" as per the Low-voltage Directive 2006/95/EG.

All luminaires meet the -conditions. In the event of faulty luminaire the fastening surfaces will not be hotter than 180° C. They may be mounted on inflammable building materials as described in DIN 4102 with an ignition point of at least 200° C (e.g. wood). Observe the installation instructions in order to avoid incorrect installation.

Identification for thermally insulated ceilings. Luminaires may be directly covered with insulating material.

EN 60598-2-24 requires that luminaires must be designated with the -symbol in production areas where dust and/or fibres pose a fire hazard and must at least fulfill protection rating IP50. Installation instructions must be observed during mounting.

Luminaires with the -symbol are intended for surface-mounted and recessed installation in furniture. They are constructed so that in the case of luminaire failure, normal or low-flammability materials cannot be ignited according to VDE 0710 Section 14. In order to avoid incorrect installation, installation instructions must be observed.

Luminaires with the -symbol are intended for surface-mounted and recessed installation in furniture. They are constructed so that in the case of luminaire failure, materials with inflammability characteristics not recognised by VDE 0710 Section 14 cannot be ignited. In order to avoid incorrect installation, installation instructions must be observed.

IK

Impact resistance - The IK-code as the internationally valid classification as per IEC 62262 describes the resistance of the housings of electric operating equipment to mechanical loads, particularly impact. The IK-classes correspond to a respective minimum impact energy in Joules that the housing must be able to withstand

IK-code	IK-code Impact energy (Joules)	IK-code	IK-code Impact energy (Joules)
00	no protection	06	1
01	0,15	07	2
02	0,20	08	5
03	0,35	09	10
04	0,50	10	20
05	0,70		

650°C 850°C

Luminaires with this symbol correspond to EN 60598-1 standard conditions for the temperature specified by this symbol.
Testing is carried out according to IEC 60695-11-5 (needle-flame test) or IEC 60695-2-10 (glow-wire flammability index).

Ball-impact-resistant luminaires following DIN 18032 Part 3 und VDE 0710 Part 13.

Luminaire optimally adapted to tennis as per DIN 67526.

CE

The CE-designation is applied by the manufacturer. The manufacturer on its own responsibility thus confirms conformity with the corresponding EU guidelines. Conformity according to the 2006/95/EG "low voltage regulation", the 2004/108/EG "EMC regulation" (interference immunity, emitted interference) and energy efficiency (2005/32/EG and EG 245/2009 directives) are the preconditions for CE-designation for our products.

1000 1500 3000

With this symbol, the suitability of luminaires for computer workstations according to DIN EN 12464-1 is specified. The degree number means that the luminance in all luminaire planes beyond that angle does not exceed certain limitation values. Depending on screen quality and screen visualisation, the norm specifies different limitation values.

UGR 19

The luminaires meet the limit value <= 19 in accordance with the unified glare rating method UGR. This rating is based on conditions in the so-called standard room with lines of vision crosswise and lengthwise to the luminaire.

Ready for IoT - Luminaires with integrated DALI or DALI2 drivers provide additional device data for further use in the Internet of Things (IoT). A suitable system controller is required for the acquisition, evaluation and transfer of these data.

The luminaires are quipped with tunable white technology and thereby allow for a dynamic progression of the light colour as well as of the lighting level in conjunction with a corresponding control system. This can be used to simulate the natural progression of daylight as part of a Human Centric Lighting solution.

Generally, the luminaires are suitable to be used in companies of the food and beverage industry certified according to IFS version 6 and /or BRC Global Standard Food version 6.

clean tested

Luminaires with this mark have been tested in regard to particle emissions and colony forming units (CFU) and certified for use in clean rooms by the Fraunhofer-Institut IPA.

Luminaires with this mark have been developed based on conclusions drawn from the testing of luminaires [clean tested],but have not been specially certified by the Fraunhofer-Institut IPA.

9. Notes on disposal

9.1 EU WEEE directive

The Europe-wide directive for the disposal of electrical devices (WEEE) and the connected directive for concentration of hazardous substances (RohS) are applied in all countries of the European Union via corresponding legislature.
The WEEE intends the designation of all devices affected by the directive (this includes luminaires) with a uniform symbol (a crossed-out dustbin).
A black bar below also symbolises that the product began being manufactured after the directive came into force. In order to be able to trace manufacturers or importers after several years, all such companies must register themselves with a national register and designate products with company or brand names. In order that the customer may determine whether a manufacturer has registered, the company must specify its registration number on its business documents (tenders, order confirmations, delivery notes and invoices). All further details are determined by national legislature.

9.2 WEEE Germany (ElektroG)

According to German law, luminaires from private households are expressly excluded from the legislation. The same is valid for applications with disposal in usual household quantities (e.g. freelancers). For luminaires with professional use (B to B), and with corresponding quantities, each manufacturer or importer must make available a suitable network of disposal points and ensure correct disposal in accordance with valid recycling quotas. This specifically means that for all devices bearing the, crossed-out dustbin sign the manufacturer must bear costs for disposal from the collection point. Products not yet bearing the crossed-out dustbin are excluded from the directive and may only be sold if they have been produced before the deadline date (13.08.2005). A return or subsequent designation of such products is not envisaged by the legislator. In order to ensure that no manufacturer shirks his duty in this regard, all manufacturers are liable to register themselves in a national register for every market. The Regiolux WEEE registry number for Germany is DE 16667402.

9.3 EU Directive 94/62/EC

94/62/EG Deutschland Packaging Regulation

Return and utilisation of packaging materials has been regulated by us with a framework contract with Interseroh. Mainly packaging from electrical wholesale companies, the electrical trade and electrical retail trade and their construction sites are disposed of. The Interseroh manufacturer number is 80019.

The following are deemed packaging materials:
1. Corrugated cardboard, cardboard, paper
2. PE stretch foil, plastic winding material
3. Wood and pallets
4. EPS (Styropor)

Packaging materials from suppliers that participate in the Interseroh process are collected and disposed off according to material on the customer side for free. The return and transport to the acceptance location is free of shipping and postal charges for the manufacturer. With return, the last owner forsakes all rights to the packaging materials.
More information about disposal:
ISD INTERSEROH Dienstleistungs GmbH
Stollwerckstraße 9a
D-51149 Köln
T +49 2203 9147 0
F +49 2203 9147 394
www.interseroh-isd.de
info@interseroh.de

94/62/EG International

In relation to legislative requirements and thir implementation in other EU countries, please contact the responsible importer.

9.4 The European RoHS directive

The directive 2002/95/EC was replaced by the directive 2011/65/EU (RoHS2) on January 03, 2013.
The European directive for concentration of hazardous substances (RohS) in electrical and electronic devices is implemented in all European Union countries by corresponding national legislation.
Regiolux works on the basis of this directive and has involved its suppliers accordingly.
If there are changes with regard to the directive 2011/65/EC, due to new information or new investigations, we will of course immediately inform you within the scope of our business relationship.

Terms of business

1. General terms and conditions

1.1 These conditions shall exclusively apply to all present and future business relationships with resellers or commercial buyers (purchasers) in terms of § 14 German Civil Code (BGB). Different or supplementary terms and conditions of the purchaser as well as ancillary agreements are only binding if they are confirmed in writing by Regiolux GmbH (supplier).
1.2 Quotation of prices and services are only binding for the supplier, if they were confirmed by him or a delivery was made. Any other declarations and approvals must be made in writing to be binding.

2. Offer and acceptance of Orders

2.1 Offers contained in brochures, advertisements, Internet pages etc. are subject to change and not binding, even with regard to price quotations. Individual offers made in writing by the supplier shall be ineffective at the latest 90 days after date of the offer, insofar as no acceptance was made.
2.2 If incoming orders arriving at the supplier are not confirmed in writing or implemented within one month after their receipt, the purchasor is entitled to withdraw the order without any claims for damages whatsoever to be asserted against the supplier.
2.3 We will invoice a reduced-quantity surcharge of 25 euros if the net order value is less than 250 euros.

3. Prices

3.1 The prices are calculated in Euro exclusive of VAT, which is invoiced separately according to the rate valid rate. The prices are calculated according to the prices valid at date of contract conclusion. If the delivery is made more than 4 months after contract conclusion, the prices valid at date of delivery can be invoiced.
3.2 The prices apply, unless other agreements are made in writing, within the Federal Republic of Germany ex works including original packing which is not taken back on the account of an agreement of the supplier with Interseroh GmbH.
3.3 The non-private purchaser undertakes to guarantee the disposal of the delivered products according to the provisions of the ordinance on the disposal of electrical and electronic equipment. In case of resale the purchaser shall assign these obligations to his contract partner.

4. Terms of payment

4.1 Insofar as nothing else is agreed upon, all payments must generally be made within 30 days following invoice date. They can, upon option of the supplier, be offset against other, still outstanding claims. A discount of 2 % shall be granted by the supplier for payments that arrive with the supplier within 8 days following the invoicing date. Checks may be accepted for the purpose of payments.
4.2 The purchaser's right of retention, as far as it is not based on the same contractual relationship, and the offsetting with contested or not legally determined claims is excluded.
4.3 If the purchaser is in default of payment as a whole or a part, he is bound – notwithstanding all other rights of the supplier – to pay from that point of time on default interests to the amount of 8 % annually above the base lending rate.
4.4 If the purchaser ceases payments or if bancruptcy is filed or mature checks or bills of exchange are not redeemed, all claims made by the supplier are immediately due.

5. Reservation of title

5.1 The supplier retains title of the goods until the complete payment of all claims resulting from a current business relationship. A pledge or chattel mortgage of the reserved goods is not permissible.
5.2 In the case of the permissible resale of the reserved goods within the ordinary course of business, the purchaser assigns already now to the supplier, until payment of all claims of the supplier, as collateral for its future claims towards his customers resulting of such resale without requiring any specific further explanations. This assignment also covers balance claims resulting from existing current account relationships or at their termination of the purchaser with its customers. If the reserved goods are sold together with other goods without agreeing upon an individual price for the reserved goods, the purchaser assigns to the supplier the priority over the other claims for such part of the total price claimed which corresponds to the value invoiced by the supplier. Until revoked, the purchaser is authorized to collect the assigned demands from the resale, he is not entitled to dispose of them otherwise, e.g. by assignment. Upon request of the supplier the purchaser must inform the customer about the assignment and to furnish the supplier the necessary documents for the assertion of his rights towards the customer, e.g. to deliver invoices and to provide the required details.

5.3 If the purchasor does not meet all or a part of his payment obligations within 10 days after due date, if he does not cash due checks or if an application for insolvency is filed, the supplier has the right to withdraw from the contract and to require the return of the goods. The purchasor is obliged to procure the supplier with the possession of the goods. The purchaser grants to the supplier or any authorized representative of the supplier the access to all business premises during business hours. The supplier is entitled to use the reserved goods with the diligence of a prudent businessman and to satisfy himself with the offsetting of open claims with their proceeds.
5.4 If the value of the security exceeds the claims of the suppliers towards the purchaser resulting from the current business relationship to more than 20 % in entirety, the supplier is obliged, when requested by the purchasor, to release securities it is entitled to according to choice.

6. Delivery

6.1 The delivery shall be made for a net order value of more than 1,200 Euro: free loading area ship-to address within Germany.
6.2 Delivery terms are only binding if they have been expressly confirmed by the supplier as being binding.
6.3 The delivery period begins with the date of written agreement about the order between purchaser and supplier. The delivery term is respected if the goods have departed the warehouse within this period. If delivery or handling is delayed for reasons for which the supplier cannot be held responsible, the delivery period is deemed as met if notification that goods are ready for dispatch is made within the agreed delivery period.
6.4 If it has been proved that the non-compliance of the delivery period is due to mobilization, war, riot, strike, lockout or the occurrence of other unexpected events which are beyond control of the supplier or its sub-contractors, the delivery time is prolonged correspondingly.
6.5 If the supplier is in default of delivery, the purchaser may claim a compensation for default of 0.5 % for each accomplished week of default, amounting to a total of 5 % of the value of the goods delivered too late. Any other claims for damages are excluded in all cases of late delivery, even after expiration of any grace period granted to the supplier. Within the scope of the legal provisions, the purchaser may only withdraw from the contract, insofar as the supplier is responsible for delay in delivery.
6.6 The purchaser is obliged, upon request of the supplier, to declare within a reasonable term whether he withdraws from the contract because of delay in delivery and/or whether he claims damages instead of the performance or insists on delivery.
6.7 If the purchaser causes delay in shipment or delivery of the goods, the supplier is entitled to invoice him for any incurring additional costs.
6.8 Partial deliveries are permissible, unless justified interests of the purchaser are opposed to them.

7. Shipment

The risk is passed to the purchaser upon handing over of the goods to the forwarding agent or the haulage contractor, regardless of who pays the costs of the delivery. If the purchaser requires, we will arrange for transport insurance; any costs arising from this are borne by the purchaser. Transport breakage is not replaced if breakage insurance is refused.

8. Acceptance

8.1 The purchaser shall specify to the supplier the name(s) of one or several person(s) who is/are authorized to accept the delivery and sign the delivery note in due time prior to the delivery date. This applies in particular if the delivery address is not the purchaser's registered office.
8.2 If none of the persons authorized by the purchaser are present to accept the goods on the agreed date and at the agreed place of delivery, the purchaser is in default of acceptance and the risk passes to him. He shall also pay any additional costs which are incurred in the event that another delivery has to be effected.
8.3 The purchaser is required to check without delay whether the goods have been damaged during transportation and to immediately inform the carrier and deliverer of any damage or loss. Negligible defects do not justify a refusal of acceptance by the purchaser.

9. Returning of goods

If the supplier has no statutory obligation to accept returned goods, the purchaser may only return goods with the supplier's express written consent and provided that they are undamaged and returned in the original packaging. 30 % of the invoiced amount will be deducted from the credit note to cover processing costs. All reworking, freight and packaging costs will be charged to the purchaser. special and recessed luminaires may not be returned.

10. Warranty

10.1 The supplier guarantees against defects in the goods, initially according to his option of either repair or replacement delivery.
10.2 If repair or replacement fails, the purchaser generally may require according to his option lowering of the payment (reduction) or cancellation of the contract (rescission). In case of only insignificant lack of conformity with the contract, in particular in case of insignificant defects, the customer is not entitled to the right of rescission.
10.3 The purchaser must notify the supplier concerning any defects within a period of two weeks after receipt of goods, otherwise the assertion of the warranty claim is excluded.
10.4 If the purchaser chooses after failed subsequent performance to withdraw from the contract, he is not entitled to any additional claim for damages because of the defect.
10.5 The warranty period amounts to one year from date of the passing of the risk of goods. This shall not apply if the purchaser has not notified us in time concerning the defect.
10.6 The supplier guarantees for subsequent rectification of defects and replacement of goods to the same extent as for the original goods, namely until expiration of the warranty period applicable. This shall not apply to rectification measures which have only been performed as a gesture of goodwill.
10.7 Claims made by the Customer against the Supplier for expenses of the Customer or its Buyer which are necessary due to the supplementary performance or for the purpose of the supplementary performance, in particular clarification, transport, infrastructure, labour and material costs, shall be excluded. These shall, in particular, also include the costs for necessary recommissioning, software reinstallations or software updates.
If the Supplier nevertheless meets its obligation to defray costs and expenses, the Supplier shall be entitled, in the event that the costs are disproportionate, to refuse to reimburse expenses due to or for the purpose of the supplementary performance or to limit the reimbursement to a reasonable amount. The Supplier shall also be entitled to reimburse these expenses by means of a credit note for goods. In that case, the Supplier is not obliged to provide advance payments for transport costs or damage assessment costs.
Any claim for compensation for damages which have not occurred on the goods themselves shall be excluded.
This shall not apply insofar as liability is imposed by law for example in cases of intent, gross negligence, the lack of assured characteristics or the Product Liability Act.
10.8 All forms of manipulation to our products and their packaging such as modification, reworking and re-stamping are impermissible and breach our registered trademarks among others. Such modifications may negatively influence the technical properties of our products, destroy them and possibly cause consequential damages to other objects. Regiolux GmbH cannot be held responsible in any way for damages thus caused by such modifications.

11. Liability

11.1 As far as it is not expressly stipulated otherwise in these conditions, the claims against the supplier and any person employed by him in the performance of his obligation and any vicarious agent resulting from damages, including consequential damages, which occur to the purchaser or a third party, in particular such damages resulting from fault at contract conclusion, culpable breach of an obligation and negligent and impermissible actions are excluded.
11.2 This does not apply, as far as compelling liability is given in case of intent, gross negligence, lack of the guaranteed properties or the Product Liability Act. Furthermore, the limitation on liability shall not apply in case of personal and health injuries ascribed to the supplier and in case of loss of life.
11.3 The purchaser's claim for damages for defect becomes time-barred after one year from date of the passing of the risk of the goods. This shall not apply if the supplier can be accused of malice.

12. Final provisions

The laws of the Federal Republic of Germany shall apply. Hassfurt is exclusive jurisdiction for all litigations. The invalidity of any term of these conditions shall not affect any part of the remaining conditions and the contract itself.

Königsberg, July 2018

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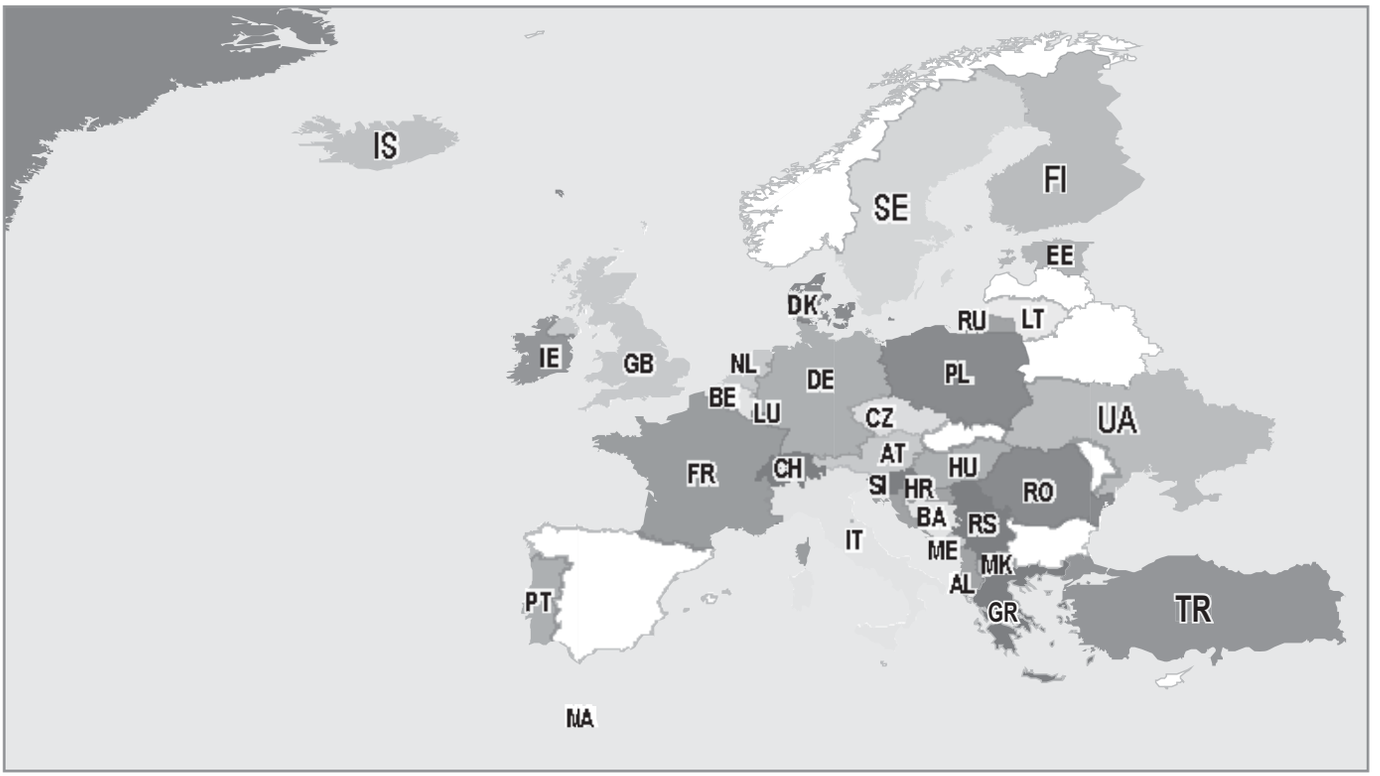
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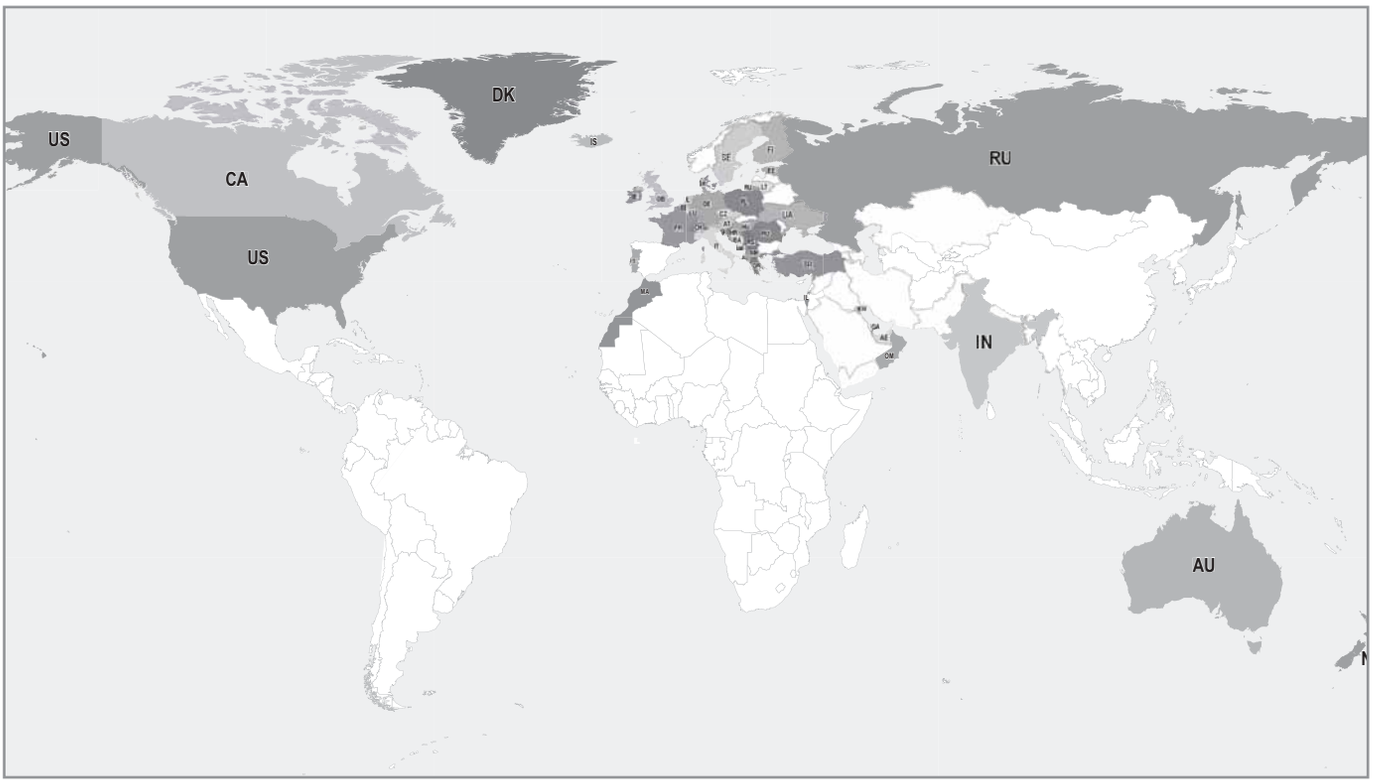
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