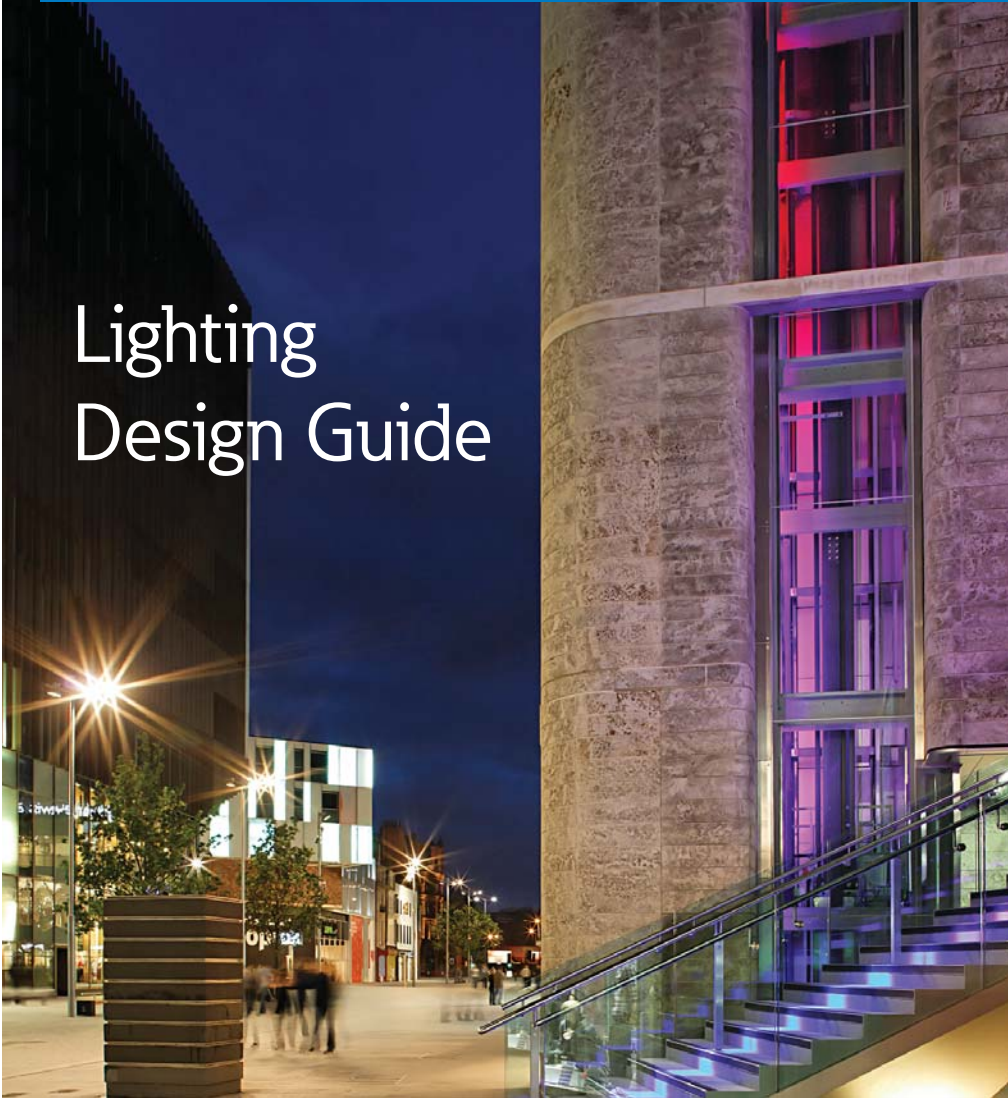


Lighting Design Guide



Powering Business Worldwide



Lighting Design Guide

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Lighting Design Guide

Mains Lighting

Lighting Design

Designing a basic lighting scheme requires the consideration of many factors, not just the achievement of a desired lighting level. Basic objectives must first be established, such as:

- What sort of tasks will be performed in the area?
- What 'mood' needs to be created?
- What type of lighting will create a comfortable environment?

There are also standards and legislation that need to be complied with. For example:

- How energy efficient must the lighting be?
- How will Building Regulations affect the design?
- Is emergency lighting required?

When all of these objectives and requirements have been established, they can be expressed as a series of lighting criteria in order to facilitate a quality lighting design. Criteria that would normally be considered are:

Level of Illumination

Illumination levels for a wide variety of environments and tasks can be found in BS EN 12464-1: 2011 and the Society of Light and Lighting's Code for Lighting. The levels stated are maintained illuminance, which is the minimum average illumination level that should be achieved at the point of scheduled maintenance.

Uniformity and Ratios of Illuminance

The combination of luminaires selected should evenly illuminate the working plane and appropriately illuminate walls and ceilings in relation to the task illumination, so that a pleasant and comfortable environment is achieved. In specific areas, increased directional lighting may be required to create a defined or more intimate environment.

Glare

The acceptable level of glare should be established as appropriate for the application, using information in BS EN 12464-1: 2011 and the SLL Code for Lighting.

Colour and Room Reflectance

The colour appearance of the lamps should be chosen for the application and complement the interior colour scheme, which should be chosen with an appreciation of the reflectance values that will be achieved. Lamps should be selected with appropriate colour rendition properties as detailed in EN12464-1 and for colour discrimination and reduction of eye fatigue.

Energy Efficiency

Luminaires should be selected that meet the requirements of the Building Regulations Part L. The distribution characteristics should also match the requirements of the criteria above.

Special Considerations

Certain applications require additional considerations, such as the addition of display lighting, the arduous nature of the environment or the use of Display Screen Equipment. Luminaires should be selected and the design completed with these elements in mind, where appropriate.

After these criteria have all been considered, a lighting scheme calculation can be undertaken. The most popular method of establishing the quantity of luminaires required, the illumination level achieved and the luminaire layout, is to use computer software created specifically for lighting design. It is important to remember that all the criteria above must still be considered prior to using computer software, if a satisfactory scheme is to be produced.

Lighting design can also be achieved using published photometric data, such as that included on the product pages of this guide. Average illumination via the lumen method of calculation can provide fast results that can then be assessed and facilitate more detailed design of the most appropriate option if required.

Lumen Method Calculations

This method uses the utilisation factor tables created from photometric measurement of each luminaire. Firstly, the Room Index (K) of the space must be calculated, which is the relationship and measure of the proportions of the room:

$$K = \frac{L \times W}{(L + W) \times Hm}$$

Where:

- L** = length of room
- W** = width of room
- Hm** = height of luminaire above working plane

The result is used in conjunction with room reflectance values to obtain a specific utilisation factor for the surface illuminated from the tables.

This can then be used as part of the calculation to determine the average illuminance level, using the following formula:

$$E = \frac{F \times n \times N \times MF \times UF}{A}$$

Where:

- E** = average luminance
- F** = initial lamp lumens
- n** = number of lamps in each luminaire
- N** = number of luminaires
- MF** = maintenance factor
- UF** = utilisation factor
- A** = area

The maintenance factor is a multiple of factors and is determined as follows:

$$MF = LLMF \times LSF \times LMF \times RSMF$$

Where:

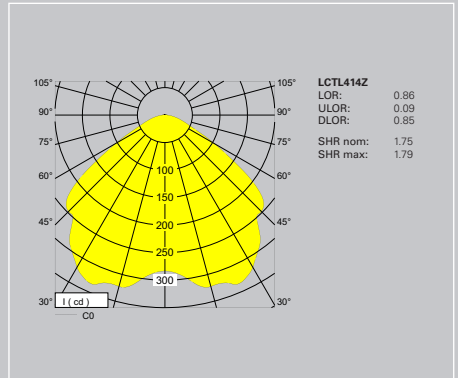
- LLMF** = lamp lumen maintenance factor - the reduction in lumen output after specific burning hours
- LSF** = lamp survival factor - the percentage of lamp failures after specific burning hours
- LMF** = luminaire maintenance factor - the reduction in light output due to dirt deposition on or in the luminaire
- RSMF** = room surface maintenance factor - the reduction in reflectance due to dirt deposition in the room surfaces

Lighting Design Guide

Mains Lighting

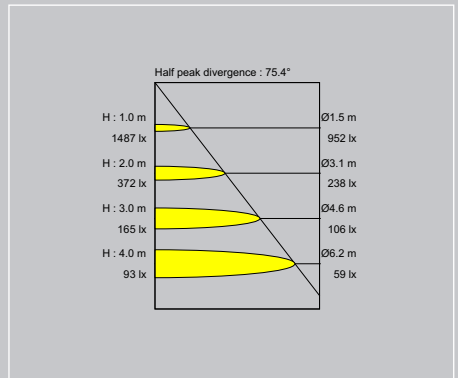
Polar Intensity Curves

This illustrates the distribution of luminous intensity, in cd/1000 lm, for the transverse (solid line) and axial (dashed line) planes of the luminaire. The curve provides a visual guide to the type of distribution expected from the luminaire e.g. wide, narrow, direct, indirect etc, in addition to intensity.



Illuminance Cone Diagrams

Usually used for spotlights or lamps with reflectors, the diagram indicates the maximum illuminance, E lux, at different distances, plus the beam angle of the lamp over which the luminous intensity drops to 50%. The beam diameter at 50% peak intensity, relative to distance away, is also shown.



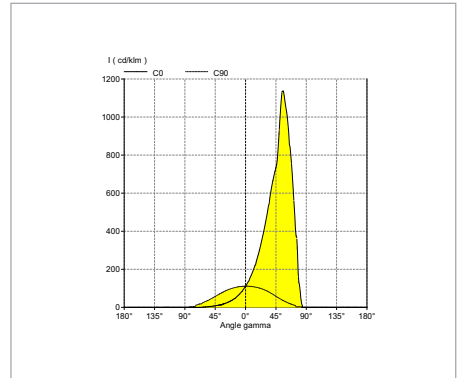
Utilisation Factors Chart

Utilisation factors show the proportion of the luminous flux from the lamp that reaches the working plan. This is for the specific luminaire and allows for surface reflectivity and Room Index. The UF is used in average lumen calculations to calculate the average illumination level for an area with a specific luminaire.

Utilisation factors / TM5											
Reflectances			Room Index								
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	N/A	66	72	76	81	85	87	90	92
70	30	20	N/A	60	66	71	77	81	84	87	90
70	10	20	N/A	56	62	67	73	78	81	85	88
50	50	20	N/A	64	70	73	79	82	84	87	89
50	30	20	N/A	59	65	69	75	78	81	84	86
50	10	20	N/A	56	61	66	72	76	78	82	85
30	50	20	N/A	63	68	71	76	79	81	83	85
30	30	20	N/A	58	64	68	73	76	78	82	83
30	10	20	N/A	55	61	65	70	74	76	80	82
0	0	0	N/A	53	58	62	67	71	73	76	78
BZ-class			1	2	2	2	2	2	3	3	3

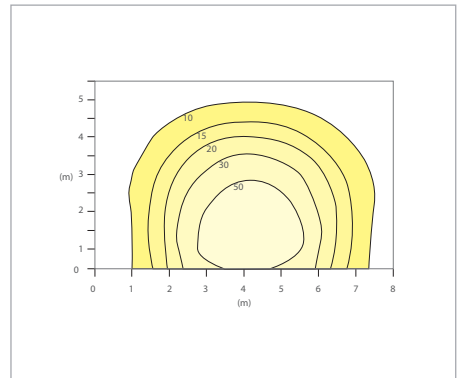
Cartesian Diagrams

Generally used for floodlights, this indicates the distribution of luminous intensity, in $\text{cd}/1000 \text{ lm}$, for the horizontal (solid line) and vertical (dashed line) planes of the luminaire. The diagram provides a visual guide to the type of distribution expected from the luminaire e.g. narrow or wide beam etc, in addition to intensity. The associated data illustrates the beam angle to 10% peak intensity.



Isolux Diagram

The contours provide the points of equal illuminance, in lux, on the floor or wall plane, from a specific stated mounting position. The diagram can be used to assess the distribution characteristics of the luminaire in addition to determining lighting levels.



Lighting Design Guide

Interior Lighting

There is a wide range of lighting application standards and guides available to aid the designer in creating a comfortable and efficient working space.

The recent updated edition of BS EN 12464-1:2011, which not only sets a standard for illumination levels for specific tasks but, also provides advice on how to achieve a lighting solution to meet the human need. Also the CIBSE Lighting Design Guides provide a very good source of guidance for the design of working spaces, and can be considered as best practice. Lighting Guide (LG) 7 is possibly the one most commonly referred to, but it is often misunderstood by being used to specify luminaires rather than the total environment of the space.

LG7 was written to supersede the original LG3 which had very restrictive cut off criteria for the luminance of luminaires. With the development of improved and flatter VDT screens this could be relaxed, allowing for higher luminance values from the luminaire. The increase being 1000 cd/m² or 200 cd/m² if the screen type is unknown. This can be increased up to 1500 cd/m² and 500 cd/m² respectively if positive polarity software only is used. This level is increased to 3000 cd/m² in EN12464. It also recommended values for the wall and ceiling illuminance which were based on a direct percentage of the working plane level. The intention being to alleviate the "cave like" appearance that the single use of the original Category 3 cut off luminaires produced. It must be stated that LG7 is often referred to as being, a guidance for luminaires but it was written as a complete guide for the lighting of the office environment, taking into account the total need of the occupants to create a pleasant working space. Within the guidance there are specific references to the recommended levels of wall and ceiling illuminances.

Wall and Ceiling Illuminance

The guide provides recommendations to address the dark and gloomy effect that can be created by 'categorised' louvres, including the sharp wall cut off and bright scalloping. To avoid this, walls and the ceiling should be lit as follows:

- The average wall illuminance above the working plane should be at least 50% of the average horizontal illuminance on the working plane, avoiding bright scallops or patches.
- The ceiling average illuminance should be at least 30% of the average horizontal illuminance on the working plane. In the case of large areas with unusually low ceilings, this may be difficult to achieve and so should be as high as practically possible.

The other misconception is that office lighting is all about creating a uniform lighting level across the whole space. What is needed is uniform lighting across each task area, which normally consists of relatively small areas on each desk. The lighting in the wider office space can, and indeed should, vary somewhat to create visual interest. Even the most dedicated office worker looks up from his or her work from time to time, and when they do they need to see an interestingly lit office space and, ideally, a more distant view out of a window.

If the building and the visual requirements of the users of an office space are understood and all possible lighting options are considered, a lit environment can be created for each office space that not only provides the required levels of lighting for each task but also provides an interesting and stimulating lit environment for people to work in.

This is a direct quote from the introduction of LG7 which goes on to discuss the whole design process. The overall intention of the guide has not been fully utilised by the majority of users and the reliance of a "single luminaire solution" has still been widely requested. The single luminaire approach when used in regular arrays to produce a high level of uniformity across the whole working space can be in contradiction to the original intent.

If designing to LG7 the certificate of conformity should be used to show the criteria of the design.

Certificate of Conformity

The guide requires that the designer and installer of the installation complete and sign a Certificate of Conformity to demonstrate that all known visual and ergonomic criteria were fully considered during the design process and installed as specified.

Due to the regular development of these guides, Eaton's Cooper Lighting and Safety business recommends you visit CIBSE on www.cibse.org to ensure the latest guides are being referred to.

EN12464-1:2011

The lighting design standards detailed in EN12464-1:2011 breaks the design process into a number of key elements to aid the design process. It however is not intended to provide specific solutions, nor restrict the designer from exploring new techniques or restricts the use of innovative equipment. The use of daylight as well as artificial light should also be fully utilised for both quality and to reduce energy.

- Luminous environment
- Luminance distribution
- Illuminance
- Glare
- Lighting in the interior space
- Colour aspects
- Flicker and stroboscopic effects
- Maintenance factor
- Energy efficiency
- Additional benefits of daylight
- Variability of light

Luminous Environment

For good lighting it is essential that as well as the required illumination level is achieved it is important that the requirements of the occupant are considered. Lighting should meet the three basic human needs:

- Visual comfort
- Visual performance
- Safety

By meeting these basic requirements the lighting scheme will offer a feeling of wellbeing and allow all tasks to be safely and efficiently carried out.

Luminance Distribution

The distribution of the source of illumination is important as this will have a direct effect on the individual and it is important to ensure that the level of adaption is balanced throughout the space.

This will increase visual acuity and contrast, as positive aspects, but good distribution will reduce the risk of excess levels of brightness which in turn can lead to glare which can lead to fatigue and poor performance. However a good level of contrast is important so as to create an interesting environment for people.

Lighting Design Guide

Interior Lighting

Luminance Distribution (con't)

A well balanced luminous environment can only be achieved by taking into consideration the reflectances and illuminance of all surfaces. To avoid a gloomy environment and to raise the level of comfort in the building it is highly desirable to have bright interior surfaces particularly walls and ceilings. The recommendations are:

- Ceilings; 70-90%
- Walls; 50-80%
- Floor; 20-40%

Additionally the reflectance of any major items of fixed equipment or furniture should be in the range of 20-70%. The standard states the minimum levels of wall and ceiling illumination along with the maximum uniformity of these surfaces:

- Walls and major vertical surfaces:
Em > 50 Lux
- Ceilings:
Em > 30 Lux

For offices, these should be increased to:

- Walls and major vertical surfaces:
Em > 75 Lux
- Ceilings:
Em > 50 Lux

Illuminance

The recommendations for minimum illumination levels are detailed for specific task areas based on the following factors:

- Comfort and well being
- Actual task requirements
- Functional safety
- Economy

The standard is based on illuminating the task area and not the total space with

references to areas referred to as "immediate surround" with a minimum band width of 0.5 meters, and "background area" with illumination ratios to the task and each other. The standard also details the uniformities of the respective areas in place of the whole work space.

Typically if the task is illuminated to 500 lux the immediate surround should be at least 300 lux, whilst the background should be illuminated to a 1/3 the value of the immediate surround.

Glare

Glare must be limited to avoid errors, fatigue and accidents. Glare can be experienced as either:

- Discomfort glare
- Disability glare

If the limits of discomfort glare are met, disability glare is not usually a problem. The glare rating for a scheme should be calculated using the Unified Glare Rating (UGR) tabular method and must be below the rating listed for the application.

It should be noted that high brightness reflections in the visual task should be avoided and these can be prevented by correct arrangement of work spaces, choice of finishes, control of luminances and bright ceiling and wall surfaces.

Minimum shielding angles for bright light sources are also specified for a range of lamp luminances.

Lighting in the Interior Space

It is important to ensure that illumination of the space fully considers the human need and ensures that the lighting solution provided has a good level of cylindrical illumination. This is important in environments where good inter-personal communication is required. Additionally the appearance of a space can be enhanced by providing a degree of modelling by controlled use of directional lighting. EN12464 offers good advice on achieving a balanced environment.

Colour Appearance and Rendering

The colour appearance of the lamps refers to the apparent colour (chromaticity) of the light emitted, and the colour used should suit what is deemed as natural for the application, e.g. relative to wall colours, furniture, climate etc.

For visual performance and a feeling of comfort and wellbeing, lamps with a suitable colour rendering index should be selected. Lamps with a colour rendering index value of Ra 80 must be the minimum used where people work or stay for long periods. For special applications, colour rendering may be acceptable with a lower index, but for other areas such as health care and retail, a higher value may be appropriate.

Flicker and Stroboscopic Effects

Lamp flicker and stroboscopic effects, which create discomfort and dangerous situations, should be avoided. This can be achieved by use of high frequency control gear in typical applications.

Energy Efficiency

Lighting should be designed to meet the lighting requirements of a particular task or

space in an energy efficient way; however it is important not to compromise the visual aspects of the lighting scheme just to reduce energy usage. The use of relevant lighting controls should be considered in any design to take account of daylight, occupancy patterns, and by using dimming control gear the benefit of maintained illuminance.

A procedure for estimating the energy requirements for a lighting installation is given in BS EN15193 Lighting Energy Numeric Indicator. (LENI), as this is based on a complete building and as such it should only be used as guidance if used for single rooms.

Additional Benefits of Daylight

A good lighting design should also utilise any available daylight which can have a beneficial effect on the occupants. Creating variance in lighting level, direction and spectral composition throughout the day creates a feeling of wellbeing and comfort, it is however important to ensure that windows and skylights do not cause visual or thermal discomfort, or a loss of privacy. Additionally the use of natural daylight is beneficial in reducing the overall total lighting energy for the installation.

Variability of Light

Light is important to health and wellbeing as it can affect the mood, emotions and general alertness, so it is important to create a lighting solution that is not just a design by "numbers"; but one which truly takes into account the person.

Lighting Design Guide

Interior Lighting

Practical Scheme Design

In order to comply with the wide-ranging requirements of the CIBSE guides and BS EN 12464-1 (interior), each element briefly described should be carefully considered before choosing the luminaires to achieve the desired effect for the installation. It is unlikely that one luminaire type alone will meet the requirements in full and provide a satisfactory result. Each installation will also differ in design, as each application varies in terms of surface colours, furniture, ergonomics, task, limiting glare requirements, available daylight etc.

These documents aim to encourage the designer to look more closely at the working environment required and to create a comfortable and balanced lighting solution. It should take into consideration the factors listed, rather than reverting to a default luminaire or single light source suitable for all applications. It is therefore more likely that schemes that successfully achieve the standard and guidance documents whilst creating a feeling of wellbeing will consist of a combination of luminaire types.

The combination of luminaires can include:

- Recessed or surface direct downlight luminaires
- Semi-recessed or recessed direct/indirect luminaires
- Suspended direct/indirect luminaires
- Wall washer luminaires
- Wall mounted or floor standing uplighters

The resultant installation will provide efficient illumination of the task area, whilst walls and ceilings are evenly illuminated to provide a visually comfortable lit environment.

Further information and advice on the application of CIBSE lighting guides, BS EN 12464-1 (Light and lighting – lighting of the work place), BS EN 15193 (Energy performance of buildings-Energy requirements for lighting) and many other standards and guides is available from our Technical Support and Application Department. They are also able to offer guidance on selecting the appropriate luminaires for the application from Eaton's Cooper Lighting and Safety Business' range of mains and emergency luminaires.

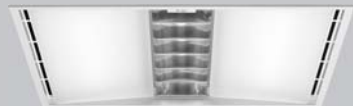
RXS Adjustable



LSR



Combiform Ultra





Lighting Design Guide

Emergency Lighting

Legal Requirements

The main reason for installing an emergency lighting system is to enable the building to meet fire safety legislation in a way that is visually acceptable and meets the user's needs for ease of operation and maintenance. Consequently it is important to establish all the relevant legal requirements for emergency lighting and fire alarm systems before commencing the design. These should ideally be agreed between the "responsible person" and the system designer.

The main legislative requirements are:

The Fire Safety Order 2005

(The Fire (Scotland) Act 2005 and Fire and Rescue Services (Northern Ireland) Order 2006 No.1254), reforms the way the law relating to fire safety in non-domestic premises and specifically replaces the Fire Precautions (workplace) regulation 1997 and the Fire Precautions Act 1971. It imposes a general duty to take such fire precautions as may be reasonably required to ensure that premises are safe for the occupants and those in the immediate vicinity.

By virtue of the order the Responsible Person (for Scotland the Duty Holder) is required to carry out a fire risk assessment of their premises. If not trained themselves, the Responsible Person must appoint, or contract, a 'Competent Person' to carry out a risk assessment. This must be a suitable and sufficient assessment of the risk to which relevant persons are exposed for the purpose of identifying the general fire precautions they need to take to comply with the requirements of the order.

This legislation requires that all premises must be safeguarded from fire by appropriate fire safety precautions.

- This must be demonstrated by the responsible person for the premises (normally the employer) conducting a fire safety risk assessment. If the site has 5 or more employees then the risk assessment must be kept as a formal record for inspection by the Fire Authority.
- The Assessment replaces fire certificates which are now no longer valid.

Main points in the guide are:

- That the law now covers all premises that have employees or are visited by members of the public. (Previously, fire certificates did not cover small premises).
- Emergency lighting should be upgraded to meet the current standards.

The building regulations detail the design and construction characteristics of a building. Approved Document B details the fire safety requirements for new buildings and the major refurbishment of existing premises. Table 9 of this document shows the locations that must be provided with emergency lighting.

This list should be used as a starting point and BS5266-1:2011 should be referred to as the main source of information. This provides information for areas requiring emergency lighting but also best practice for the lighting of a selection of high risk tasks. It also clarifies that emergency lighting is needed for all parts of schools that either do not have natural light or are used outside normal school hours. The regulations require that systems comply with BS 5266-1:2011 the code of practice for emergency lighting. In order for greater clarity, it is now split into two separate volumes.

Emergency Design Process

STEP 1	Identify fire hazards - such as sources of ignition, fuel or work processes.
STEP 2	Identify the location of people at risk in the case of fire.
STEP 3	Evaluate the risks to check whether existing fire safety measures are adequate, including control of ignition and fuel sources, fire detection and warning, means of escape and the provision of emergency lighting, means of fighting fire, maintenance and testing of fire precautions, fire safety training of employees.
STEP 4	Carry out any improvements needed.
STEP 5	Record findings and action taken.
STEP 6	Keep the assessment under review - revise provisions if the situation changes.

Lighting Design Guide

Emergency Lighting

The Government has produced 11 guides* for individual applications to help employers to conduct their assessments and gives guidance on the safety equipment required.

The guides make it clear that occupants have to be protected from risks in the event of the normal supply failing. To assist users they advise that:

- Emergency lighting is likely to be required where any escape routes are internal and without windows or if the premises are used during darkness (including early darkness in winter).
- The assessment should cover the location of employees and any visitors (including information on those persons with disabilities) to the site to assist in determining the areas requiring emergency lighting.
- The guidance gives detailed requirements for the suitability of escape routes and calls for the installation of emergency lighting to be in accordance with BS 5266-1.
- The risk assessment should identify any areas that require additional emergency lighting provision. BS5266-1:2011 lists examples of these areas detailing the required levels, duration, and the plane to be illuminated, as examples, a school chemical laboratory which may be smaller than 60m² but still need emergency lighting, as combustible materials and sources of ignition would be present, or commercial kitchens.
- It recommends that advice on the installation should be given by a competent person who specialises in emergency lighting systems.
- Continued maintenance and testing must be correctly carried out to comply with the directive.

- One way of ensuring the competence of your provider would be registration of a reputable scheme such as the BAFE (British Approvals for Fire Equipment) SP203-4 scheme.
- The equipment used must be capable of being demonstrated as of adequate quality. Compliance with the appropriate British Standard, or other approved third party scheme, gives evidence of this. The standard for luminaires is BS EN 60598-2-22. ICEL 1001 registration endorses the spacing data of these luminaires. The standard for central battery systems is BS EN 50171.

Note: When the premises are being assessed for risk, shortcomings in other areas of fire protection can be compensated for by improved levels of emergency lighting and fire alarms.

The Health & Safety Regulations (1996)

These regulations bring into force the EC Safety Signs Directive (92/58/EEC) on the provision and use of safety signs at work. From 2012 the new ISO 7010 Pictogram signs will also be legal but should not be mixed with other formats on an installation.

These regulations apply to all safety signs including those which provide directional signage for escape routes.

Other Regulations

In addition to fire safety legislation, some workplaces require a licence from the Local Authority, including theatres and cinemas, sport stadiums and premises for public entertainment, music, dancing, gambling and the sale of alcohol. Other premises must be registered with the Local Authority and be inspected by the Fire Authority, including nursing homes, children's homes, residential care homes and independent schools. Both licensed and registered

premises have to pass a fire inspection to confirm that they have systems complying with BS 5266-1 for the emergency lighting and BS 5839 for fire equipment. Records of a system are now essential to maintain the validity of approvals and licences.

Emergency Lighting System Design

This section provides guidance on system design to meet BS 5266 Parts 1 EN1838:13 and so achieve compliance with legislation.

Design Objective

BS 5266-1:2011 gives recommendations and guidance on the factors that need to be considered in the design of, and the installation and wiring of, electrical emergency escape lighting systems. This provides the lighting performance needed for safe movement of people in the event of the supply to normal lighting failing. It also gives recommendations for lighting in areas with fixed seating. From this it can be seen that you should ensure the following provisions are fulfilled.

BS 5266-1 recommends that discussions should be held prior to commencing the design, to establish the areas to be covered, the method of operation, the testing regime and the most suitable type of system. These discussions should include the owner or occupier of the premises, the system designer, the installer and the supplier of the equipment.

At this stage the provision of plans should be made available to identify:

- A** Escape routes
- B** Open areas
- C** High risk task areas
- D** Safety equipment, including fire safety equipment, safety signs and any other aspects identified by risk assessment
- E** Details of normal lighting and controls

A	Indicate clearly and unambiguously the escape routes.
B	Provide illumination along such routes to allow safe movement towards and through the exits provided.
C	Ensure that fire alarm call points and fire fighting equipment, provided along escape routes can be readily located.
D	To ensure that any area requiring special consideration as identified by the risk assessment have the necessary level of emergency illumination.
E	To permit operations concerned with safety measures.

* These guides can be viewed at:
www.firesafetyguides.communities.gov.uk

Lighting Design Guide

Emergency Lighting

Stage One

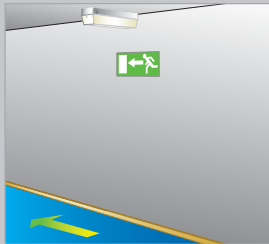
Locate Luminaires at Mandatory Points of Emphasis

Initial design is conducted by situating luminaires to reveal specific hazards and highlight safety equipment and signs, in addition to providing illumination to assist safe travel along the escape route. This should be performed regardless of whether it is an emergency escape route or an open (anti-panic) area.

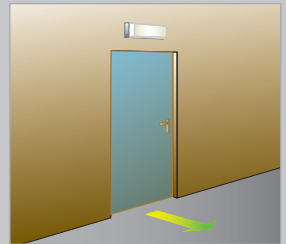
Only when this is accomplished should the type of luminaire or its light output be considered. EN1838:2013 states that the luminaires sited at points of emphasis must comply with BS EN 60598-2-22. Specific locations where a luminaire must be provided are:



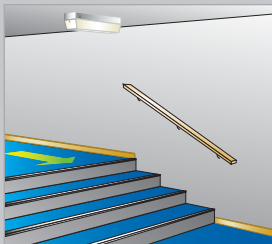
At each exit door



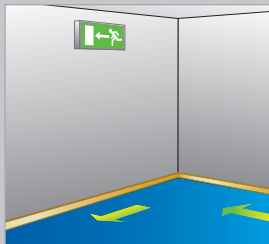
All safety exit signs



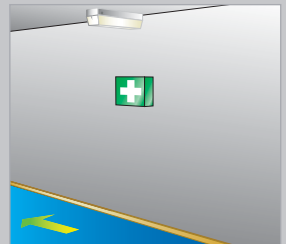
Outside the final exit and to a place of safety



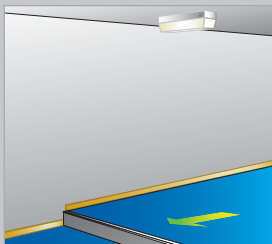
Near stairs so that each tread receives direct light



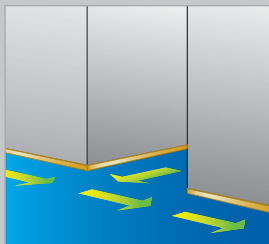
At each change of direction



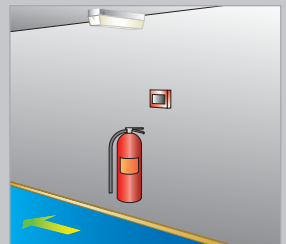
Near each first aid post



Near any other change of floor level



At each intersection of corridors



Near each piece of fire fighting equipment and call point

Stage Two

Ensure the Exit Signs are of Correct Format and Size

Section 5 of EN1838:2013 stipulates that “signs which are provided at all exits intended to be used in an emergency and along escape routes shall be illuminated to indicate unambiguously the route of escape to a point of safety”. Where direct sight of an emergency exit is not possible, an illuminated directional sign (or series of signs) should be provided to assist a person’s progression towards the closest emergency exit.

Details on the range of emergency exit signs available, the maximum viewing distances and illumination requirements can be found below:

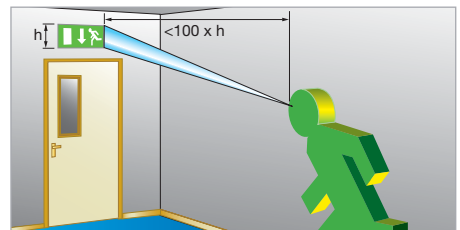
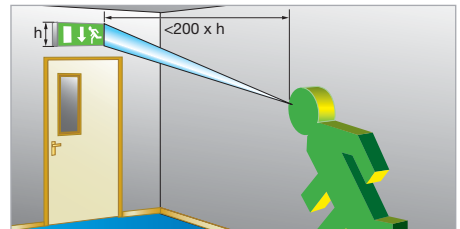
Sign Formats Should Not Be Mixed

- BS2560:197**
 Old-style signs are now obsolete. These should have been replaced by December 1998.
- BS5499 Part 1**
 Signs are still acceptable, if they are already in the building.
- European Signs Directive Format**
 This came into force on 1st April 1996, under The Signs Directive.
- ISO 7010**
 In 2011, it was decided by many of the National Standards bodies to consider adoption of a single pictogram format as detailed in ISO 7010. This format was adopted by BSI in the latest edition of BS5266: 2011 which is considered to be the ‘de-facto’ emergency lighting standard.

Maximum Viewing Distances

For all formats of safety signs, the maximum viewing distances and luminance conditions are given in BS 5266 pt7/EN 1838 Signs can be either internally illuminated, such as exit boxes or edge lit emergency luminaires with a screened sign that have a controlled illuminance, or painted signs. These include photoluminescent signs but to be acceptable they must have an external emergency light illuminating them.

Maximum viewing distances are:



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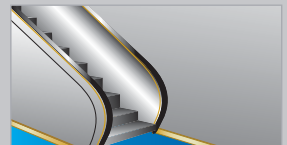
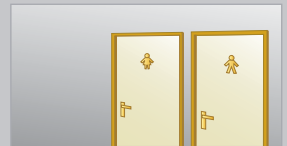
Emergency Lighting

Stage Three

Locate Luminaires at the Following Essential Areas in a Building

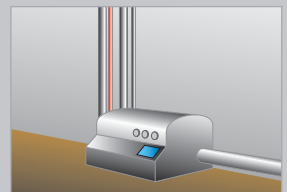
These locations are not part of the escape route but because of their risk they require protection by emergency lighting. Some of these areas are specifically defined in BS 5266-1:2011. Others are likely to be hazard areas defined by the risk assessment.

- A** Lift cars - although only in exceptional circumstances will they be part of the escape route, they do present a problem in that the public may be trapped in them in the event of a supply failure.
- B** Toilets - all toilets for the disabled and facilities exceeding 8m² floor area or without borrowed lights. Note the current issue of BS 5266-1: 2011 now excludes the en suite facilities in hotels.
- C** Escalators - to enable users to get off them safely.
- D** Motor generator, control or plant rooms - require battery supplied emergency lighting to assist any maintenance or operating personnel in the event of failure.
- E** Covered car parks - the normal pedestrian routes should be provided with non-maintained luminaires of at least 1 hour duration.



Other Areas to Consider:

Kitchens: Sudden failure of lighting while staff are cooking hot food is potentially dangerous. Currently these areas would need an emergency light over the extinguisher but emergency lighting is also needed over the area for hot food preparation. Employees need to be able to locate and turn off machinery/ovens/hobs etc. to ensure that they do not turn on once the supply is re-instated and cause a possible unsafe condition.



First Aid and Training Rooms: Currently the requirement is for the light level needed for the safety of the individual, however system designers need to consider the light level response and duration times of emergency lighting of first aid rooms where treatment is to be given.

Panic Bars and Pads: The emergency lighting must provide adequate direct illumination on crash bars on exit doors to enable them to be easily seen and operated, consider using exit signs above with downward light panels.

Motor Generator, Control or Plant Rooms: Require battery supplied emergency lighting to assist any maintenance or operating personnel in the event of failure.

Refuge Areas for Disabled People: In these areas fire wardens will now have to go and collect disabled persons, often transferring them into rescue sleds to enable them to be safely taken downstairs. Consideration should be given to the light level response and duration times of emergency lighting in refuges.

Fire Equipment: In a fire condition, users must inspect and act on the condition of fire alarm panels and repeaters. The light must be of a sufficient level to the correct plane of visual task to enable displays to be read accurately. The staff will also have to contact the fire brigade so they must have sufficient illumination for the number to be dialled correctly in the emergency condition.

Covered Car Parks: The normal pedestrian routes should be provided with non-maintained luminaires of at least 1 hour duration.

Further information regarding duration and emergency illumination levels for high risk areas are shown in BS5266-1: 2011.

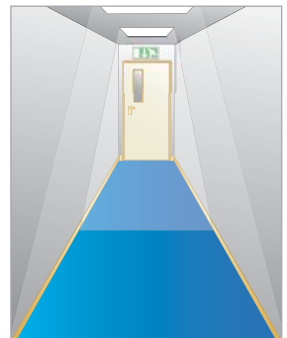
Stage Four Escape Route Lighting

When the points of emphasis have been covered, it is essential to provide any additional luminaires to ensure that minimum illuminance levels are met to enable the routes to be used safely. In addition, every compartment on the escape route must have at least two luminaires, to provide some light in the event of luminaire failure.

Lighting Level Requirements

EN 1838:2013 4.2 calls for a minimum of 1 lux anywhere on the centre line of the escape route for normal risks. A uniformity ratio of 40:1 maximum to minimum must not be exceeded. This illuminance must be provided for the full duration and life of the system. 50% of the illuminance must be available within 5 seconds and the full value within 60 seconds of supply failure.

Note: The UK had an "A deviation" which allowed a 0.2 lux minimum value for routes that will be permanently unobstructed. This has now been removed and any existing escape routes illuminate to this level must be upgraded to the current 1 lux value.



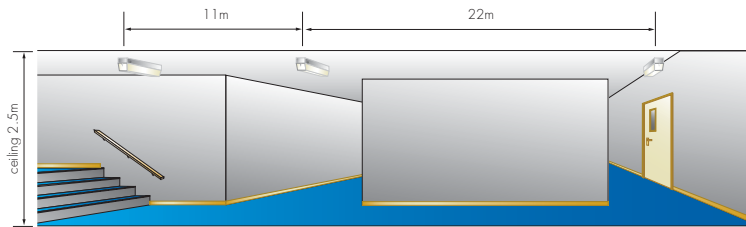
Lighting Design Guide

Emergency Lighting

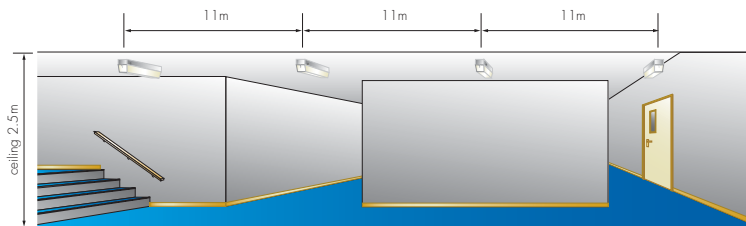
Photometric Design - Emergency Escape Routes

The use of authenticated spacing tables or a suitable computer program provides the information to determine whether luminaires are needed in addition to those for the points of emphasis, to provide the minimum required level of illumination on the escape routes. To ensure that the design will meet the required levels at all times the data is de-rated, as required by the standard, to cover: reduction in light as the battery voltage reduces discharge, ageing of lamps in maintained circuits and the effects of dirt.

Mode	Mounting Height (m)	Lux Level Directly Under	Escape Route 2m wide 1 lux min				Open (Anti-Panic) Area 0.5 lux min			
Self-Contained										
NM	2.5	3.28	3.9	11.3	4.0	2.0	4.0	12.0	6.0	1.9
	4.0	1.28	2.1	9.6	5.6	1.2	3.3	14.8	7.2	1.9
	6.0	0.57	-	-	-	-	1.6	12.4	7.4	0.8
M	2.5	2.75	3.3	10.7	5.2	1.8	3.7	11.7	5.8	1.8
	4.0	1.07	1.5	8.0	5.0	0.7	3.5	14.2	7.0	1.7
	6.0	0.48	-	-	-	-	-	-	-	-



Locate luminaires at mandatory "points of emphasis"



Add additional luminaire to achieve 1 lux minimum

Stage Five

Open Area (Anti-Panic) Core Areas

Areas larger than 60m², open areas with an escape route passing through them, or hazards identified by the building risk assessment all require emergency lighting. The current standard is easy to design for and to verify, promoting systems that provide good uniformity rather than ones that use a few large output luminaires.

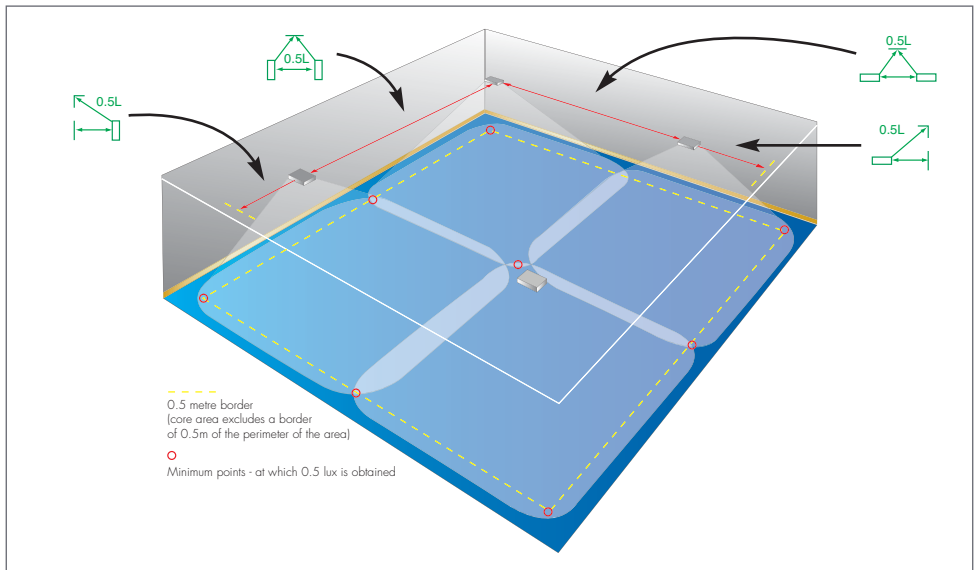
Lighting Level Requirements

EN 1838:2013 4.3 calls for 0.5 lux minimum of the empty core area, which excludes a border of 0.5m of the perimeter of the area. Spacing tables or a suitable computer program provide simple and accurate data that can easily be used. The spacing tables for 0.5 lux are de-rated on the same basis as those for escape routes. They can also be used as a guide for initial selection of the location of luminaires when using a computer program.

Spacing Data

Specific data is available for self-contained dedicated emergency luminaires. This can be found on each of the individual product entries in this catalogue.

If using standard mains luminaires fitted with an emergency conversion kit, you should use one of the available computer programs to calculate the layout of converted luminaires. By using the actual distribution of the luminaire ensures that the correct emergency lumen value is used with the relevant depreciation factors.



Lighting Design Guide

Emergency Lighting

Stage Six

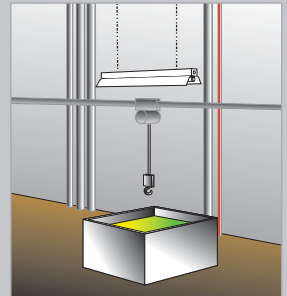
High Risk Task Area Lighting

The risk assessment carried out will have identified a number of locations needing special consideration. These may be areas in which plant and production lines are deemed to have a high risk or control rooms managing dangerous processes. In addition to these identified areas a selection of other typical areas are detailed in BS5266-1:2011.

EN1838: 2013 defines that in areas of high risk the maintained illuminance on the reference plane shall be not less than 10% of the required maintained illuminance for that task, however it shall not be less than 15 lux.

Design Procedures

In order to reach this enhanced level of emergency illumination it is important to consider all options, which may include converted luminaires, either operated from integral batteries or the use of luminaires supplied from a central emergency unit. These versions in most instances would have higher Ballast Lumen factors (BLF). It is also important to consider the emergency response time which may require that the emergency luminaires are operated in maintained mode, or possibly require the use of tungsten projector units. If these are used it is important to maintain a reasonable level of uniformity.



Stage Seven

Control

Non-maintained luminaires must be activated by failure of supply to the normal lighting. They must therefore be connected to an un-switched live taken from the local normal lighting final circuit. It is important at this stage to ensure that the luminaires used in the design process are not changed without a full assessment of the lumen output and distribution of any alternative proposal. Failure to validate the performance could lead to a non-compliant installation.

Stage Seven (con't)

Testing and Log Book

The Fire Safety Order requires that appropriate testing is performed to maintain compliance of the system. The system should include adequate facilities for testing and recording the system condition. These need to be appropriate for the specific site and should be considered as part of the system design. Discussions with the user or system designer should identify:

A	The calibre and reliability of staff available to do the testing.
B	The level of difficulty in performing the test.
C	If discharge tests need to be done outside normal working hours, or phased so only alternate luminaires are tested in buildings that are permanently occupied.

The testing requirements in the code of practice are:

Function Test

All emergency luminaires should be tested by breaking the supply to them and checking that they operate satisfactorily. The supply must then be restored and the charging indicators must be seen to be operating correctly. This test must be performed at least once per month and the results logged.

Discharge Test

The luminaires must be tested for their full rated duration period and checked for satisfactory operation. The supply must then be restored and the charging indicators rechecked. This test must be performed at least annually and the results logged.

If manual testing is utilised, the following points should be considered:

Is a single switch to be used? Unless the whole building is to be switched off, a separate switch should be used for each final circuit. As the feed to non-maintained circuits must be taken from the switch, this will probably mean that the building will have to be walked around twice, once to check the luminaires and once to check that they are recharging.

With manual testing it is difficult to correctly validate that the emergency luminaires illuminated within the specified time and at the correct level. Validation is also required that all emergency luminaires meet the minimum duration. Again, this would be difficult to validate for all locations.

Are luminaires to be individually switched? In practice, only a single walk around the building will be needed. However, the test switches could spoil the décor of the building and they must be of a type that is tamper proof.

After the tests, the performance of the luminaires must be logged.

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Emergency Lighting

Stage Seven (con't)

Commissioning Certificate

BS 5266 Pt 1: 2011 and the European Standard both require written declarations of compliance to be available on site for inspection. These consist of:

1 Installation Quality

IEE regulations must have been conformed with and non-maintained fittings fed from the final circuit of the normal lighting in each, as required in BS 5266 Pt 1: 2011.

2 Photometric Performance

Evidence of compliance with light levels has to be supplied by the system designer.

Photometric tests for Eaton's Cooper Lighting and Safety business luminaires are normally performed at BSI and spacing data is registered by the ICEL scheme. Therefore copies of the spacing data in this guide provides the verification required.

3 Declaration of a Satisfactory Test of Operation

A log of all system tests and results must be maintained. System log books, with commissioning forms, testing forms and instructions are available from Eaton's Cooper Lighting and Safety business.

Maintenance

Finally, to ensure that the system remains at full operational status, essential servicing should be defined. This normally would be performed as part of the testing routine, but in the case of consumable items such as replacement lamps, spares should be provided for immediate use. Eaton's Cooper Lighting and Safety business can provide a full maintenance service for your emergency lighting system by fully qualified BAFE registered engineers. For more information, call our service team on 01302 303349.

Stage Seven (con't)

Automatic Test Systems

Finally, to ensure that the system remains at full operational status, essential servicing should be defined. This normally would be performed as part of the testing routine, but in the case of consumable items such as replacement lamps, spares should be provided for immediate use. Eaton's Cooper Lighting and Safety business can provide a full maintenance service for your emergency lighting system by fully qualified BAFE registered engineers. For more information, call our service team on 01302 303349.

EasiCheck

Particularly suited to medium to large sized installations, EasiCheck is a versatile addressable emergency lighting test system. It uses a central control panel to perform automatic test schedules, initiate manual tests and download event logs and test reports. It is available for use with both self-contained luminaires and central power systems. EasiCheck continuously monitors all components of an emergency lighting system, reporting faults as soon as they occur. Up to 63 panels can be networked together, ensuring EasiCheck can be utilised in the largest of projects of up to 12,600 emergency luminaires. It also has advanced software options for PC monitoring and control.

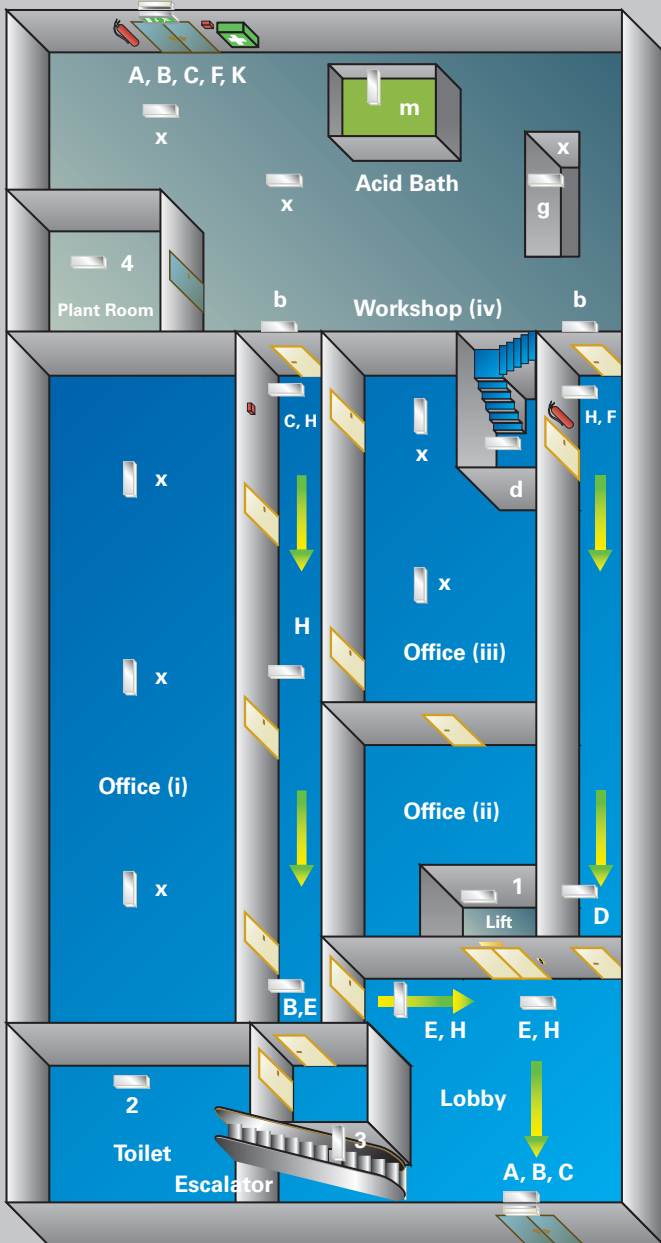


Intellem

Designed for use with self-contained emergency luminaires, Intellem is a stand alone self-test system for small to medium sized installations. The testing module self calibrates and carries out testing at predetermined intervals. Faults are precisely reported by an audible alarm and the flashing sequence of the LED indicator. For applications where an audible alarm would be inappropriate, this feature can be disabled during installation. Intellem has a function which enables tests of adjacent luminaires to be staggered to avoid complete loss of emergency cover during the recharge period after a full discharge test.

Lighting Design Guide

Emergency Lighting



Example of System Design

Stage One

Locate luminaires at points of emphasis on escape route:

- A** At each exit door
- B** To illuminate exit and safety signs
- C** Near call points (covered by a.)
- D** Near each staircase
- E** Change of direction (covered by b.)
- F** Fire fighting equipment (covered by a.)
- G** Change of floor level
- H** Near intersection of escape routes
- I** Outside final exits
- J** Near first aid points

Stage Two

Exit sign location is covered by Stage 1, but it is important to check that maximum viewing distances are not exceeded and that if the normal lighting is dimmed, e.g. in cinemas, the exit signs must be permanently illuminated while the building is occupied (maintained lighting).

Stage Three

Other areas, which require emergency lighting but are not on the escape route area.

- 1** Lift car
- 2** Toilet (above 8m² floor area)
- 3** Escalators
- 4** Plant room

Stage Four

Check minimum illuminance levels on the escape routes. After selecting a suitable luminaire, consulting the spacing table shows the number of fittings needed to provide a minimum of 1 lux on the centre line of the escape routes.

Stage Five

Anti-panic open areas (x) apply to any areas over 60m² floor area, or that have an escape route passing through them.

- (i)** Office over 60m²
3 x Micropoint 2
- (ii)** Office under 60m²
No requirement
- (iii)** Under 60m², but part of escape route from office
2 x Micropoint 2 fittings, either as compartment of escape route or an open anti-panic area
- (iv)** Workshop 4m high
3 x *i*-P65 + maintained Alfalux Highbay LED unit for high risk (m)

Stage Six

High risk lighting requirement for an acid bath (m) is included in the design for stage 5. However an alternative option would be the use of a suitable high powered tungsten projector such as Beamlite.

Lighting Design Guide

Emergency Lighting

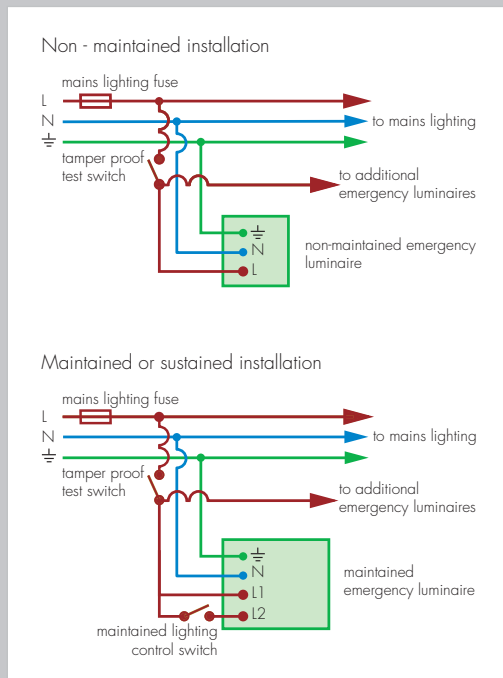
Wiring Installation

The wiring of emergency luminaires should generally be in accordance with normal wiring practice (I.E.E. Wiring Regulations), statutory requirements applicable to the type of building, local bylaws and regulations. The supply for self contained luminaires should be taken from the unswitched local light source.

Cabling used when installing self-contained emergency luminaires should be of a similar type to that used for the normal mains light. In the event of a fire, if the cabling used for the emergency luminaires has greater protection, there may be a chance of the normal lighting failing and the emergency lighting remaining in the normal mode (i.e. inoperative). Hence it is recommended that self-contained emergency luminaires are wired in PVC insulated cable.

The supply to self-contained luminaires should be such as to prevent unauthorised disconnection, but should incorporate suitable means for simulating a mains failure for test purposes. The source of supply should be from the same local fuse as the normal lighting, so that in the event of a fuse failure causing the normal lighting to be extinguished, the emergency lighting is brought into operation in the same locality.

Wiring Details





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