BUREAU OF INDIAN STANDARDS
DRAFT FOR COMMENTS ONLY

Draft National Lighting Code of India

Part 9 Emergency Lighting

First Revision of SP 72 (Part 9)

Illumination Engineering and Luminaries Sectional Committee, ETD 49

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FOREWORD

(Formal clauses of the draft will be added later)

When the normal mains lighting fails in areas without natural light, it is necessary to evacuate the premises, to move people to a place of safety or to allow essential processes to continue or be shut down. During this period, emergency lighting should be provided from a power source independent of that supplying the normal lighting. Such an emergency lighting shall be available for a minimum continuous period to tide over the panic situation and enable the evacuation of the building to take place.

This implies that an employer, owner or any person who exercises control over any part of the premises takes reasonable steps to reduce the risk of fire and to ensure that occupants can safely escape if a fire does occur. To meet these obligations, it is necessary for the designated responsible person (or a delegated competent person) to carry out a risk assessment, create and implement a plan to deal with an emergency and, where five or more persons are employed, to document the findings.

For this purpose, both the equipment design & performance and the design of emergency lighting products & systems are required to comply with this standard. Therefore, emergency lighting is a legal requirement and should be installed in all the premises, - new or old.

Draft National Lighting Code of India

PART 9 EMERGENCY LIGHTING

(First Revision)

1 SCOPE

This Part of the code (Part 9) covers the basic principles of emergency lighting as applicable to premises, thereby, to furnish guidance on the various aspects that should be considered when seeking to design an effective and reliable installation.

This Part encompasses product standards for luminaires, including lamps and individual components, as well as specific requirements for emergency lighting, emergency safety lighting, and standby lighting. It also covers signage system standards, addressing aspects such as location, operation, colors, design, photometric requirements, and layout of emergency signs. Additionally, it provides guidelines for the design of emergency lighting systems and certain specialized equipment. As a result, this document serves as a key reference for professionals involved in the design, specification, installation, and management of emergency lighting and signage systems.

2 REFERENCES

IS/ Other Standards	***Title***
IS 9457: 2005	Safety colours and safety signs – Code of practice (First Revision)
BS 5266-1	Emergency lighting-Code of practice for the emergency lighting of premises
EN 62034	Automatic test systems for battery powered emergency escape lighting
EN 50172	Emergency escape lighting systems including design and the required system records
EN 1838	Lighting applications-Emergency escape lighting and standby lighting systems
EN 60598-2-22	Emergency escape lighting and standby lighting systems Luminaires-Particular requirements-Luminaires for emergency lighting
IEC 62386-202	Digital addressable lighting interface (DALI)-Particular requirements for control gear; self-contained emergency lighting
ISO 7010	Graphical symbols — Safety colours and safety signs — Registered safety signs

3 TERMINOLOGY

For the purpose of this part of the code, the following definitions in addition to those given in Part 1 of this code shall apply.

3.1 Exit

A way out of the building that is intended to be used at any time whilst the building is occupied.

3.2 Emergency Exit

A way out of the building that is intended to be used only during an emergency.

3.3 Escape Route

A route from a point inside the building to an exit or emergency exit.

3.4 Emergency Lighting

Lighting that illuminates or continues to provide sufficient illumination on an independent self-contained power source after the failure of the normal mains power supply.

3.5 Emergency Escape Lighting

That type of emergency lighting that is provided to ensure that an escape route can be effectively identified and used.

3.6 High-Risk Task-Area Lighting

That type of emergency lighting that is provided to ensure the safety of people involved in a potentially hazardous process/areas.

3.7 Normal Lighting

All permanently installed artificial lighting normally used when the building is occupied.

3.8 Standby Lighting

That type of emergency lighting that enables normal operations to be carried on ceaselessly.

4 AREAS OF APPLICATIONS

4.1 This standard is applicable to all class of areas of application which needs safe evacuation of people under emergency but not limited to examples given in Table 1 in existing and new Premises.

Table 1 Examples of Areas of Application Which Needs Safe Evacuation of People Under Emergency

(Clause 4.1*)*

Sl. No	**Areas of Application-Occupancy Class**	**Areas of Application-Occupancy Examples**
(1)	(2)	(3)

i)	Premises used as sleeping accommodation	Hotels, hospitals, care homes, guest, houses, boarding schools
ii)	Non-residential premises used for treatment or care	Clinics, dental practices, special schools
iii)	Non-residential premises used for recreation	Theatres, cinemas, concert halls, exhibition halls, sports halls, public houses, restaurants etc.
iv)	Non-residential premises used for teaching, training and research, and offices	All types of Offices, Schools, colleges, technical institutes, laboratories etc.
v)	Non-residential public premises	Shops, shopping malls, libraries, town halls, art galleries, museums etc.
vi)	Industrial premises	Factories, workshops, warehouses, etc.
vii)	Common access routes within residential accommodation	Flats and bungalows
viii)	Covered car parks	Single level or multi-storey car parks
ix)	All types of sports areas indoor or outdoor types	Cricket, Football, Athletics, Velodromes, etc.

5 TYPES OF EMERGENCY LIGHTING

Emergency lighting can take several different forms depending on its purpose, as shown by Fig.1. The main classifications are ‘emergency escape lighting’, ‘emergency safety lighting’ and ‘standby lighting’. Emergency escape lighting is further subdivided into the lighting of the escape route, the lighting of open areas where there is no defined escape route, and the lighting of high-risk task areas where a hazardous activity takes place and needs to be made safe before evacuation.

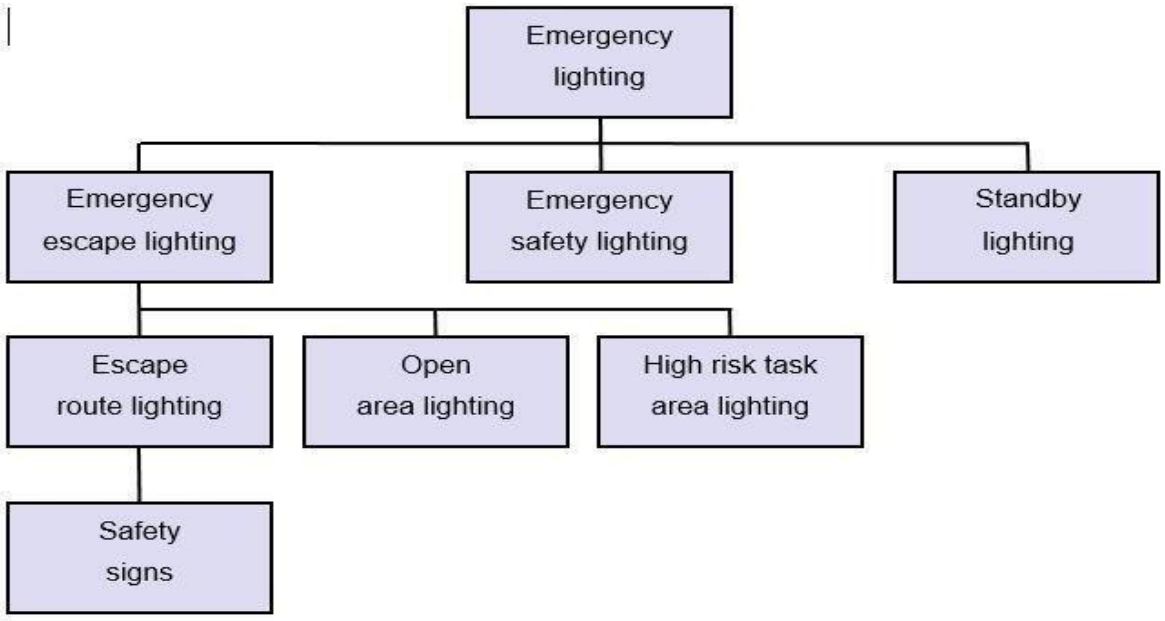

Fig. 1 Types of Emergency Lighting

5.1 Emergency Escape Lighting

Emergency escape lighting provides illumination of escape routes, signs and points of emphasis to assist occupants in evacuating a building in a safe manner.

5.1.1 *Escape Route Lighting* — An escape route is a clearly defined route provided for the safe evacuation of occupants in an emergency to a place of safety. The lighting of such routes is specified in terms of minimum illuminances on the floor, illuminance diversity, glare limits, response times, duration and light source colour rendering. The specific criteria are as follows:

a) *Minimum illuminance* — 1 lux along the centre line for escape routes up to 2 m in width;
0.5 lux along the centre band of the route, consisting of at least 50 percent of the route width. For wider escape routes, these may be considered as a number of 2 m wide strips or are treated as open area lighting.

b) *Illuminance diversity* — maximum/minimum illuminance on the centre line < 40.

c) *Maximum luminaire luminous intensity for level routes* — see values in Table 1 below; these apply in all directions for angles between 60 and 90 degrees from the downward vertical.

d) *Maximum luminaire luminous intensity for non-level routes* — see values in Table 1 below; these apply for all directions and angles.

e) *Maximum response time*: 50 percent of required illuminance within 5 seconds

of supply failing and 100 percent of required illuminance within 60 seconds.

f) *Minimum duration* — 1 hour if premises are evacuated immediately upon supply failure and not reoccupied until batteries are fully recharged, otherwise 3 hours.

g) *Minimum light source general colour rendering index* — CRI > 70.

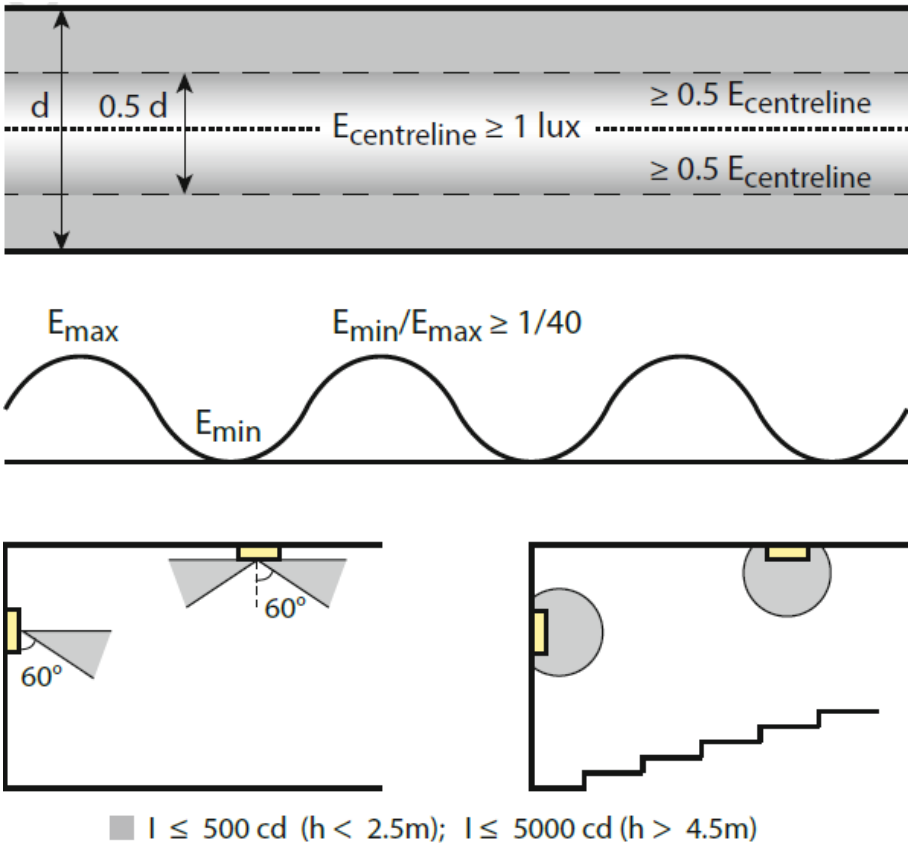

Fig. 2 Illustrates the Escape-Route Lighting Requirements for Routes up to 2 M in Width

Fig. 2 Illustrates Escape-route lighting requirements for routes up to 2 m in width. Top: illuminance levels; middle: illuminance diversity; bottom: zones in which luminous intensities have to be limited to restrict disability glare. Values are based on EN 1838: 2013.

5.1.2 *Open Area Lighting*

An open area is defined as a room with a floor area greater than 60 sq.m or a room that has been deemed as requiring emergency lighting via risk assessment; for example, an inner room that forms part of the escape route or an underground or windowless room. Signage defining access to escape routes should be visible from all points within an open area. The lighting requirements for open areas are as follows:

a) *Minimum illuminance* — on the empty floor, excluding a 0.5 m wide perimeter

band:
0.5 lux.

b) *Illuminance diversity* — maximum/minimum illuminance on the empty floor < 40.

c) *Maximum luminaire luminous intensity* — see values in Table 2 below. These values apply in all directions for angles in the zone 60 to 90 degrees from downward vertical.

d) *Maximum response time* — 50% of required illuminance within 5 seconds of supply failing and 100% of required illuminance within 60 seconds.

e) *Minimum duration* — 1 hour if premises are evacuated immediately upon supply failure and not reoccupied until batteries are fully recharged, otherwise 3 hours.

f) *Minimum light source general colour rendering index* — CRI > 70.

5.1.3 *High-Risk Task Area Lighting*

A high-risk task area is defined as one where a hazardous activity occurs that has to be made safe or terminated before leaving or where people passing by may be exposed to the hazard,
e.g. cooking, moving machinery. The presence of a high-risk task area should be revealed by the mandatory risk assessment required by the applicable fire safety regulations.

The lighting requirements for high-risk task areas are as follows:

a) *Minimum illuminance* — 10% of the required maintained illuminance on the reference plane for the task or the illuminance level determined by risk assessment if higher, but at least 15 lx and free from any stroboscopic effects that could create a hazard.

b) *Minimum/average illuminance uniformity* — on the reference plane for the task > 0.1.

c) *Maximum luminaire luminous intensity* —see values in Table 1. These values apply in the zone 60 to 90 degrees from downward vertical.

d) *Maximum response time* — 100% of minimum illuminance within 0.5 seconds of supply failing.

e) *Minimum duration* — period for which the risk exists to people.
f) *Minimum light source general colour rendering index* — CRI > 70.

Table 2 Disability Glare Limits
(*Clause* 5.1.3)

Sl. No.	Mounting Height Above Floor (m)	Maximum Luminous Intensity for Escape Route and Open Area Lighting (cd)	Maximum Luminous Intensity for High Risk Task Area Lighting (cd)
(1)	(2)	(3)	(4)
i)	$h < 2.5$	500	1000
ii)	$2.5 > h < 3.0$	900	1800
iii)	$3.0 > h < 3.5$	1600	3200
iv)	$3.5 > h < 4.0$	2500	5000
v)	$4.0 > h < 4.5$	3500	7000
vi)	$h \geq 4.5$	5000	10 000

5.1.4 *Safety Signs*— Safety signs must be visible at all times when the premises are occupied to indicate safety equipment locations and safe routes to leave a building, whether the main lighting is working or not.

Safety signs include escape route and exit signs, fire safety notices and any other safety-related signs identified by risk assessment and that need to be conspicuous and legible whenever the premises are occupied.

Normal exit sign should be illuminated at all times when the building is in use and should also remain so when the normal supply fails.

Where direct sight of an exit is not possible, a directional sign or series of signs should be provided which should be so placed that a person following them will be guided towards the nearest suitable exit, which may be either the normal exit or emergency exit. The directional signs should be illuminated when corresponding exit signs are illuminated.

For new installations, the best advice is to use internally illuminated emergency sign luminaires with the minimum number of sign formats as given in Fig. 3 to avoid confusion. Almost all escape route scenarios can be clearly indicated with the basic ISO 7010 pictogram signs conveying the messages ‘straight on’, ‘go left’, ‘go right’.

Go Left **Go Straight on or up** **Go Right**

Fig. 3 Emergency Safety Signs

In the event of failure of the supply to the normal lighting, escape route sign should receive the power needed for illumination from the self-contained emergency lighting supply.

All signs used for the escape route indication should bear an appropriate pictograph in accordance with the local regulations. When no local regulations are in force in this respect, it is recommended that the signs as per figures including the colour as given in IS 9457 are used. Some of these are shown in Fig. 4.

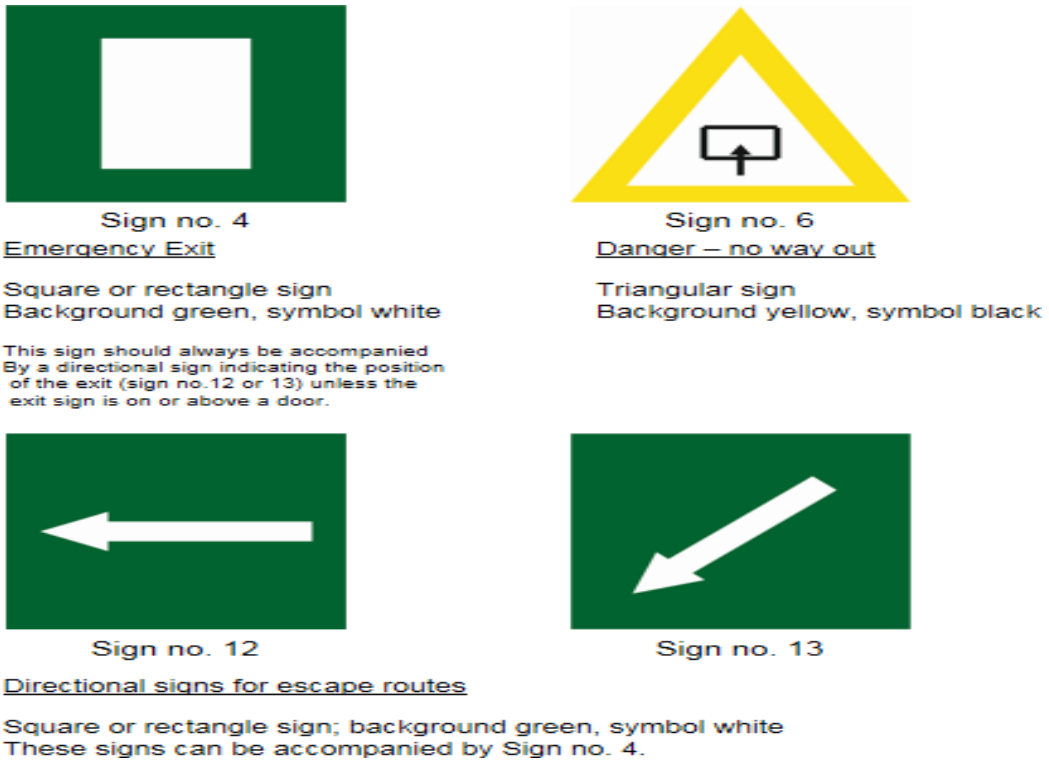

Fig. 4 Signs for the Escape Route Indication

5.1.4.1 *Visual impact and legibility of signs*

Visual impact and legibility are dependent upon size, viewing distance, positioning, contrast and luminance.

The size of pictograph in an exit or emergency exit sign should be least 1/300 of the maximum distance from which the sign is expected to be viewed.

The contrast between illuminated face of a sign and the background against which a sign will be viewed in times of emergency, should be sufficient to make the sign easy to see but not so great as to produce disability glare. The contrast contained within the pictograph must be such as to make its message instantly clear when illuminated during times of emergency. Effective contrast in either case may be in brightness and/or in colour.

5.1.4.2 *Technical requirements for safety signs*

a) The lowest luminance present in the pictograph should be at least 2 cd/m².

b) The luminance ratio within either the contrast colour white or the safety colour green, shall be the minimum luminance divided by the maximum luminance and shall be greater than 0.2.

c) The ratio of the luminance contrast to the luminance safety colour shall be not less than 5:1 and not greater than 15:1.

d) Signs shall be illuminated to at least 50 percent of the required luminance within less than 1 second and full required luminance within 60 seconds

In order to give the signs maximum visual impact, they should be placed perpendicular to the line of sight of persons using the escape route.
For non-internally illuminated signs, that includes phosphoresce signs, in the emergency mode – these should be illuminated by an emergency luminaire to 5 lux vertical illuminance; and in the mains healthy mode – illuminated by the mains luminaires to 100 lux vertical illuminance.

5.1.5 *Points of emphasis* —In addition to providing illumination and signage for escape routes, open areas and high-risk task areas, emergency escape lighting luminaires should also be positioned at or within a 2 - metre horizontal distance of any points that present an increased hazard on the escape route or that require particular highlighting.

The most critical Points of emphasis are defined are given below:

a) Any Exit doors intended for use in an emergency.
b) Each flight of stairs or any other change in level.
c) Each change of direction and intersection of corridors.
d) Any safety signs including escape route signs that need to be externally illuminated.
e) Fire-fighting equipment and first aid points.
f) Areas where escape equipment is provided for disabled people.
g) Refuge and call points, including two-way communication systems and disabled toilet call points, including two-way communication systems.
h) Disabled toilet alarm call points.
i) Manual release points for electronically locked doors.
j) Safety signs that are part of the emergency plan.
k) Outside the final exit at a place of safety.

NOTE — first-aid boxes and fire-fighting equipment points must have emergency lighting providing a vertical illuminance of at least 5 lux.

5.1.6 *Non-Residential Premises Used for Recreation*

For premises such as theatres, cinemas and restaurants, the recommendations for emergency escape lighting are modified to allow for typical use of the building. It is often necessary for such premises that the normal lighting be dimmed or turned off, and in these circumstances a maintained system should be installed.

For cinema and theatre auditoria, where the recommended maintained illuminance level could affect normal working, a reduced maintained level of 0.02 lx is acceptable provided required emergency illuminance levels are restored within 5 seconds of a failure in supply to the normal lighting.

For areas with fixed seating, the recommendations for open area lighting apply except that the acceptable minimum illuminance for the emergency lighting level is reduced to 0.1 lx on a plane 1 m above the floor, taking into account the fact that seating rows tend to direct people to adjacent gangways for which the recommendations for escape routes apply.

5.2 Emergency Safety Lighting

If the risk assessment of the premises allows occupants to remain in the building in the event of a failure of the normal lighting supply, then additional measures to those specified for emergency escape lighting, may be applied.

Minimum illuminance within any areas that occupants remain or move in this case: 1 lx.

However, a risk assessment should consider whether higher illuminance levels may be necessary, for example, to ensure the safe movement of people within the building or to allow for people with visual impairments.

When the emergency plan includes a 'stay put' strategy, it should clearly outline any subsequent actions necessary to maintain safety. For instance, it should specify procedures for initiating an evacuation if a power supply failure persists to the extent that only one hour of emergency battery power remains.

5.3 Standby Lighting

Standby lighting is, by definition that lighting provided to enable normal activities to continue, should the supply to the normal lighting fail. The quantity and quality of the standby lighting must, therefore, satisfy the minimum requirements of the various activities concerned. Standby lighting is often provided by some or all of the normal luminaires. It is recommended that the illuminance should not be less than 10 per cent of that normally recommended for the activity concerned, or such higher value as may be needed to satisfy special requirements. The interruption time in switching from normal to standby lighting is a matter of economic consideration**.** The response time for standby lighting should not exceed 0.5s.

An example of such a location would be an operating theatre in a hospital. The system should provide adequate illumination for the visual tasks as recommended in the concerned sections of this code.

If standby lighting is used for escape lighting, then the escape lighting part should be segregated from the rest of the system and should conform to the rules applied to emergency lighting systems.

5.4 Design Approaches

a) Emergency lighting should be considered as an integrated part of the building lighting. Unless this is done, there is a risk that the normal lighting and the emergency lighting will clash in function and will lead to the detriment of the whole scheme.

b) Emergency lighting can be provided either by self-contained units or a centrally powered system using batteries or a motor-generator set. A self-contained unit contains its own power source and can be a stand-alone luminaire or an emergency version of the normal lighting luminaires.

c) Central systems provide power to the emergency light source via separate, protected wiring to slave luminaires.

d) For small buildings, the most economical solution is self-contained units, with centrally supplied systems tending to be specified for larger buildings such as office blocks, factories and shopping centres.

e) The balance of costs between the two types of system is related to the equipment cost, installation cost and maintenance costs. Recent advancements in the technologies associated with emergency lighting tend to even out the cost differences between the two types of system regardless of installation size.

The technology factors influencing this trend include:

a) widespread adoption of LED, allowing improved reliability and system efficiencies with consequent reduction in battery capacities

b) improved reliability and operating lifetime of batteries, increased adoption of automatic testing as recommended by relevant standard.

c) utilisation of standardised communication protocols (e.g. DALI (digital addressable lighting interface)), allowing the remote monitoring of automatically tested self- contained luminaires

d) greater availability of cost-effective LED luminaires suitable for use with centrally powered inverter systems (e.g. DALI-dimmable LED drivers).

Together, these factors have provided significant improvements in the overall safety and reliability of emergency lighting systems whilst allowing reductions in system component and maintenance costs.

6 LIGHT SOURCES

To be suitable for use in emergency lighting luminaires, light sources need to have fast runup and restrike times, and preferably a long life.

Light emitting diodes (LEDs) are now the most widely used light source in emergency lighting. Their small footprint, high efficacy and long life have revolutionised the way emergency

lighting is designed and operated. Small form factors coupled with the availability of high lumen packages provide a highly efficient and reliable light source suited to the requirements of emergency lighting, particularly when combined with appropriate optics.

Fluorescent lamps, in either linear or compact form, continue to be used in many emergency lighting schemes. Lamps may be run with hot or cold cathodes, hot cathode provide advantages in cycle life and starting reliability. Lamps with internal starters should not be used.

6.1 Unpowered Light Sources

There are two forms of safety sign that do not require any power to be delivered. One uses radioactive tritium as a light source.

a) Tritium powered signs give a low light output but can be useful in locations where flammable or explosive atmosphere is present.

b) A risk assessment should be undertaken to ensure that their output is adequate at the location where they are intended to be used.

c) Special care must be taken during disposal of these devices as they are radioactive and there are legal obligations for their safe handling and storage.

The other uses the phenomenon of photo-luminescence to provide light.

a) For this to work, the sign has to be well illuminated prior to the emergency. In the event of mains failure, a chemical reaction, created by the previous illumination, causes the sign to emit light at a low level, considerably less than the signage requirements of standard,

b) However, they are useful to provide additional information and are required for emergency lighting on ships.

c) Low-mounted way guidance systems may be used in addition to the required emergency lighting.

6.2 Luminaires

There are two basic types of emergency lighting luminaires: self-contained and slave. These should both conform to relevant product standards

6.2.1 *Self-Contained Luminaires*

Self-contained emergency luminaires contain a battery to provide power and may be of three main types: maintained, non-maintained or combined.

a) A maintained luminaire is one in which all the emergency lighting light sources are operating when the normal lighting is on and when there is a failure of the mains electricity supply.

b) A non-maintained luminaire is one in which all the emergency lighting light sources are in operation only when the electricity supply to the normal lighting fails.
c) A combined (or sustained) luminaire is one containing at least two light sources, one of which is energized from the normal lighting supply and the other from the emergency lighting supply.

Self-contained luminaires may be dedicated or may be converted from normal luminaires by adding an emergency conversion unit. When carrying out a conversion, it is essential that the modified luminaire complies with all relevant standards; for example, to ensure that the temperature limits of components, particularly batteries, are not exceeded. If the work is not carried out by the original equipment manufacturer, the person who does it must have relevant training and experience.

6.2.2 *Slave Luminaires*

Slave luminaires are normal luminaires that have mains-voltage operating components or have components intended only for emergency use, and have a power feed from a central emergency power source. Special care must be taken over the loop-in and loop-out of supply wiring using joint glands so that fire will not damage the feed cables in the luminaire. Alternatively, the luminaires can be powered through a spur from a protected ring circuit.

Slave luminaires may be designed to operate from either AC or DC power supplies. For an AC supply, the luminaire is normally AC, but may be DC with internal rectifiers. Supply voltage in emergency mode may not be the same as that in mains mode. If the luminaires are maintained, a changeover relay will be needed. For a DC supply, the luminaires may be DC or fitted with an inverter to operate on AC.

Again, if they are maintained, a changeover relay will be required. In both cases, the designer must be clear as to the lumen output available from the luminaires in emergency mode.

6.2.3 *Luminaire Classification*

Table 3 shows the emergency lighting luminaire classification system. Emergency luminaires must be marked with the resulting code, which identifies the type of system, mode of operation, facilities and, for self-contained luminaires, the rated duration.

Table 3 Recommended Illuminance for Specific Locations
(*Clause* **6.2.3**)

Sl. No	**Location**	**Response Time** (s)	**Illuminance** (lux)	**Duration** (min)	**Reference Plane**
(1)	(2)	(3)	(4)	(5)	(6)
i)	Kitchens	0.5	15	30	Horizontal on working plane, switches and cut-out visible
ii)	First aid rooms	5	15	30	Horizontal on working plane

iii)	Treatments rooms	0.5	50	30	Horizontal on working plane
iv)	Refuges	5	5	Full rated*	Horizontal on floor, Vertical at wall–mounted communication devices and signs
v)	Plant rooms including emergency operation control for lifts	5	15	Full rated*	In planes(s) of visual task
vi)	Fire alarm panel	5	15	Full rated*	In plane of visual task
vii)	Reception areas	5	15	Full rated*	In plane of visual task
viii)	Panic bars and security devices	5	5	Full rated*	In plane(s) of visual task
ix)	Swimming pool surrounds, swimming areas and diving areas	0.5	5	Full rated*	Horizontal on floor and treats

NOTE — *Rated duration of the emergency lighting for the associated area or building

7 EMERGENCY LIGHTING EQUIPMENT

7.1 Power Sources

7.1.1 *Self-Contained Luminaires*

a) Self-contained luminaires have a secondary sealed battery, a charger (control unit), circuitry (which monitors the mains supply) and a light source. In the mains-healthy condition, the battery is charged. In the event of a failure of the mains supply, the battery supplies the light source via an inverter or drive circuit. The battery is commonly a sealed rechargeable nickel cadmium or nickel-metal hydride type conforming to its respective performance requirements of relevant standards.

b) Other battery types may also be used provided they conform to their relevant performance and safety standards as well as the specific requirements like standardised temperature classifications, charge and discharge current limits, and a requirement that the battery allows the luminaire to meet its rated duration for a minimum service life of four years. Where lithium–ion batteries are used, these are generally limited to the more stable chemistry types such as lithium–ion phosphate (LiFePO4).

c) Precautions must also be applied in the transport and disposal of batteries, for which significant differences in associated costs between the various battery chemistries can also apply.

7.1.2 *Central Battery Systems* — Central battery systems consist of a remotely located power source connected by protected wiring to slave luminaires. The batteries consist of either vented or sealed lead-acid or nickel cadmium alkaline cells. These have high storage capacity, long life and a wide operating voltage range. Batteries used for central battery systems must conform to relevant standards.

In addition to the battery, the system includes sub-circuit monitoring of the supply to normal lighting, and an automatic change-over device to connect the slave luminaires to the power supply when the mains supply fails.

There are three main types of systems:

a) *AC/DC battery powered systems* — these systems supply direct current from the battery to the emergency slave luminaires, normally at 24, 50 or 110 V. If a maintained system is required, this is normally achieved by using a transformer to provide the appropriate output voltage in the supply healthy condition.

Special or modified luminaires have to be used to be compatible with both AC and DC supplies over the range of output voltages and the effects of supply-cable voltage drop. These luminaires normally provide higher light outputs than are available from self- contained luminaires.

b) *AC/AC battery powered systems* — these modify the output from the battery by using an inverter to create 230/240 V AC. These systems can operate any suitable normal luminaires, which do not need to be modified, and so they can provide full light output in the emergency condition.

The power unit has to be matched to the emergency load and be capable of supplying both the total wattage and VA rating of the load and also of providing the full starting surge of the luminaires.
Static inverters designed for the application should be compatible with the luminaire characteristics but caution should be exercised, if a system using a general-purpose uninterruptible power supply unit is being designed.

c) *Uninterruptible power supplies (UPS)* — these are a form of AC inverter that continue to provide their output without a break during a supply failure, enabling them to be used with discharge lamps that otherwise would have unacceptably long re-strike times. Because these inverters are normally used for computer back-up, care must be taken to ensure they are correctly engineered for emergency lighting use.
The UPS must comply with the requirements of the various relevant standards. The charger must be capable of recharging the battery to 80 percent of capacity within 12 hours. The battery must be designed for a 10-year design life (lower life batteries exhibit a sudden failure mode, which will not be picked up by the emergency lighting testing procedures). The output must be capable in the emergency condition of clearing all distribution protection devices and fuses (normally a UPS unit drops to zero voltage when sensing a distribution short circuit).

It is important to clear the protection device and re-supply those parts of the building that do not have a fault. The inverter must be capable of starting the load from the battery in an emergency. The system monitors, as per standard, should be supplied.

7.1.3 *Generators* — The main components of a generator system are a prime mover driving an alternator, fuel tanks, operating controls, and starter batteries or flywheel drive. The generator has to be able to start automatically and to provide the power for the load within 5 seconds as per relevant standard. As with all central systems, the distribution wiring must be fire protected and the final normal lighting circuit must be monitored such that emergency luminaires are automatically activated if the local circuit fails. As compliance with the safety requirements for the whole generator system may be arduous, it may be preferable to provide one-hour-duration battery-powered luminaires in addition to the generator set. Testing of generators should be in accordance with the manufacturer's instructions.

NOTE — As the Emergency Lighting is meant for only Emergency purpose, selection criteria of Emergency Lighting Products and systems verses the use of appropriate Power supply shall be the

responsibility of the concerned group of people designing and implementing the Emergency Lighting.

7.2 Circuits

Electrical circuits and cabling for emergency lighting shall be according to emergency lighting system selected and the associated standards.

Cabling provided solely for emergency lighting purposes shall be clearly identified as such and labelled accordingly. It is desirable to include some form of sensing to prove the integrity of the emergency lighting circuits.

8 ELECTROMAGNETIC COMPATIBILITY (EMC)

It is important that the overall design of emergency lighting systems are EMC-compliant, as many of the components used in these systems, although individually suitable, may interact in such a way as to generate electrical interference. Verification should be sought from the equipment manufacturers and systems integrators that EMC issues have been considered properly. This is particularly important when attempting to convert conventional luminaires to emergency lighting luminaires with an ‘emergency pack’.

9 PROTECTION

Cabling, changeover relays and luminaires should be resistant to interference from transient over-voltages caused by supply surges and by switching (changeover). Protection should be provided that ensures safe operation of the emergency lighting under transient conditions, as well as protecting the equipment itself from damage. Surge-protection devices should be self- resetting and not render the emergency lighting inoperative.

10 INTERACTIONS

Where a Building Management System (BMS) is employed, it is essential that any failure of this does not adversely affect the emergency lighting, for example by incorrectly switching maintained luminaires.

A BMS system failure should not be seen by the emergency lighting system hold-off relays as a general lighting power-supply failure.

The increased use of lighting controls has seen a greater integration of emergency lighting monitoring and testing as part of overall lighting control and management systems. Depending on the type of emergency system selected, additional care must be taken to ensure the emergency lighting is capable of operating independently from the control system, thus in the event of a power failure allowing the emergency lighting to default to emergency operation condition.

Systems utilizing a communication interface such as DALI (Digital Addressable Lighting Interface) must be configured such that emergency luminaires default to a safe ‘system failure level’ upon a power failure, including where supply may be lost to system controls. Luminaires used on central systems must also default to a defined output, and it must be ensured that any dimming system is overridden under alarm conditions.

11 SCHEME PLANNING

11.1 Risk Assessment

The first step in planning an emergency lighting installation is to carry out a fire risk assessment according to the type of premises. In workplaces where five or more people are employed, such an assessment is a legal requirement. A fire risk assessment requires working through the following steps:

a) Identify potential fire hazards in the workplace i.e. sources of ignition, fuels, work processes etc.

b) Identify the location of people at significant risk in case of fire i.e. who might be in danger (employees, visitors) and why?

c) Evaluate the risks i.e. Adequacy of safety measures, fire detection, warning, means of fighting fire, means of escape, fire safety training of employees, maintenance and testing of fire precautions etc.

d) Carry out improvements.

e) Record findings and actions taken i.e. prepare emergency plans, inform, instruct and train employees.

f) Keep assessment under review and revise it when situation changes.

11.2 Planning Sequence

Given that the risk assessment reveals a need for emergency lighting, it is then necessary to identify the lighting requirements that have to be met, the type of system to be used, mode of operation and aspects such as duration and photometric performance.

11.2.1 *Mode of Operation*

a) Maintained luminaires should be specified for exit signs where occupants may be unfamiliar with the premises in areas, where failure of an individual luminaire affecting the normal lighting could lead to a hazardous situations, for non-residential premises used for recreation (e.g. cinemas, theatres) where the normal lighting might be dimmed or turned off.

b) Where emergency illumination only needs to be provided upon failure of the mains supply, non-maintained luminaires may be specified.

11.2.2 *Duration*

a) Factors to be taken into account when specifying the duration of the system include the size and complexity of the premises, its intended use, and whether occupants may be unfamiliar with its layout for each application class.

b) A minimum duration of one hour should only be specified if the premises are evacuated immediately in the event of a supply failure and are not reoccupied

until the batteries have fully recharged following re-establishment of the supply. Owing to these restrictions, the application of 1-hour rated systems is uncommon in practice.

c) A minimum duration of three hours should be specified where occupants might be unfamiliar with the building layout or where emergency safety lighting is being deployed.

d) For premises that are not expected to be evacuated immediately upon a supply failure, such as sleeping accommodation or places of entertainment, or where reoccupation is expected to take place as soon as the supply is restored, a minimum duration of three hours should be specified.

11.2.3 *Photometric Compliance* — Manufacturers of emergency luminaires must provide intensity distribution data to enable system designers to calculate the photometric parameters of the emergency lighting installation.

When authenticated, these data can be used

a) to confirm photometric compliance of the system

b) to design procedures as required

c) to compare on-site photometric measurements, with that of design data though it is complex to set up and time consuming.

11.3 Installation, Testing and Maintenance

The success of an emergency lighting system depends not only on the design, planning and selection of the right equipment but also on the satisfactory installation and maintenance of the equipment throughout its service life. Systems should be installed with appropriate test facilities for the application and testing must be able to be conducted without risk to occupants of the premises either at the time of the test or during the recharge period afterwards.

11.3.1 *Installation* — The emergency lighting system shall be installed as instructed by the designer of the scheme and in accordance with the equipment manufacturer's instructions. The designer usually provides a schedule of installation, including scheme plans and wiring/piping drawings in which the location of equipment, placing of protection devices and the choice and routing of wiring/piping are set out. The schedule or drawings may also give the sequence of fixing and connections, particularly of complex systems. All such schedules and drawings should be added to the log book on completion of the installation. These should be updated with information of all scheme modifications made during the life of the installation.

11.3.2 *Maintenance and Inspection* — Maintenance and inspection of the installation shall be done regularly. The designer shall provide a maintenance schedule that should list and give details of replacement components such as lamp type, battery, fuses, cleaning and topping-up fluids.

Inspection and testing of various aspects of emergency lighting should be carried out daily, monthly and yearly.

Luminaires and safety signs should be cleaned at regular intervals that may coincide with the time of inspection. The cleaning interval is dependent on the environment around the installation.

The charging supply to central battery systems should be checked daily, along with monitoring the progress on rectifying any faults recorded in the logbook.

A short functional test should be performed at least monthly, by simulating a failure of the normal lighting power supply, to verify that all emergency luminaires are operating a full duration test of all systems should be performed at least yearly to verify that the emergency lighting provides its design output for the full design duration. The duration test should be arranged to occur at a point in time where the time needed to recharge batteries has the least impact on the occupation of the building.

Records should be kept of all the tests made and of the results obtained

It is advisable that an automatic test system is used in all installations to ensure compliance and documentation.

11.3.3 *Documentation* — Given the extensive regulatory framework associated with emergency lighting, good documentation of the installation is essential.
The documentation shall include the completion certificate, initial inspection certificate and periodic test and inspection log.

11.4 Commissioning and Certification

11.4.1 *Electrical Testing* — A full electrical test shall be carried out in accordance with relevant standard when commissioning an emergency lighting installation.

For self-contained systems, an electrical test should be carried out to ascertain that all luminaires are working in the correct manner, i.e. maintained, non-maintained and, where appropriate, combined. It should be verified that the battery-charging supply is present and indicated, and that the luminaires operate in emergency mode on simulation of a general supply failure. After initial commissioning, and allowing for a full charge of all batteries, a duration test should be performed to confirm that the system will perform for the designed duration. It should be confirmed that all luminaires reset to normal or standby mode as appropriate after the restoration of the normal supply. Where additional controls such as switched–maintained, inhibiting or rest mode facilities are fitted, it shall be verified that these operate in the correct manner.

For central battery or generator systems, the system should be tested in normal and emergency modes to determine the correct changeover of luminaires and full functionality in emergency mode. With central systems, it is essential that a duration test is carried out. It should be confirmed that all luminaires and off-line battery units reset to normal or standby mode, as appropriate, after the restoration of the normal supply.

Where self-testing and remote testing systems are included, the system should be set up and tested for functioning in accordance with the supplier's instructions. A copy of these instructions should be placed with the log book.

11.4.2 *Photometric Measurements* — On-site photometric measurements shall be made to allow confirmation of illuminance levels by calculation. On-site performance testing of emergency lighting installations requires good instrumentation and well laid out plans for the measurement conditions.

Any illuminance meter used should have a photocell with good cosine incident light correction. An illuminated-dial or digital-display type meter should be used so that readings may be visible at low illuminances. The light meter should have an operating range of 0.01 lx to 100 lx with a sensitivity of 0.01 lx for escape routes and areas, and a range of 10 lx to 1000 lx with a sensitivity of 1.0 lx for high-risk areas. The accuracy of the instrument should conform to relevant standard.

The photocell should preferably be on a remote lead to avoid shadowing. The illuminance measurements should be made on a horizontal plane on the escape route area or task area. In most cases it is advisable to select a number of specific areas or points for test that represent the worst conditions. The results of these illuminance measurements can be checked against design data.

Measurements should be taken during the hours of darkness. If there is steady extraneous light from street lighting or moonlight the contribution of the emergency lighting can be estimated by taking the difference between measurements of the same point, with and without emergency lighting.

The illuminances provided by the emergency lighting system will vary with time, so the tests should be completed as quickly as is possible within the rated duration. This will minimize the charge losses from the batteries. This is particularly relevant in an occupied building because, with fully discharged batteries, the building may have reduced emergency lighting cover for up to 24 hours. It is valuable to have data that relate the lumen output of the luminaire at any time to the lamp/battery life cycle

11.4.3 *Completion Certificate* — On completion of design, installation and commissioning of the emergency lighting system, a completion certificate shall be prepared signed by the specified competent persons and supplied to the occupier/owner of the premises as part of the handover.