Ernest Magog
Industry Committee for
Emergency Lighting

Emergency lighting

1 Types of product

The aim of emergency lighting is to enable people to exit quickly, safely and without panic from any location in a building to a place of safety in the event of an emergency involving failure of the normal lighting supply. This is met by providing sufficient illuminance along the escape routes, typically of at least 1 lux, to enable the occupants to use the most direct path and to avoid obstacles and, where necessary, installing illuminated safety signs.

In addition, safety equipment, such as fire alarm call points and extinguishers, must be adequately illuminated so they can be located and used if needed. Specific areas of high risk and any relevant control rooms need a higher level of illumination to enable the processes in these areas to be shut down safely in an emergency.

Emergency systems for a particular application have to be designed to cater for an appropriate duration for the application. This is normally 3 hours for premises that are not to be evacuated immediately in the event of a supply failure. This particularly applies to premises for entertainment, or those with a sleeping risk, such as hotels or hospitals. Systems used in premises that will be evacuated immediately may only require 1 hour of duration, but most operators still use the standard 3-hour units. This avoids having to wait for 24 hours while the batteries recharge before re-entering the building after the mains have been restored.

Some applications, such as theatres, where the normal lighting may be dimmed, require the lamp to be illuminated at all times that the building is occupied. This is called maintained operation. For most sites, non-maintained operation, where the lamp is only illuminated in a supply failure, is acceptable.

There are three main types of emergency lighting product:

a) self-contained dedicated luminaires

These use an integral rechargeable battery to store power, which in an emergency supplies the lamp. The lamp is typically a low wattage fluorescent with an output of 100 to 200 lumens. In addition to fittings designed for interior use in corridors, specialised luminaires are available for vandal-resistant, weatherproof and exit sign applications.

b) emergency variant of normal lighting

For aesthetic reasons, it is becoming increasingly popular to use an emergency variant of the normal lighting. In these fittings, a charger, changeover device and inverter are located in the luminaire, together with a rechargeable battery. In the event of a supply failure, the emergency circuit connects the stored power to one of the normal mains lamps. It then continues to provide illumination, normally at 200 to 300 lumens, which is a lower level than when supplied from the mains.

This form of product can either be supplied as an option by the manufacturer of the mains lighting, or fitted by specialist installers, who should conduct the modification in accordance with the Industry Committee for Emergency Lighting (ICEL) standard, ICEL 1004: *The modification of normal luminaires for emergency use.* Compliance with this standard is important to ensure that, when the fitting has been converted, the components are all kept within their rated temperature limits and that European legislative requirements for electromagnetic compatibility and CE marking are observed.

c) central power systems

For larger buildings, particularly those with large open areas, central power systems are often used. In these products, a single large battery supplies a considerable number of remote, or slave, luminaires. In the past, most of these systems used a DC output from the battery feeding luminaries, fitted with integral inverters, but now it is also common to convert the battery output to AC at source and then distribute a 230V AC supply to selected normal fluorescent lighting luminaires. These luminaires can then be operated at full light output from the central power system.

Batteries

Batteries normally employ recombination techniques, which use the oxygen and hydrogen gases evolved during charging and combine them, to replace the electrolyte they were generated from. This principle has removed the need for topping up the small nickel cadmium cells (used in self-contained systems) or the large lead acid cells (available for central systems).

To keep batteries within the capabilities of their recombination technology, charge conditions have to be carefully controlled. This ensures that they will meet their recharge duties, while remaining below their limit for gas recombination. If the current is exceeded, or the cell temperature is too hot, gas pressure will build up and eventually vent outside the housing, resulting in a loss of cell capacity. Larger lead acid cells use constant voltage chargers with a fixed current limit. These charge the cells safely and automatically balance the charge to compensate for cells' open circuits and aging losses.

Inverters convert the DC stored energy from the battery via high frequency switching circuits to produce AC. In self-contained systems, the battery voltage is normally 2.4 or 3.6V. The inverter operates at typically 40 to 50kHz and is transformed up to a suitable voltage to directly run the lamp. Central inverters have much higher battery voltage and are controlled to maintain the same voltage output and frequency as the normal lighting supply, thus enabling some of the same luminaires to be used as for normal lighting. However, the circuit protection and output waveform of these central inverters must be specifically designed for emergency lighting applications.

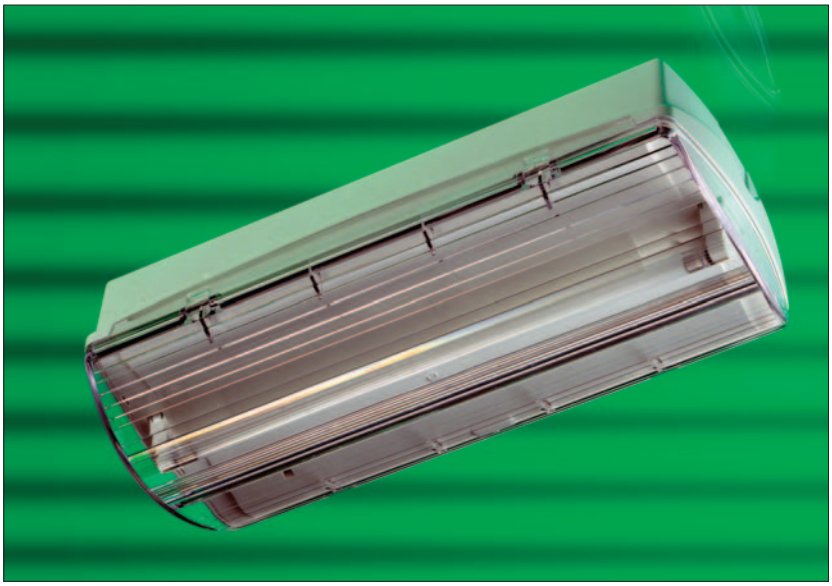
System benefits

Dedicated self-contained luminaires are readily available and can easily be fitted to new or existing buildings. They are provided with full design data, with maximum spacing between fittings, tabulated to meet industry recommendations. Their light output is quite low and, while ideal for corridors of escape routes, considerable numbers will be needed for open areas. These can prove expensive to buy, install and maintain. Batteries should last for at least four years, and considerably longer for non-maintained fittings.

Conversions of normal mains fittings can be more aesthetically satisfactory than using dedicated luminaries, and their slightly higher output may mean fewer fittings are needed. Use of this technique depends on the normal luminaires being suitable for conversion. Improper conversion can result in early operational failures.

Central battery systems can provide higher levels of illumination, so fewer fittings may be needed. Batteries are available of five, 10 or even 25 year life. They can be replaced from a single location with a minimum amount of disruption to the site.

The central battery system has to be accommodated in the building in a suitable space and the cable connections to the emergency luminaires must be of fire-protected cable, making the initial purchase and installation relatively expensive.



Cooper Lighting and Security

2 Design and installation issues

Product specifications should ensure that the safety of designs is maintained. Dedicated self-contained fittings should comply with standards, such as BS 5266-1: 1999: *Emergency lighting. Code of practice for the emergency lighting of premises other than cinemas and certain other specified premises used for entertainment* and ICEL 1004. ICEL-registered products provide third-party verification of the photometric spacing tables.

Converted luminaires should use circuits approved by a national test house to the control gear specification and should have been modified in accordance with ICEL 1004. Design of these luminaires is normally based on the circuit ballast factor de-rated for the effect of battery end-of-life discharge and aging. This data is then used, together with the luminaire distribution – obtained either from a computer-based calculation package or by calculation from basic principles.

Emergency lighting design should always be conducted using zero factors for reflectance, since during the life of the emergency system, the décor could change significantly. In addition, lighting designs must be recalculated on this confirmed data from the converted luminaire, since the original manufacturer's data will be different and there is a risk the systems will not meet the illumination levels required for the installation.

Central power systems require the input of specialist engineers to ensure component and load compatibility. The most important information required is the quantity, wattage and volt/amp rating of the load luminaires.

3 Maintenance and inspection

When initially commissioned, the full operating regime of the system should be checked. BS 5266 provides a list of the items that should be covered at this stage – for instance, ensuring that non-maintained luminaires are controlled from the local lighting final circuit.

Once these checks have been made, routine inspections should include monthly functional checks to ensure that the luminaires operate, and an annual full-rated battery discharge test. In addition, a physical inspection should be conducted regularly to look for instances of damage to the equipment or changes in the layout of the building that would result in the emergency illumination becoming less effective.

Any faults identified by routine testing must be recorded in the test log and rectified. While the system is known to be performing unsatisfactorily, the risks should be evaluated and additional precautions taken if necessary.

Routine maintenance consists of cleaning the diffusers and changing any lamps that show excessive tube-end blackening. Battery replacement should only normally be undertaken if the luminaires fail to provide their rated discharge duration but central system batteries should be inspected in accordance with the manufacturer's instructions. Provided these stages are followed, emergency illumination will enable occupants to locate and use escape routes in the event of fire or failure of the supply.

4 Relevant standards and other documents

BS 5266-1: 1999: *Emergency lighting. Code of practice for the emergency lighting of premises other than cinemas and certain other specified premises used for entertainment*

BS EN 1838/BS 5266-7: 1999: *Lighting applications. Emergency lighting*

BS EN 60598-2-22: *Luminaires. Particular requirements. Luminaires for emergency lighting*

BS EN 60924/5: *Product standard for luminaire circuits*

BS EN 50171: *Central power supply systems*

prEN 50172: *Emergency lighting application standard*

ICEL 1004: *The modification of normal luminaires for emergency use*

Published by *Fire Prevention & Fire Engineers Journal*
Bastille Court, 2 Paris Garden, London SE1 8ND