Selecting And Applying Emergency Lighting Systems

A revision of an article originally published in Electrical Construction & Maintenance by David Crippen, CEO & Marketing Manager

Laws, Codes And Regulations

Although state and local building codes vary, most are generally based upon:

1. The National Electrical Code, NFPA 70, Article 700
2. Life Safety Code, NFPA 101 Section 5–8 through 5–10
3. The Occupational Safety and Health Act (OSHA) which states some general guidelines.

These codes provide complete information about emergency lighting requirements; however, a basic starting point is provided in the NFPA 101, Section 5–9.2.1, which states:

“Emergency illumination shall be provided for a period of 1 1/2 hr in the event of failure of normal lighting. Emergency lighting facilities shall be arranged to provide initial illumination that is at least an average of 1 ft-candle (10 lux) and a minimum at any point of 0.1 ft-candle (1 lux) measured along the path of egress at floor level. Illumination levels shall be permitted to decline to 0.6 ft-candle (6 lux) average and a minimum at any point of .06 ft-candle (0.6 lux) at the end of the emergency lighting time duration. A maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.”

Maintenance Is A Must

These regulations also mandate periodic monitoring of this equipment once it is installed. Emergency operation must be tested at 30-day intervals for a minimum of 30 seconds, and a 90-minute discharge test must be conducted once a year. Additionally, the NFPA requires that records be kept as proof of this maintenance.

Because this emergency equipment is used only on an emergency basis, it is important that this regular maintenance be performed. Like all capital investments, upkeep is vital and provides proof when liability questions arise.

Common sense must be used in planning emergency lighting. The major objective of adequate and reliable emergency lighting is a safe, panic-free exit from an unfamiliar building should the normal power fail.

Just like fire extinguishers, smoke alarms and other life safety equipment, emergency lighting is required in commercial, industrial and institutional buildings for times when emergency situations arise.

This brochure is provided by Bodine to help you understand the technical and legal aspects of emergency lighting so that you can specify it with confidence.

AC power failures occur for a variety of reasons; storms, tornadoes, hurricanes and other extreme weather conditions can affect AC power. Vehicular accidents, fires or equipment failure can also result in power outages.

When this happens, liability concerns are inevitable. Serious accidents or mishaps could occur when occupants are left in total darkness during a power failure. In such instances, the first area of inquiry is often, “Did this building meet code?”
How To Design
Emergency Lighting Systems
Factors To Be Considered

The proximity, shape, and size of exits

The configuration of walls adjoining the exit way, the amount of space devoted to exit passages, and travel distance to exits should be considered when determining the number and placement of emergency lighting units. For example, it is important to place emergency lighting at an intersection of a corridor or hallway. If it is a large area, additional units may be needed to provide adequate light to see any objects blocking the exit path (emergency lighting should be evenly spaced.)

Color and texture of ceiling, floor, wall coverings

Emergency lighting levels are affected by the color and texture of surrounding areas. Light-colored walls and floors with smooth surfaces require less emergency lighting because of their reflective characteristics than darker floors and walls with rough surfaces.

Number of persons expected to occupy a building

The number of people expected to occupy a building and their knowledge of its interior also influences the level of emergency illumination needed. Large numbers of people unfamiliar with exit paths require more emergency lighting than smaller numbers of people who know the surroundings. Consequently, auditoriums, convention halls, and sports arenas often need higher levels of emergency illumination than factories, office buildings, and warehouses.

Intended use of a building

Additional emergency lighting may be required depending on the types of people using a facility. Elementary school children, the elderly, and the handicapped need more emergency lighting than apartment residents, college students, and factory or office workers. Retail situations where valuable merchandise is accessible or high-security facilities may require extra emergency illumination. Adequate lighting can be especially critical in hospital settings such as operating and emergency rooms.
There are several types of emergency lighting including unit equipment (both fluorescent and incandescent), engine–generators, central battery systems utilizing inverters, and separate circuits. Here are some important factors that should be considered when making a selection.

### Unit Equipment

There are two principal types available: fluorescent and incandescent.

#### Fluorescent

Self-contained, fixture-mounted emergency ballasts convert fluorescent fixtures into emergency lights. Each unit consists of battery, charger, inverter, and sensing circuitry. Because they are concealed in or near the fixture, they do not detract from the interior design.

- Light produced is similar to that under normal conditions.
- External and internal power failure can be detected.
- Batteries that do not require maintenance are incorporated.
- Unseen mounting deters vandalism and theft.
- Can be used with a wide variety of fluorescent lamp and AC ballast types.
- Power is not dependent on central distribution system.
- Power usually is limited to 90 minutes.

#### Incandescent

Self-contained, wall or ceiling–mounted unit utilizes sealed-beam or quartz lamps. Each unit consists of a battery, charger, and sensing circuitry.

- External and internal power failure can be detected.
- They can be mounted in almost any location.
- Power is not dependent on a central distribution system.
- Many models use batteries which require routine maintenance.
- Light may be aimed in a direction that produces a blinding glare and dangerous shadows. Also, light may not be directed on the path of egress.
- Detracts from the interior design.
- Wall-mounted units are vulnerable to vandalism and theft.
- Power is usually limited to 90 minutes.

### Engine generators

Emergency power is supplied to specific lighting fixtures by an engine generator when the AC power fails.

- Emergency power can be provided to a large number of fixtures.
- Additional power is available for other functions such as elevators, operating rooms, and life-support systems.
- Operating time is not restricted to the 90 minutes provided by most battery–operated emergency equipment.
- Remote sensing devices are necessary to detect internal partial power failure.
- Several seconds may lapse between power failure and engine start-up.
- Engine and starting battery require routine maintenance.
- Storage of flammable fuel presents hazards.
- Damage to the central distribution system could shut off emergency lighting to any part or all of the building.

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**Chapter 5**

**Means Of Egress**

**Section 5–8**

**Illumination Of Means Of Egress**

5-8.1 General.

5-8.1.1* Illumination of means of egress shall be provided in accordance with this section for every building and structure where required in Chapters 8 through 32. For the purposes of this requirement, exit access shall include only designated stairs, aisles, corridors, ramps, escalators, and passageways leading to an exit. For the purposes of this requirement, exit discharge shall include only designated stairs, aisles, corridors, ramps, escalators, walkways, and exit passageways leading to a public way.

5-8.1.2* Illumination of means of egress shall be continuous during the time that the conditions of occupancy require that the means of egress be available for use. Artificial lighting shall be employed at such places and for such periods of time as required to maintain the illumination to the minimum criteria values herein specified. Exception: Automatic, motion sensor-type lighting switches shall be permitted within the means of egress, provided that switch controllers are equipped for fail-safe operation, illumination timers are set for a minimum of 15 min duration, and the motion sensor is activated by any occupant movement in the area served by the lighting units.

5-8.1.3* The floors and other walking surfaces within an exit and within the portions of the exit access and exit discharge designated by 5-8.1.1 shall be illuminated to values of not less than 1 ft-candle (10 lux) measured at the floor. Exception: In assembly occupancies, the illumination of the floors of exit access shall be not less than 0.2 ft-candle (2 lux) during the periods of performances or projections involving directed light.

5-8.1.4* Any required illumination shall be arranged so that the failure of any single lighting unit shall not leave any area in darkness.

5-8.1.5* The equipment or units installed to meet the requirements of Section 5-10 shall be permitted also to serve the function of illumination of means of egress, provided that all requirements of Section 5-8 for such illumination are met.

5-8.2 Sources of Illumination.

5-8.2.1* Illumination of means of egress shall be from a source of reasonably ensured reliability.

5-8.2.2* Battery-operated electric lights and other types of portable lamps or lanterns shall be used for primary illumination of means of egress. Battery-operated electric lights shall be permitted to be used as an emergency source to the extent permitted under Section 5-9.
Section 5–9 Emergency Lighting

5–9.1 General.

5–9.1.1* Emergency lighting facilities for means of egress shall be provided in accordance with this section for
(a) Every building or structure where required
in Chapters 8 through 32, and
(b) At doors equipped with delayed egress locks, and
(c) The stair shaft and vestibule of smokeproof enclosures.
A standby generator that is installed for the smokeproof enclosure mechanical ventilation equipment shall be permitted to be used for such stair shaft and vestibule power supply.

For the purposes of this requirement, exit access shall include only designated stairs, aisles, corridors, ramps, escalators, and passageways leading to an exit. For the purposes of this requirement, exit discharge shall include only designated stairs, ramps, aisles, walkways, and escalators leading to a public way.

5–9.1.2 Where maintenance of illumination depends upon changing from one energy source to another, there shall be no appreciable interruption of illumination during the changeover. Where emergency lighting is provided by a prime mover-operated electric generator, a delay of not more than 10 sec shall be permitted.

5–9.2 Performance of System.

5–9.2.1* Emergency illumination shall be provided for a period of 1 ½ hr in the event of failure of normal lighting. Emergency lighting facilities shall be arranged to provide initial illumination that is at least an average of 1 ft-candle (10 lux) and a minimum at any point of 0.1 ft-candle (1 lux) measured along the path of egress at floor level. Illumination levels shall be permitted to decline to 0.6 ft-candle (6 lux) average and a minimum of 0.06 ft-candle (0.6 lux) at the end of the emergency lighting time duration. A maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.

5–9.2.2* The emergency lighting system shall be so arranged to provide the required illumination automatically in the event of any interruption of normal lighting, such as any failure of public utility or other outside electrical power supply; opening of a circuit breaker or fuse; or any manual act(s), including accidental opening of a switch controlling normal lighting facilities.

5–9.2.3 Emergency generators providing power to emergency lighting systems shall be installed, tested, and maintained in accordance with NFPA 110, Standard for Emergency and Standby Power Systems. Stored electrical energy systems where required by this Code shall be installed and tested in accordance with NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems.

5–9.2.4* Battery-operated emergency lights shall use only reliable types of rechargeable batteries provided with suitable facilities for maintaining them in properly charged condition. Batteries used in such lights or units shall be approved for their intended use and shall comply with NFPA 70, National Electrical Code®.

5–9.2.5 The emergency lighting system shall be either continuously in operation or shall be capable of repeated automatic operation without manual intervention.

5–9.3 Periodic Testing of Emergency Lighting Equipment. A functional test shall be conducted on every required battery-powered emergency lighting system at 30-day intervals for a minimum of 30 sec. An annual test shall be conducted for a 1 ½-hr duration. Equipment shall be fully operational for the duration of the test. Written records of visual inspections and tests shall be kept by the owner for inspection by the authority having jurisdiction.

Except: Self-testing/self-diagnostic, battery-operated emergency lighting equipment that automatically performs a minimum 30-sec test and diagnostic routine at least once every 30 days and indicates failures by a status indicator shall be exempt from the 30-day functional test, provided a visual inspection is performed at 30-day intervals.

Section 5–10 Marking Of Means Of Egress

5–10.1 General.

5–10.1.1 Means of egress shall be marked in accordance with this section where required in Chapters 8 through 32.

5–10.1.2* Exits shall be marked by an approved sign readily visible from any direction of exit access. Exception: Main exterior exit doors that obviously and clearly are identifiable as exits.
National Electrical Code - NFPA 70 - 1999
Article 700 - Emergency Systems

A. General

700-1. Scope. The provisions of this article apply to the electrical safety of the installation, operation, and maintenance of emergency systems consisting of circuits and equipment intended to supply, distribute, and control electricity for illumination or power, or both, to required facilities when the normal electrical supply or system is interrupted.

Emergency systems are those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination or power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life.

(FPN No 1): For further information regarding wiring and installation of emergency systems in health care facilities, see Article 517.


700-2. Application of Other Articles. Except as modified by this article, all applicable articles of this Code shall apply.

700-3. Equipment Approval. All equipment shall be approved for use on emergency systems.

700-8. Signs.

(a) Emergency Sources. A sign shall be placed at the service entrance equipment indicating type and location of on-site emergency power sources. Exception: A sign shall not be required for individual unit equipment as specified in Section 700-12(e).

B. Sources of Power

700-12. General Requirements. Current supply shall be such that, in the event of failure of the normal power supply to, or within, the building or group of buildings concerned, emergency lighting, emergency power, or both will be available within the time required for the application but not to exceed 10 seconds. The supply system for emergency purposes, in addition to the normal services to the building and meeting the general requirements of this section, shall be one or more of the types of systems described in (a) through (d). Unit equipment in accordance with (e) shall satisfy the applicable requirements of this article.

In selecting an emergency source of power, consideration shall be given to the occupancy and type of service to be rendered, whether of minimum duration, as for evacuation of a theater, or longer duration, as for supplying emergency power and lighting due to an indefinite period of current failure from trouble either inside or outside the building.

Equipment shall be designed and located to minimize the hazards that might cause complete failure due to flooding, fires, icing, and vandalism.

(FPN No 1): For definition of occupancy class, see Section 4-1 of Life Safety Code, NFPA 101-1997.

(FPN No 2): Assignment of degree of reliability of the recognized emergency supply system depends on the careful evaluation of the variables at each particular installation.

(a) Storage Battery. Storage batteries used as a source of power for emergency systems shall be of suitable rating and capacity to supply and maintain the total load for a period of 1½ hours minimum, without the voltage applied to the load falling below 87 ½ percent of normal.

Batteries, whether of the acid or alkali type, shall be designed and constructed to meet the requirements of emergency service and shall be compatible with the charger for that particular installation.

For a sealed battery, the container shall not be required to be transparent. However, for the lead acid battery that requires water additions, transparent or translucent jars shall be furnished. Automotive-type batteries shall not be used.

An automatic battery charging means shall be provided.
(b) Generator Set.

(1) A generator set driven by a prime mover acceptable to the authority having jurisdiction and sized in accordance with Section 700-5. Means shall be provided for automatically starting the prime mover on failure of the normal service and for automatic transfer and operation of all required electrical circuits. A time-delay feature permitting retransfer in case of short-time reestablishment of electrical circuits. A time-delay feature permitting for automatic transfer and operation of all required prime mover on failure of the normal service and shall be provided for automatically starting the

(2) Where internal combustion engines are used as the primary mover, an on-site fuel supply shall be provided with an on-premise fuel supply sufficient for not less than 2 hours full-demand operation of the system. Where power is needed for the operation of the fuel transfer pumps to deliver fuel to a generator set day tank, this pump shall be connected to the emergency power system.

(3) Prime movers shall not be solely dependent upon a public utility gas system for their fuel supply or municipal water supply for their cooling systems. Means shall be provided for automatically transferring from one fuel supply to another where dual supplies are used. 

Exception: Where acceptable to the authority having jurisdiction, the use of other than on-site fuels shall be permitted where there is a low probability of a simultaneous failure of both the off-site fuel delivery systems. Means shall be provided for automatically transferring from one fuel supply to another where dual supplies are used.

(4) Where a storage battery is used for control or signal power, or as the means of starting the prime mover, it shall be suitable for the purpose and shall be equipped with an automatic charging means independent of the generator set. Where the battery charger is required for the operation of the generator set, it shall be connected to the emergency system. Where power is required for the operation of dampers used to ventilate the emergency system. Where power is required for the operation of the battery charger is required for the operation of the generator set, it shall be connected to the emergency power system.

(5) Generator sets that require more than 10 seconds to develop power shall be acceptable, provided an auxiliary power supply will energize the emergency system until the generator can pick up the load.

(c) Uninterruptible Power Supplies. Uninterruptible power supplies used to provide power for emergency systems shall comply with the applicable provisions of Section 700-12(a) and (b).

(d) Separate Service. Where acceptable to the authority having jurisdiction as suitable for use as an emergency source, a second service shall be permitted. This service shall be in accordance with Article 230, with separate service drop or lateral, widely separated electrically and physically from the normal service, to minimize the possibility of simultaneous interruption of supply.

(e) Unit Equipment. Individual unit equipment for emergency illumination shall consist of the following:

(1) A rechargeable battery; (2) A battery charging means; (3) Provisions for one or more lamps mounted on the equipment, or shall be permitted to have terminals for remote lamps, or both; 2 and (4) A relaying device arranged to energize the lamps automatically upon failure of the supply to the unit equipment.

The batteries shall be of suitable rating and capacity to supply and maintain at not less than 87 1/2 percent of the nominal battery voltage for the total lamp load associated with the unit for a period of at least 1½ hours, or the unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1½ hours. Storage batteries, whether of the acid or alkali type, shall be designed and constructed to meet the requirements of emergency service.

Unit equipment shall be permanently fixed in place (i.e., not portable) and shall have all the wiring to each unit installed in accordance with the requirements of any of the wiring methods in Chapter 3. Flexible cord and plug connection shall be permitted, provided that the cord does not exceed 3 ft (914 mm) in length. The branch circuit feeding the unit equipment shall be the same branch circuit as that serving the normal lighting in the area and connected ahead of any local switches. The branch circuit feeding unit equipment shall be clearly identified at the distribution panel. Emergency illumination fixtures that obtain power from a unit equipment and are not part of the unit equipment shall be wired to the unit equipment as required by Section 700-9 and by one of the wiring methods in Chapter 3.

Exception: In a separate and uninterrupted area supplied by a minimum of three normal lighting circuits, a separate branch circuit for the unit equipment shall be permitted if it originates from the same panelboard as that of the normal lighting circuits and is provided with a lock-on feature.

OSHA Standards for General Industry, February 3, 1997
Subpart S – Electrical 1910.308 Special systems

(b) Emergency Power Systems.

(1) Scope. The provisions for emergency systems apply to circuits, systems, and equipment intended to supply power for illumination and special loads, in the event of failure of the normal supply.

(2) Wiring Methods. Emergency circuit wiring shall be kept entirely independent of all other wiring and equipment and may not enter the same raceway, cable, box, or cabinet or other wiring except either where common circuit elements suitable for the purpose are required, or for transferring power from the normal to the emergency source.

(3) Emergency Illumination. Where emergency lighting is necessary, the system shall be so arranged that the failure of any individual lighting element, such as the burning out of a light bulb, cannot leave any space in total darkness.