

**COSINE DEVELOPMENTS**

Reg. No. IT 1637/97

**LEADERS IN LIGHTING TECHNOLOGY**

# South African Emergency Lighting Legal Requirements

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# 1. Occupational Health and Safety Act

(OHS Act: Act 85 of 1993)

## 1.1. General

The OHS Act is a statutory law prescribing minimum standards necessary to ensure the safety of workers in the workplace. It is illegal not to comply with its provisions and contraventions are punishable by a fine and/or prison sentence. In terms of the Act, emergency lighting must be provided to enable safe egress in the event of fire or power outages and must be kept in good working order.

The following excerpts were taken from the section titled: “Environmental Regulations for Workplaces 1987”:

## 1.2. Emergency lighting required

The act states that emergency lighting must be provided in areas where there is no natural light or where persons habitually work at night. The minimum light level required is 0.3 lux at the floor level.

Further, an illuminance of not less than 20 lux shall be provided where it is necessary to stop machinery, shut down plant, where dangerous materials are present or where dangerous processes are carried out.

## 1.3. Emergency lighting performance requirements

- The emergency lighting must be activated within 15 seconds
- The duration shall be long enough to ensure safe evacuation of all indoor places
- The emergency lighting must be kept in good working order and tested for efficient operation at least every three months
- Directional emergency luminaires must be mounted at least 2 m above floor level and aimed downwards, below 45 degrees from vertical.

## **2. Building Regulations (SABS 0400-1990)**

**(Code of Practice for The application of the National Building Regulations)**

### 2.1. General

This code of practice sets out the requirements to ensure that buildings will be designed and built in such a way that people may live and work in a healthy and safe environment. As such, it includes workplaces, entertainment, restaurants, places of worship, learning institutions, hospitals and shops (for more than 25 people). The following excerpts are from sections TT29 and TT30:

### 2.2. Marking and signposting

Any building having emergency routes shall be clearly marked and signposted to indicate the direction to be travelled in the case of any emergency, the size and positioning of the required marks shall be determined by the local authority.

The marking or signs must comply with SABS 1186: Symbolic safety signs (this Standard defines the logo, colours and performance (where relevant) of the sign. In the case of an auditorium or hall, a sign reading "EXIT/UITGANG" shall be displayed over any exit doors with letters not less than 150mm high.

Emergency exit signs shall be illuminated by not less than 50 lux.

In any building occupied during hours of darkness and with a population exceeding 100 persons then emergency sign duration must be not less than 120 minutes.

The signs must be protected against the effects of fire for a duration of 120 minutes. This requirement inherently prescribes signs with internal batteries or, in the case of central battery or generator sets, fire retardant wiring.

### 2.3. Lighting of feeder and emergency routes

Emergency routes shall be provided with artificial lighting at any time the building is occupied at an illuminance of 50 lux on a horizontal plane 100 mm above the floor (during normal mains conditions).

In any building of more than 100 persons the emergency route must be illuminated by emergency lighting whose power is independent of the mains power:

- for not less than 60 minutes,
- with an illuminance along the route of not less than 0.3 lux and

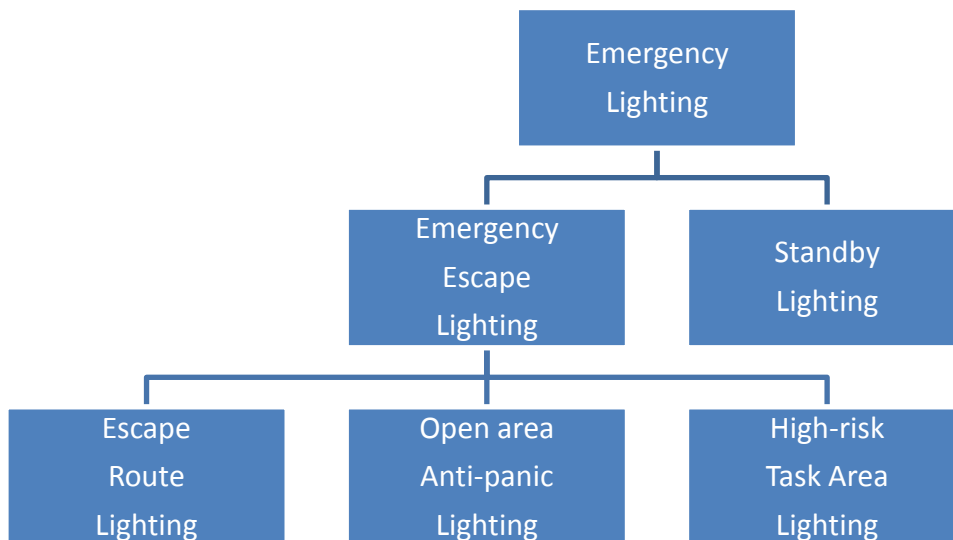
- a uniformity ration of not greater than 40:1.

The uniformity ratio is the ratio between the brightest and darkest points along the escape route. These requirements indicate a preference for many, low light output, emergency lights rather than a few high light output units. This improves safety because failure of a few emergency luminaires will not adversely affect building evacuation.

### 3. Emergency Lighting Code of Practice (SABS 0114-2) (SABS 0114-2:2002 Code of practice for Interior Lighting. Part 2: Emergency Lighting)

#### 3.1. General

This Standard deals with the design of an emergency lighting system. It describes emergency luminaire positioning for escape routes, open areas and high-risk task areas. Choices of appropriate systems, exit signs, logbooks and servicing are also covered.



The above chart shows the various categories of emergency lighting. Standby lighting is defined as lighting provided to enable normal lighting levels and hence normal activities to be continued in the event of a power failure, and so falls outside the scope of this work. Emergency escape lighting is defined as lighting provided to enable safe egress from a building in the event of a power failure or fire and hence much lower lighting levels are required. It would be more appropriate to define the illuminance as orientation lighting because all that is required is for the occupants to safely negotiate their way to an escape route, follow the signs and exit the building.

### 3.2. Emergency escape lighting

Luminaires should be mounted at a height 2 to 2.5 m above floor level. All signs indicating the escape routes shall be illuminated to indicate an unambiguous path out of the building. Where an emergency exit is not in direct view, an illuminated directional sign shall be provided to assist progression. An escape lighting luminaire shall be sited above each exit door, where there is potential danger and at safety equipment providing a minimum illuminance of 5 lux out to a horizontal distance of 2 m.

Escape lighting luminaires shall be positioned at the following locations:

- At each escape exit door
- Over stair wells
- Near any other change in level
- Where mandatory safety signs are installed
- At each change in direction
- At each corridor intersection
- Outside the final exit
- Near each first aid post
- Near each piece of fire-fighting equipment

In order to identify colours on safety signs the minimum colour rendering index shall be 40. The emergency lighting duration of any emergency luminaire shall be at least 60 minutes.

The disability glare shall be kept low within the field of vision. The disability glare specification limits light emitted between 60 and 90 degrees from the vertical axis.

The luminaires should be mounted as low as possible but not below 2 m above floor level if possible (car parks may be a problem). If they are mounted below 2 m then they must be mechanically protected.

The emergency lighting shall be activated not only on complete failure of normal power but also in the case of a localised failure if such a failure would present a hazard, for example, if a single sub-circuit on a stairway were to fail.

The illumination along an escape route should come from more than one luminaire so that failure of one luminaire does not plunge the entire escape route into complete darkness.

### 3.3. Escape route lighting

The general requirements for escape route lighting are:

- Minimum illuminance of 0.3 lux
- For retirement centres at least 3 lux is recommended
- Maximum uniformity ratio of 40:1
- Activation within 25 to 30 seconds with full illuminance within 60 seconds

The response time requirement was 15 s (in line with the international figure) but has been extended here in South Africa possibly to enable the use of generator sets.

### 3.4. Open area anti-panic lighting

General requirements:

- Illuminance of at least 0.5 lux at empty floor area up to a height of 0,5 m on the perimeter
- Maximum uniformity ratio of 40:1
- Response time within 30 seconds with full illumination within 60 seconds

The response time here was also 15 s (in line with the international figure) but has been extended here in South Africa possibly to enable the use of generator sets.

### 3.5. High risk task area lighting

General requirements:

- Illumination of at least 10% of normal lighting or 20 lux, whichever is greater
- Maximum uniformity ratio of 10:1 within 5m of task
- Duration of at least 30 minutes
- Response time of at least 0.5 seconds

### 3.6. Siting of additional escape lighting

- External areas in immediate vicinity of exits
- Lift cars with a duration of at least three hours
- Toilets, lobbies and closets
- Motor generator, control and plant rooms
- Cover car parks



### 3.7. Choice of an appropriate system

- Exit signs shall be maintained in premises where people are unfamiliar with layout
- Maintained emergency lighting shall be used in dimming circuits
- Three hours duration for any building higher than 10 storeys and underground areas
- Three hours duration for shopping malls

### 3.8. Emergency exit signs

- Shall be used to ensure that the emergency route can be easily recognised
- Comply with 1186-3 (colour and performance)
- Shall be illuminated at least 50% within 15 s and full brightness within 60 s. Internally illuminated signs (in compliance with SABS 1186-3) shall be displayed at all the exit doors of auditoriums or halls. The duration of the exit signs shall be at least equal to the duration of the emergency escape lighting.
- Safety colour at least  $2 \text{ cd/m}^2$  in all relevant viewing angles.
- Uniformity ratio across sign not less than 10:1
- The maximum viewing distance of an emergency exit sign shall be determined from the equation:

$$D = S \times P$$

Where  $D$  is the maximum viewing distance in metres,  $P$  is the sign height in metres and  $S$  is a constant (100 for externally illuminated signs and 200 for internally lit signs)

- Signs shall be positioned so their base is between 2 and 2.5 m from the floor level.

### 3.9. Emergency escape lighting system drawings and log book

- Drawings of emergency lighting installations shall be retained on the premises and regularly updated to reflect changes.
- A log book shall contain date of commissioning, date of each inspection and test, defects and remedial action, alterations and tests of duration
- On completion of any inspection as required in the OHS Act (Act 85 of 1993) a periodic inspection and test report shall be supplied to the person responsible for the premises.

The log book shall contain the following information:

- Date of commissioning
- Date of each periodic inspection (see OHS Act)
- Date and brief details of service, inspection or test
- Date and brief details of any defects and remedial action taken
- Date and brief details of alterations to the emergency lighting system
- If self-test devices used then description and performance of that device
- Date and brief details of annual tests for duration, illumination and system recovery after testing.

### 3.10. Servicing

Regular servicing of an emergency lighting system is essential. It is even more important now that the OHS Act demands that systems be maintained.

#### 3.10.1. Monthly checks

A monthly inspection shall be carried out in accordance with a systematic schedule detailing inspection criteria and required actions. A status report of self testing devices (if used) shall be compiled indicating system status, error codes and required action. Tests on non self testing devices shall not exceed  $\frac{1}{4}$  of the rated duration and check all devices to ensure function both during and after test. In the case of central battery systems the system monitors, if fitted, shall be checked or system functionality must be determined. Generator sets are required to be tested for at least one hour.

#### 3.10.2. Annual checks

Each emergency luminaire and sign shall be tested for its full duration. After the supply has been restored all devices shall be rechecked for normal functioning and battery charging. Results must be recorded in the log book.

## **4. Safety of emergency luminaires (SANS 1464-22)**

**(SANS 1464-22:2004 Safety of Luminaires. Part 22: Luminaires for emergency lighting)**

### 4.1. General

This Standard deals with the safety and performance of the emergency luminaires. It prescribes marking, reliability, electrical safety, photometric performance and battery charging requirements. This is a compulsory specification (VC 8055) and so failure to comply can be prosecuted by fines and/or jail terms.

### 4.2. Marking

The most obvious indication of compliance to this specification is manifested by marking and labelling. Correct labelling and marking enables easy identification of emergency luminaires, their performance and replacement parts. This information benefits the end user because most relevant information is displayed on the luminaire instead on some easily lost brochure. All too often cheap hardware store variety emergency luminaires are scrambled into service to placate an angry official. This false economy usually means that the entire luminaire needs replacement when it stops working.

The following labels, stickers and leaflets are required in addition to those specified in SANS 60598-1 (Luminaires: General requirements and tests).

The rated voltage, classification and warning labels (see below for details) shall be placed in a position where they are visible after the installation of the luminaire. In the case of recessed luminaires, these labels need only be visible when the diffuser is removed.

All labels must survive the tests in SANS 60598-1 Section 3.4, which calls for the completed label to be subject to lightly rubbing the label with a cloth soaked in water for 15 seconds, allowing it to dry and then rubbing it lightly with a cloth soaked in petroleum spirit. Normal inks will not survive this test nor will permanent marker inks. Only inks from pure resin ribbons or plasticized labels will suffice.

#### 4.2.1. Marking on the luminaire

This information must appear on the luminaire itself:

- Rated voltage
- Details of correct replacement lamps
- Rated ambient temperature ( $t_a$ ) and range of ambient temperatures
- DC supply connections should be marked +/- or coloured red/black. AC supply connections shall be marked by the symbol “~”.
- Display a clear warning notice that circuits must be regarded as live even when the mains power is off
- Details of replaceable fuses or indicator lamps (if fitted)
- Details of test facilities to simulate a power failure (if fitted)
- A green dot, at least 5mm diameter, under the lamp holder of the emergency lamp in combined luminaires
- Classification label must bear the information below:

*	*	****	***
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Each symbol in the segments shall indicate a number, letter or point of no indication *i.e.*, no symbol can be left blank.

The first segment indicates “Type”;

- X = self contained and
- Z = centrally supplied.

The second segment indicates “Mode of operation”;

- 0 = non-maintained
- 1 = maintained
- 2 = combined non-maintained
- 3 = combined maintained
- 4 = compound non-maintained
- 5 = compound maintained
- 6 = satellite

The third segment indicates “Facilities”;

- A = including test devices
- B = including remote rest mode
- C = including inhibiting mode
- D = high-risk task area luminaire

The fourth segment indicates “Duration” for self-contained luminaires;

- \*10 = ten minutes duration
- \*60 = one hour duration
- 120 = two hours duration
- 180 = three hours duration

The following example shows the marking for a combined, self-contained, one hour duration (say 4 x 18W recessed with one lamp on emergency) luminaire:

<b>X</b>	<b>1</b>	<b>****</b>	<b>*60</b>
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An example of required emergency luminaire labelling is shown in Figure 1 below. It is imperative that all emergency luminaires carry such labelling otherwise they do not comply with SANS 1464:22 and are thus illegal.

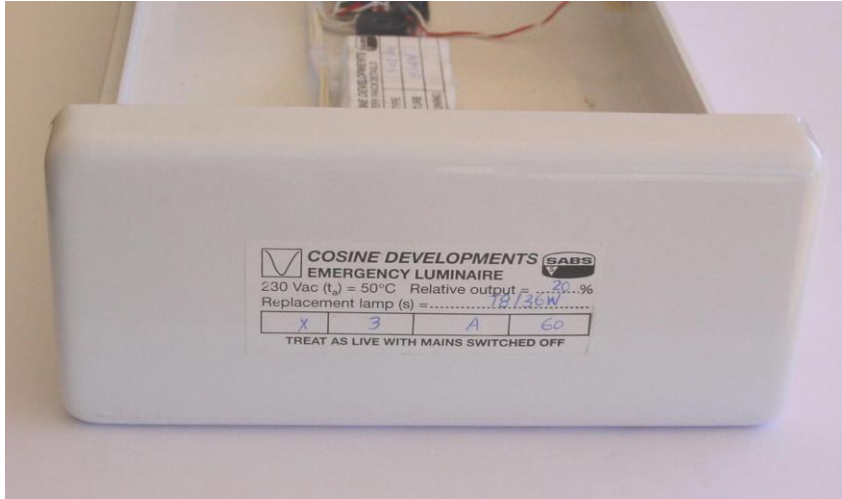


Figure 1

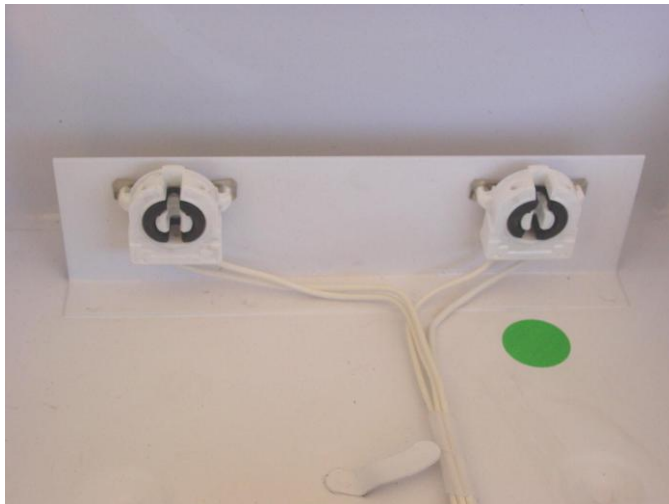


Figure 2

An identifying green dot (see Figure 2) of at least 5 mm diameter must be affixed under the emergency lamp so that it is visible whilst the lamp is being replaced.

#### 4.2.2. Marking on batteries (for self contained luminaires)

This information must appear on the battery pack. A difficulty arises when the dates have to be written on the labels and then still satisfy the wiping test because even indelible ink smudges. In this case, it is best to print the labels bearing all the months and a few year numerals and then during commissioning the date can be logged by simply scratching out the relevant date. The information required on the battery pack is:

- Details of correct battery replacement type and rated voltage
- Date of manufacture
- Date of commissioning
- Maximum case temperature ( $t_c$ )

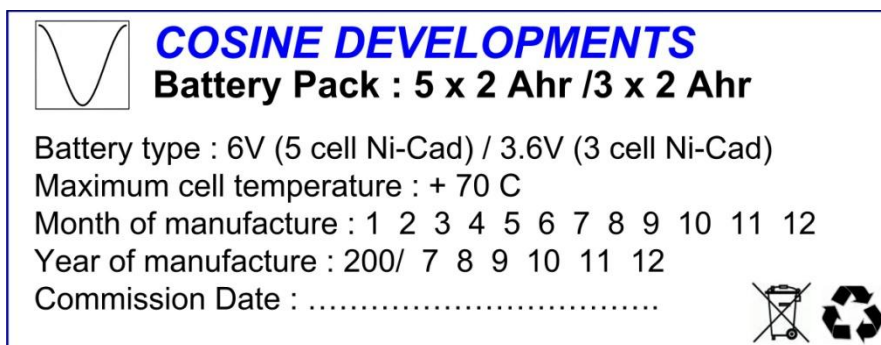


Figure 3

Figure 3 shows an example of a battery label. Note that the manufacture date is captured by scratching the relative month and year. In this way, no surface treatment is required thereafter to ensure indelibility.

#### 4.2.3. Instruction leaflet

- Batteries must be replaced when the measured duration is less than the rated emergency duration
- Correct lamp replacement for all lamps in combined luminaires
- Details of test facilities or self test emergency related instructions, if provided
- Details of rest mode, if provided
- Details of connection leads between a compound luminaire and satellite luminaire or central battery connections, to limit the volt drop to 3% of the rated voltage
- Rated light output of the luminaire

### 4.3. Construction

Safety in construction shall be ensured by complying with SANS 60598-1. Included here is insulation strength and electric strength etc..

In centrally supplied luminaires, adequate separation between normal (mains) and emergency (usually dc) shall be ensured by double insulation, reinforced insulation, earthed screen or other means. The use of basic insulation for both circuits fulfils the requirement.

Batteries shall be protected against excessive discharge currents by the incorporation of a safety device.

The battery case temperature shall not exceed the stated ( $t_c$ ) temperature in an ambient temperature of 25 °C.

In self-contained luminaires, lead-acid and nickel-cadmium batteries shall be protected against polarity reversal of individual cells and against harmful complete discharge. For lead-acid batteries low voltage cut-off shall be:

- 12 V batteries must be 10.5 V
- 6 V batteries must be 5.1 V.

For nickel cadmium batteries, the cut-off shall be 0.8 V per cell.

### 4.4. Endurance and thermal test

#### 4.4.1. Endurance test

Mounted on a similar mounting surface and at the same orientation as used in service and at an ambient temperature of  $t_a + 10^\circ\text{C}$  (where  $t_a$  is 25°C unless otherwise marked on the luminaire).

The mounting is important especially with bulkhead type fittings because heat rise within the luminaire are more dramatically affected by the direction of the convection currents from the lamps and surface dissipation. The worst-case orientation is usually ceiling mounting against surfaces with a high thermal resistance such as wood or ceiling board. In this case a significant portion of the whole surface dissipating area is insulated and can cause significant increases in internal temperature.

The test shall last 390 hours consisting of ten cycles of 36 hours (30 hours with mains on and 6 hours in emergency mode) and a final cycle of 30 hours to charge the batteries fully to be ready for the next test.

Afterwards the luminaire must function and a visual inspection shall reveal no damage such as cracks, scorches or deformation.

Thereafter the luminaire shall survive 50 supply switchings of 60 seconds mains on and 20 seconds mains off *i.e.* emergency power.

In the case of emergency products having an inherent delay after the restoration of power the 50 switching cycle test may have to be modified in duration to allow additional battery charging.

Compliance shall be checked by inspection.

Note that the Standard allows for chance failure of components including the lamp. By chance failure, it allows abnormal failure due to, for example, a defective lamp. It should be noted that, as most emergency circuits cause rapid lamp ageing, the lamp must survive this test and still be functional.

#### 4.4.2. Thermal test - Normal operation

During normal operation, no part of the luminaire (including the lamp), the wiring or mounting surface shall attain a temperature that would impair safety.

Again, the mounting orientation must be the most onerous. The mains voltage is set to 244V (1.06 x 230V) and the ambient temperature should preferably be 25°C. For measurement of the temperature rise of the emergency control unit ( $t_c$ ) then the mains voltage must be set at 230V.

Measurements shall be taken when all temperatures have stabilised or when temperatures are changing less than 1°C per hour.

The temperature of the emergency control unit shall not be more than 2°C above the rated  $t_c$  value or, if no  $t_c$  value is given then the temperature of its case should not exceed 50°C.

The temperature of unmarked components, *i.e.* the battery pack (in self-contained emergency luminaires), must not exceed 50°C. This measurement cannot be underemphasised and is especially important in bulkhead type emergency luminaires.

This test is to be carried out in both normal and emergency modes until complete battery discharge (in self-contained units). In the normal mode the battery charger may cause over-heating and during the emergency mode the emergency driver circuitry may over-heat and, at high discharge currents, the battery temperature may also rise. Complete battery discharge is given by 1 V/cell in the case of nickel-cadmium batteries and 1.75 V/cell (or 10.5 V on a 12 V battery) for lead-acid batteries.



#### 4.4.3. Thermal test - Abnormal operation

This test is included to ascertain the luminaire performance during high mains voltage and lamp fault conditions, which may arise at the end of lamp life. The test must be conducted at 253 V (or 1.1 times rated mains voltage) and with a variety of lamp faults including:

- Starter short circuited (where applicable)
- Lamp rectification (see below)
- Lamps removed
- One electrode open circuited
- Electrodes intact but tube glass cracked

The lamp rectification is the most difficult to simulate (details are given in Annex C of SANS 60598-1) but its results may well be the least onerous for emergency lighting circuitry using the standard current fed oscillator.

Tests shall be conducted for both normal and emergency modes until complete battery discharge (in self-contained units). Complete battery discharge is given by 1 V/cell in the case of nickel-cadmium batteries and 1.75 V/cell (or 10.5 V on a 12 V battery) for lead-acid batteries.

Another demanding test is the battery short circuit test. Here the batteries are removed and replaced with a short circuit still with the mains voltage at 253 V. The temperature of the emergency control unit casing shall not exceed  $t_c + 10^\circ\text{C}$  or, if no  $t_c$  value is given,  $60^\circ\text{C}$ . After the test, the battery charger must function normally.

#### 4.5. Photometric performance

The luminaire shall provide rated lumen output claimed by the manufacturer during emergency mode for 1 minute after failure of supply and continuously to the end of rated duration. A luminaire for high-risk task area lighting shall provide rated light output within 0.25 seconds after mains failure.

The luminaire light output is calculated by measuring the light output on a plane 2 m below the luminaire in normal mode and then in emergency mode. The ratio of light output can then be directly scaled to suit the luminaire photometry data. Note that in normal mode all lamps must be burning (in a combined emergency luminaire).

For non-maintained luminaires, the normal light output must be measured using the appropriate mains ballast.

#### 4.6. Changeover operation

The changeover from normal to emergency mode shall occur at greater than 0.85 times the maximum rated supply voltage (range).

#### 4.7. High temperature operation

Self-contained emergency luminaires shall be capable of operating satisfactorily at an ambient temperature of 70°C for at least half the rated duration and at 50% lumen output. This test has been included to both ensure that high temperature batteries are used and that the temperature rise of the batteries due to heat gain from surrounding components is not excessive.

#### 4.8. Battery chargers (self contained emergency luminaires)

The battery charger in a self-contained luminaire shall charge the batteries within 24 hours when the mains supply is between 90 and 106% of the rated mains voltage and charge the batteries as specified by the battery manufacturer. This requirement ensures that batteries are charged at C/20 rate.

Transformers shall comply with SANS 61558-1. This requirement details separate winding bobbins for primary and secondary in order to prevent unsafe conditions during a transformer failure.

## 5. Symbolic safety signs (SANS 1186-1)

(SANS 1186-1:2004 Symbolic safety signs. Part 1: Standard signs and general requirements)

### 5.1. General

The Standard defines the legends and specific colours required for all safety signs.

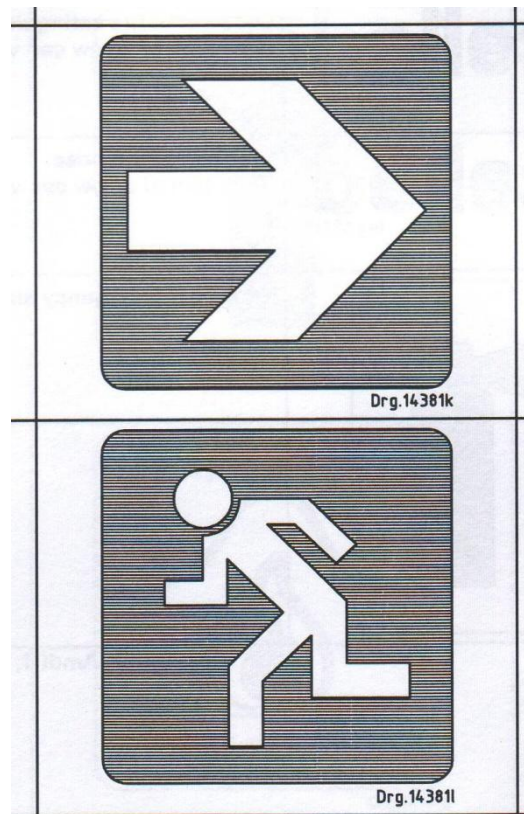
### 5.2. Safety colours

The required colours associated with their respective sign meanings are given below. It is important to have standardised colours to denote various safety signs so that both workers and the general public get accustomed to their meaning. Notice also that, although often used in South Africa, red should not be used for an exit sign.

<b>Safety colour</b>	<b>Meaning</b>	<b>Example of use</b>	<b>Suitable SANS 1091 colour</b>
Red	Prohibition	Prohibition signs (and fire fighting equipment)	Signal red (A11)
Blue	Mandatory action	To wear personal protective equipment	Ultramarine blue (F09)
Yellow	Warning, risk of danger	Indication of danger or obstacles	Golden yellow (B49)
Green	Information, safe condition	Escape routes, emergency exits, first aid stations	Emerald green (E14)

The Standard specifies a suitable SANS colour and gives boundaries of suitable colours on a chromaticity chart. It is clear therefore that as long as the sign colour is more or less emerald green, etc., then it is acceptable. The Standard also specifies the contrast colour for a green safety logo is white (i.e., the background). This means that, for example, green LED edge lit transparent pendant signs are only suitable if the background wall is white.

### 5.3. Standard legends



**Figure 4**

Figure 4 shows typical exit sign logos. There are many different logos available in the marketplace and there seems to be no standardisation in South Africa.

## **6. Symbolic safety signs (SANS 1186-3)**

**(SANS 1186-3:2004 Symbolic safety signs. Part 3: Internally illuminated signs)**

### 6.1. General

This Standard specifies the construction and performance of internally lit exit signs. It covers electrical safety, viewing distance, brightness and colour.

### 6.2. Safety and electrical performance

The provisions of SANS 60598-1 and SANS 1464-22 shall apply with respect to electrical safety, earthing, thermal limits, endurance, marking and electrical

performance. In brief, this means that all thermal and endurance testing must be conducted and that all relevant labels and markings must be affixed.

### 6.3. Viewing distance

The maximum viewing distance of an internally illuminated sign shall be determined from the equation:

$$D = 200 \times P$$

Where  $D$  is the maximum viewing distance in metres,  $P$  is the logo height in metres. Also, the pictogram (logo) shall occupy between 75% and 90% of the total sign area.

### 6.4. Internal lighting requirements

The internal lamps shall emit a “white” light that is not detrimental to the colours of the sign. This requirement demands the use of white fluorescent lamps (which may be dimmed during emergency mode) or incandescent lamps running at full brightness during emergency mode.

The light emitted from the sign face shall be diffused and the minimum luminance of any point shall not be less than  $2 \text{ cd/m}^2$ .

The ratio of brightness across the face of the sign shall not be more than 6:1. The ratio of brightness between the background colour and the pictogram colour shall lie between 15:1 and 5:1.

The boundaries of chromaticity co-ordinates (colour tolerance) for the internally illuminated signs are broader than those specified in SANS 1186-1, especially for green. This is probably to allow for reduced colour rendering during emergency mode.

## **7. Automatic test systems (SANS 62034)**

### **(SANS 62034:2007 Automatic test systems for battery powered emergency escape lighting)**

#### 7.1. General

The OHS Act requires that emergency lighting systems are kept in good working order and tested every three months. Traditionally this poses a logistics headache for the building owner because testing the emergency lighting requires switching off the mains supply to the building and then examining each emergency light and exit sign for operation. Full duration tests would require watching all the emergency fittings for up to three hours – a costly and time-consuming task. This task has been simplified by the arrival of the microprocessor; this miniature computer chip can be inserted into emergency lighting products to conduct autonomous testing and reporting.

These, so called self testing emergency lighting systems or Automatic Test Systems (ATS), have the ability to test itself, its batteries, lamp, and then to report any problems. This Standard attempts to standardise the operation and performance of self-testing emergency lighting systems.

#### 7.2. Safety and electrical performance

All parts of the ATS shall conform to the requirements of SANS 60598-1 and SANS 1464-22. That means all safety, electrical performance, photometric performance, battery charging *etc.* shall apply as with normal emergency lighting products.

The design and construction of the ATS shall ensure that only authorised personnel can change the test duration and frequency of tests.

#### 7.3. Automatic test requirements

The ATS shall check the functional operation of the emergency lighting luminaires and associated power supplies to identify any faults that would impair their operational duty. Any faults shall be indicated or reported within 24 hours after their inspection.

##### 7.3.1. Short duration functional tests

A functional test shall be performed at least once a month. The duration shall be sufficient to check the illumination of the lamp and shall not be more than 10% of the rated duration.

##### 7.3.2. Full duration tests

Random automatically initiated full duration tests shall be conducted between 4 and 52 weeks after commissioning *i.e.*, at least every year.

If a mains supply failure occurs up to 24 hours before a pre-programmed rated duration test then the start of the test shall be postponed.

#### 7.4. Test of emergency lamps

The ATS shall indicate if the emergency lamps do not operate. This test is included to ascertain the luminaire performance during lamp fault conditions, which may arise at the end of lamp life. The test must be conducted with a variety of lamp faults including:

- Starter short circuited (where applicable)
- Lamp rectification (see below)
- Lamps removed
- One electrode open circuited
- Electrodes intact but tube glass cracked

The lamp rectification is the most difficult to simulate (details are given in Annex C of SANS 60598-1) but its results may well be the least onerous for emergency lighting circuitry using the standard current fed oscillator.

#### 7.5. Requirements if the building is occupied during scheduled tests

Systems designed for installation in premises, which may be occupied during the duration test, shall include the following precautions to keep the security level high and to minimise disruption in the workplace:

- Schedule tests on alternate luminaires
- Enable manual initiation of the tests
- Schedule random tests

#### 7.6. Indication of test results

The ATS shall give an indication of all test results. The result of a test shall be indicated for at least one week when the mains is present.