

How to install emergency lighting?

Eaton's CEAG Emergency Lighting Business



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Structure of Emergency Lighting





Installation of low-voltage systems - Part 5-56: Selection and installation of electrical equipment -Set-up for safety purposes

This norm/standard contains the German interpretation/takeover of the European harmonization documents **HD 60364-5-56:2010 + A1:2011** "Installation of low voltage systems – Part 5-56: Selection and installation of electrical equipment – Facilities for safety purposes", the international standard **IEC 60364-5-56:2009** "Low-voltage electrical installations – Part 5-56: Selection and installation of electrical equipment – Safety services" includes the common modifications from CENELEC.





Electrical systems for safety purposes (560.3.1)

- Emergency lighting
- Fire extinguishers
- Lifts for fire-fighters
- Danger notification systems, such as fire alarms, CO warning systems and burglar alarm systems
- Evacuations systems
- Smoke extraction systems
- Important medical systems



Power source for safety purposes (560.3.2)

• Power source, which is intended for use as part of an electrical system for safety purposes.

Back-up power source (560.3.5)

 Power source, which is intended for use as the supply for either an electrical system, or for one or more parts of a plant, in case of an interruption of the normal power supply for reasons other safety purposes.











Switching time (560.3.11)

• The period between the **failure** of the normal power supply and the **initiation** of the supply of operation from an auxiliary power source.

Switching (560.9.9)

 The changeover/switching from normal operations to emergency operation must be carried out automatically, when the supply voltage falls to within 0,6 times the rated supply voltage for more than 0.5 seconds. When the supply voltage achieves a value greater than 0.85 times the rated supply voltage, normal operation is restored.





Error in the control or bus system (560.5.4)

• A fault in electrical system's control or bus system **shall not impair the function** of the equipment for safety purposes.

Therefore the control system, such as DALI, EIB, KNX, DMX etc. that are found in the use of general lighting, must be monitored accordingly.





Approved power sources for safety purposes (560.6.1)

- Rechargeable Batteries
- Primary elements (e.g. for smoke detectors in the living area)
- Generators, with drive machines independent of the general power source
- Dual system / separate input from the supply network, which is actually independent from the normal power supply.











Facility power source for safety purposes (560.6.3)

 Power sources for safety purposes must be placed at suitable locations and only by qualified electricians (BA5) or properly trained persons (BA4).





Independent power source for safety (560.6.5)

 Independent feeds that are separate from each other from the supply network may only be used as energy sources for safety purposes, if it is assured that a simultaneous failure of both supplies is unlikely.

Dimensions of power source for safety (560.6.6)

• The power source for safety purposes must have a **sufficient capacity** to supply the associated equipment.





Limitation of power source for safety purposes (560.6.7)

• A power source for safety purposes may only be used for additional purposes other than the supply of equipment for safety purposes, if the availability of the supply of equipment for safety purposes is not affected.







Power sources for safety purposes (560.6.10 - 13)

- **CPS** Central power supply system (EN 50171)
- **LPS** Power supply system with power limitation (EN 50171)
- EB Self-contained Battery System (EN 60598-2-22) (560.6.1 & 560.9.1)



Power generator (DIN 6280-13 & -14) \dots s = Duration of interruption in seconds



Dual System / separate Input from the supply network, which is actually independent from the normal power input. (560.6.1 & 560.6.5)





Notifications (560.6.14)

 The state of the power source for safety purposes (Ready for operation, fault, power source for safety purposes in operation) must be displayed.

Location (560.9.14)

• The operation of emergency lighting shall be displayed for each power source at a **highly visible location**.













Protective measures (560.7.4)

 Excess current protection equipment are chosen and installed that an excess of current in a circuit does not interfere with the intended function of other circuits for safety purposes

Switching and control gear (560.7.5)

 Switchgear and controllers must be clearly labelled and must only be installed in locations that are solely accessible to qualified electricians (BA5) or properly trained persons (A4).





Independent circuits (560.7.6)

 In two independent circuits, an error, that occurs in a circuit, may affect neither the electro-shock protection nor the intended function of the other circuits.

Control switch (560.9.13)

 Control switch for emergency lighting must be arranged and installed at marked Positions so that they cannot be operated by unauthorised persons.









Documentation (560.7.9 – 560.7.12)

- General principle circuit diagram with details of power sources.
- Drawings with the recorded positions of:
 - all electrical equipment and distribution boards,
 - Safety devices with circuit labelling,
 - Switching and monitoring equipment.
- List of connected current-using equipment (Wiring diagrams)
- Instruction manual



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Circuits (Cable network) (560.8.2)

 Cable and wiring systems for control and bus facilities for safety purposes must comply with the same requirements as the cables and wired that are used for the equipment for safety purposes themselves. This does not apply to circuits that have no adverse effect on the operation of the safety devices.







Differential monitoring:

F3-Switch closed: F3-Switch open(1 $k\Omega$) : Short circuit or interruption lead to the enablement of the system System operational System blocked



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Protective Measure (560.8.4)

DIN VDE 0100-560

Circuits for safety purposes, that can be supplied with **direct current** must be carried out with two-pole current protection equipment.









Final circuits (560.9.2)

- A short circuit in an electrical circuit shall not affect other circuits.
- Maximum 20 Luminaires may be installed per circuit.
- The total load of the circuit must not exceed 60% of the rated current of the current protection equipment.







Switching modes for emergency lighting (560.9.4)

• Within a final circuit of emergency lighting, it is permitted to jointly operate luminaires in standby mode and continuous operations.







Switching modes for emergency lighting (560.9.5)

• Standby: The emergency lighting shall be activated automatically, if there is a loss of power in one area or a failure of the general lighting.







Switching modes for emergency lighting

• For continuous operations, the general power supply will be monitored at the main distributor of emergency power supply.





Functional safety of control systems (560.9.8)

• The function of emergency lighting systems must not be affected by deployed control systems. The functional safety requirements must also be fulfilled even with changes to the control systems.

Therefore the complete emergency lighting must have their functionality checked after making changes to control systems, such as DALI, EIB, KNX, DMX etc., which may affect the operation of emergency lighting.





V-CG-SB.1 with ext. DALI-Controller







Subsequent emergency lighting and manual reset (560.9.10)

- After power is restored, restarting the luminaires of the general lighting must be considered = Emergency lighting delay time
- In darkened rooms, the switching back of emergency lighting must not be automatic. You may only be able to turn off by hand = Manual reset





Identification (560.9.15)

 In emergency lighting systems, Luminaires, connection and junction points must be marked in red. The distributors, circuits and luminaire number must be labeled on/near the luminaires. The label must be at least 30mm in diameter.



The legibility of fonts is regulated in DIN 1450



Installation of low voltage systems

- Requirements for special types of operation installations, areas and systems

With the introduction of DIN VDE 0100-560, most sections of DIN VDE 0100-718 were replaced, namely those associated with emergency lighting. The following sections of DIN VDE 0100-718 are to be considered for emergency lighting.





Protective measures (718.473.2.1 / 1. paragraph)

• The shut-down by excess-current protection equipment within 5 seconds

Mains circuits (718.563.7)

 Circuits for safety purposes are to be switched into operational rest periods, so that any unintentional effect from the power source for safety purposes is prohibited from supplying the electrical system for safety purpose









Laying cable and wiring (718.521.2)

• The wire connection between power source and main distributor must be protected against short-circuiting and earth fault.

Multi-core cables and wires (718.521.5)

• Final circuits in one cable / in one wire with shared neutral conductors are not allowed.



DIN EN 50172

Emergency Lighting Systems

As well as

- Pre-norm/standard -DIN V VDE V 0108-100

Emergency Lighting Systems



Validity

- The UK 221.3 "Construction systems for public areas " of the DKE German Commission for Electrical, Electronic & Information Technologies of DIN und VDE recommend the application of DIN V VDE V 0108-100.
- Since DIN V VDE V 0108-100 is recommended by the UK 221.3 and thus reflects the present state of technology, the content of these standards is displayed in this training from CEAG Notlichtsysteme GmbH



Opposite DIN EN 50172:2005-01, the following changes were made:

- a) Luminous requirements for emergency lighting in mains operation,
- b) additional requirements for the electrical system for emergency lighting systems,
- c) requirements for the circuits of electrical systems for emergency lighting systems,
- d) requirements for the control and bus system of the emergency lighting system,
- e) requirements for luminaires for emergency lighting with external connection,



Opposite DIN EN 50172:2005-01, the following changes were made:

- f) requirements for self-contained systems,
- g) identification of luminaires and of connection / branch locations that are part of an emergency lighting system,
- h) receiving the requirement for the initial assessment, the weekly examination and the measurement of illuminance every 3 years.



Application area(1)

• This pre-norm define the designation and the illumination of the escape route at disturbance of the normal current supply, also at minimum standards of safety lighting according size, kind and use of the physical construction. They apply for workplaces, physical construction for gathering and public accessible routes within apartment buildings

The necessity of safety lighting system in buildings and areas is arranged in Germany of the state building code.

Furthermore apply the requirement of the Working Guidelines.



DIN EN 50172 / DIN V VDE V 0108-100 7

General (4.1)

The emergency lighting must fulfill the following functions:

- Lighting or backlighting of safety signs for escape routes
- Lighting of escape routes
- Lighting of the fire and alarm equipment
- Enabling emergency operations

Final circuits of emergency lighting (4.4.3 only in DIN V VDE V 0108-100)

 If more than one safety luminaire is required in a room, they must be alternatively distributed between two circuits with independent protection devices.




Circuits for general lighting (4.4.4)

• In standby, the general lighting must be divided on two different circuits (if there is more than one luminaire).



• At use of residual current protective device (RCD) the circuits from the general lighting must be divided on 2 RCDs.







In case an error in the control of the general lighting leads to a blackout of an area or escape route, this control must be also monitored.







General lighting circuits can be divided into two different RCDs. 1st does not lead to a complete loss of light.













High-rise apartments, Accommodation facilities and Homes (4.4.8)

- To reduce the operating time of 8 hours to 3 hours in residential highrise buildings and accommodation facilities and homes, the following switching should be applied:
 - Local illuminated switches, so that from any location, at least one light switch is visible.
 - The emergency lighting must switch off again automatically when it is powered again from the standby power supply after an adjustable period of time.











Switching/set-up of Emergency lighting (4.4.9)

- The emergency lighting must be supplied from the general power supply, as long as mains is available at the distributor of the emergency lighting.
 = Mains emergency operating mode
- After power is restored, the restart of luminaires for general illumination is taken into account
 - = Emergency lighting delay time
- In dark areas, the switching of emergency lighting must be carried out manually. It must only be turned off by hand.
 - = Manual reset





System integrity (5.2)

 Lighting has to be carried out during the development of the escape route in every area with two or more luminaires, so that the entire escape route will not be darkened during a blackout of a luminaire or if the labelling of the escape route is not effective.

Basic principle:

The first fault must not lead to there being no light on the escape route.



Power sources for emergency lighting (5.3.2 / 5.3.3)

- **CPS** Central power supply system (EN 50171)
- LPS Power supply system with power limitation (EN 50171)
- EB Self-contained Battery System (EN 60598-2-22)
- EA...s Power generator (DIN 6280-13 & -14) ...s = Duration of interruption in seconds



Especially secured network (DIN VDE 0100-560.6.1 & 560.6.5)



General: Drawings and reports (6.1)

 A general assembly drawing must be produced that indicates the emergency lighting system. The drawings must comply with DIN VDE 0100-510 section 514.5.1.

Recording system(6.2)

• With annual inspections and periodic testing, a test certificate must be created.

Test/log book (6.3)

• A print-out from the automatic testing device must meet the requirements of this section.



Log book (6.3)

• The log book must be conducted by the owner or a responsible person nominated by the owner and must be available for public inspection.

The following minimum information must be entered into the log book:

- Date of commissioning of the system
- Date of every test (both initial test and routine tests)
- Date and brief detail about each performed maintenance and testing
- Date and brief detail about each error and each completed corrective action
- Date and brief detail of any change to the emergency lighting system





	Illuminance	Switching time	Operating period	Safety label	Power Sources
Congregational buildings ⁾ , Theatres, Cinemas, Exhibition halls, Sales areas	1 Ix Acc. DIN EN 1838	1 s	3 h	DS	CPS LPS EB EA ₀ EA _{0,5}
Restaurants Temporary buildings, that are congregational buildings	1 Ix Acc. DIN EN 1838	1 s	3 h	DS	CPSLPSEBEA0EA0,5EA
Accommodation facilities, Homes	1 Ix Acc. DIN EN 1838	1 s ²⁾	8 h ³⁾	DS	CPSLPSEBEA0EA0,5EA15
Schools	1 Ix Acc. DIN EN 1838	1 s ²⁾	3 h	DS	CPSLPSEBEA0EA0,5EA15

1) Apart from temporary buildings

- 2) Depending on panic risk 1 s 15 s
- 3) 3 h is sufficient, if the switch is carried out according to 4.4.8





	Illuminance	Switching time	Operating period	Safety label	Power Sources
Car Parking facilities, including underground garages	1 lx Acc. DIN EN 1838	15 s	1 h	DS	CPSLPSEBEA0EA0,5EA15
Airports, Train stations	1 Ix Acc. DIN EN 1838	1 s	3 h ⁴⁾	DS	CPSLPSEBEA0EA0,5EA
High-rise buildings and apartments	1 Ix Acc. DIN EN 1838	1 s ⁵⁾	3 h 8 h ⁶⁾	DS	CPSLPSEBEA0EA0,5EA15
Stages	3 lx	1 s	3 h	DS	CPSLPSEBEA0EA0,5EA

- 4) For above-ground areas of train stations is also permissible for 1 h, depending on the evacuation plan.
- 5) Depending on the panic risk of 1 s 15 s
- 6) 3 h is sufficient, when switching is carried out according to 4.4.8





	Illuminance	Switching time	Operating period	Safety label	Power Sources
Escape routes in work places	1 Ix Acc. DIN EN 1838	15 s	1 h	DS ⁷⁾	CPSLPSEBEA0EA0,5EA15BSEAEA
Particularly hazardous/ Work places/ with particular hazards	10% E _N min. 15lx Acc. DIN EN 1838	0,5 s	For the timespan, in which people survive a danger	DS	CPSLPSEBEA0EA0,5Image: Constraint of the second sec

7) Not required for escape routes in work places



DIN EN 50272 - 2

Safety requirements for Batteries and Battery-systems Part 2: Stationary Batteries







Application area (1)

- This standard applies to stationary batteries and battery systems with a maximum rated DC voltage of 1500V and describes the basic measures to protect against hazards that may come about from electrical current, exiting gases or electrolytes.
- This specifies requirements with regards to safety that arise in connection with erection, operation, inspection, maintenance and disposal.
- This includes both lead and NiCd-batteries.







Secondary cell, single cell (4.1)

• Assembly/Component, consisting of electrodes and electrolytes, that form the basic unit of a secondary battery.

Closed cell (4.2)

• Secondary cell, in which the lid is provided with an opening, through which gases may escape.

Blocked cell (4.3)

 Under normal conditions with a closed secondary cell, the discharge of gas is enabled, if the inner pressure exceeds a predetermined value. The refilling of the electrolyte is generally not possible.







Ventilation requirements (8.2)

- Through the ventilation of the battery area or cabinet, the concentration of hydrogen should be kept below the level of 4% hydrogen content.
- Battery areas are not deemed to contain explosion hazards, if the hydrogen concentration remains below this limit by natural or technical ventilation.







Natural Ventilation (8.3)

- The size of the airflow rate is preferably ensured by natural ventilation, otherwise by artificial ventilation.
- Battery areas or cabinets require an incoming and outgoing air opening with a minimum cross section, which is calculated by the following equation:

$\mathbf{A} = \mathbf{Q} \times \mathbf{28}$

- Q: Flow rate of fresh air in m³/h
- A: Free opening sections of the incoming and outgoing air opening in cm²
- Approval: Air velocity of 0,1 m/s.







Example: 216 V / 57 Ah Pb-Battery // Blocked

- $Q = 0.05 x n x (I_{gas} x C_N) x 10^{-3}$
- $Q = 0.05 \times 108 \times (I_{gas} \times 57) \times 10^{-3}$
- $Q = 2,4624 \text{ m}^3/\text{h} (I_{gas} = 8 = \text{Starkladung})$
- $Q = 0,3078 \text{ m}^3/\text{h} (I_{gas} = 1 = \text{Erhaltungsladung})$

Ventilation cross-section for boost charge

- A = 28 x Q
- A = 28 x 2,4624 m³/h
- $A = 68,95 \text{ cm}^2$







Technical Ventilation (8.4)

• When the natural ventilation is not sufficient, then an artificial ventilation system must be provide, that will vent the air from the battery compartment to the ambient air outside the building.

For further details, see National Construction Law (EltBauVo)







Requirements for special areas (10.1)

• d) In sealed Battery models, the floor must be impermeable to electrolyte and chemical resistant. Alternatively the battery must be placed in appropriate tanks.

CEAG install closed cells as standard These measures are not valued for closed cells

For further details, see National Construction Law (EltBauVo)



DIN EN 1838

Applied light Engineering Emergency Lighting











EN 1838



Charges from DIN EN 1838:1999-07

- External lighting to a safe area (Assembly point)
- Fire and alarm equipment, first-aid posts and BMA to be illuminated vertically with 5 lx
- Required illumination levels are set for maintenance
- First reflection allows for indirect lighting if the reflecting surface is due to for maintenance
- The color and design of escape signs according to ISO 7010
- Escape signs in bright environments and with intact general lighting in inline with ISO 3864-1 and ISO 3864-4
- Determination of the viewing distance of a escape sign at 20° above the horizontal line of sight















Emergency lighting for safety signs

EN 1838

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Escape routes are easy to find and use

Emergency lighting for escape routes

Risk-free evacuation of a building, easy to locate and operate fire lighting and safety equipment



for Emergency Escape Route







EN 1838

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Anti-panic lighting

Avoid panic situations, achieve safe escape routs, lighting obstacles up to 2m

Emergency lighting for workplaces with particular hazards

Safety of people in the workplace with • potential hazardous work processes



LBO demand 1 Lux!





EN 1838



Requirements for installation (4.1.1)

- The emergency lighting shall comply with EN 60598-2-22, EN 50172 and EN 62034
- Rate/share/portion of the reflected light are negligible
- If luminaires are installed that shine indirectly, the first reflection (based on the maintenance value of the reflectance of the surfaces) can be considered and other reflections are negligible.







Emergency lighting (1 lx) must be installed (4.1.2) so:



Safety signs for emergency conditions



4 2

Near (max. 2 m away from) stairs, directly lighting every step







Emergency lighting (1 lx) must be installed (4.1.2) so:



Near (max. 2m away from) every change of level



Every change of direction



At each intersection of corridors



Near (max. 2m away from) every exit and outside to the safe area

Not valid in France (Appendix B)







Emergency lighting (1 lx) must be installed (4.1.2) so:



Near (max. 2m away from) escape equipment for handicapped people

Not valid in France (Appendix B)



Near (max. 2m away from) safe areas for handicapped people and P.A. systems



Alarm devices in toilets for handicapped people



EN 1838



Emergency lighting (11x) must be installed (4.1.2) so:







EN 1838



Illuminance for escape routes (4.2.1)



Escape route up to 2m wide are to be illuminated along the central axes with 1 lx and up to 50% of the remaining width illuminated with 0.5 lx.

Measuring height max. 2 cm (Appendix A)

Wider escape routes can be considered as multiple 2m strips or be equipped with anti-panic lighting

Luminance intensity



0.5 lx to1 lx





Light sensitive non-uniformity of illuminance (4.2.2)



Due to the sluggishness of vision, the visibility of obstacles and escape route are affected by high differences between light and dark.

Uniformity < 40:1 (E max / E min)

Measuring height max. 2 cm (Appendix A)



EN 1838



Physiological glare reduction (4.2.3)



Physiological glare must be kept low by limiting the luminaires within the field of vision.

For horizontal escape routes between 60° and 90°.

Luminous intensity limited between 60° - 90°


EN 1838



Physiological glare reduction (4.2.3)



Physiological glare must be kept low by limiting the luminaires within the field of vision.

Luminous intensity limited in the entire area







Physiological glare reduction (4.2.3)

Lighting height above ground [m]	Max. luminous intensity for escape routes and anti- panic lighting [cd]	Max. luminous intensity for workplaces with increased hazards [cd]	
h < 2.5	500	1000	
2.5 < h < 3.0	900	1800	
3.0 < h < 3.5	1600	3200	
3.5 < h < 4.0	2500	5000	
4.0 < h < 4.5	3500	7000	
h > 4.5	5000	10000	

Luminous intensity limited between 60° - 90°







Colour rendering safety colours (4.2.4)



Colour rendering index of luminaire (Ra) minimum 40







EN 1838

Operating time (4.2.5)

For escape route and anti-panic lighting

- Rated duration of emergency lighting= minimum 1 hour ۲
- Except for workplaces with higher hazard levels Rated duration \geq hazard time
- LBO/DIN V VDE V 0108-100 For most areas, the rated duration of • emergency lighting is required to be a minimum of 3 hours













Required illuminance (4.2.6/ 4.3.6)



 E_N Nominal illuminance (1 lx or 0.5 lx)



ASR A3.4/3 (acc. A-deviation EN 1838)



Required illuminance after 15s: 100%





EN 1838



Anti-panic lighting (4.3.1)



Germany: LBO requires 1lx

Netherlands: "Bouwbesluit" required 1 lx

France: Luminaires must achieve 5 lm/m². Uniformity – Distance between the luminaires < 4 x Mounting height

The horizontal illuminance must not exceed 0.5 lx on open floor areas.

The edge portions with a width of 0.5 m are not included.



EN 1838



Workplaces with particular hazards (4.4)

- $\frac{E}{E_N}$ [%] $\ge 10 \% \ge 15 \text{ lx}$
- Uniformity≤ 1:10
- Glare reduction in areas 60° to 90°
- Ra ≥ 40
- Rated duration ≥ Hazard time
- Achievement of nominal illuminance ≤ 0.5 s



4.4. shall not apply to France (acc. Appendix B)

EN 1838 / ASR A3.4/3



Required illuminance (4.4.6) / ASR (4.3(4))









Back-up/stand-by lighting (4.5)

- If replacement lighting is used as emergency lighting, then all regulations of EN 1838 must be observed.
- If replacement lighting falls below the minimum requirement values, the activity is to be terminated or the operation is to be shut down.
- Demands on the required minimum illuminance are regulated in the workplace guidelines.



Switching time after 1s





Switching time after 15s

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General (5.1 & 5.3)

- Safety signs must correspond to ISO 3864-1 (Design principles), ISO 3864-4 (Photometry) und ISO 7010 (design).
- Safety signs can be illuminated or backlit
- For general lighting, other requirements apply.

For Germany ASR A1.3 and DIN 4844-1 are observed.

France is regulated by Norm NF X 08-003 (acc. Appendix B)







Marking of emergency exits, including directional arrow



PL



PU







EN 1838 / ISO 710



Further marking:



Emergency exit with escape ladder



This is no longer allowed



Finding emergency exits via emergency personnel





Luminance of safety/exit signs (5.4)

EN 1838 for Emergency Lighting

- Luminance/Brightness Safety colour (Green) > 2 cd/m²
- Ratio of brightness within each colour > 1:10

White brightness $\leq 15:1$ 5:1 ≤

- Colour brightness
- Colours according to ISO 3864-1 and ISO 3864-4 ۲
- Lighting duration minimum 1 hour (where national standards do not specify larger values.)

France is regulated by Norm NF X 08-003 (acc. Appendix B)









EN 1838



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Required luminance (5.4.6)



France is regulated by Norm NF X 08-003 (acc. Appendix B)



DIN 4844-1

Luminance of safety/exit signs

DIN 4844-1 for General lighting (DIN 4844-1 only applies for use with DIN ISO 3864-1)

- Brightness of colour contrast (white) > 500 cd/m^2 ۲
- Ratio of brightness within each colour > 1:5

White brightness 5:1 ≤ − _____ ≤ 15:1 Colour brightness

Colours according to ISO 3864-1 and ISO 3864-4 ۲









Luminance of safety/exit signs

ISO 30061

ISO 30061 for the spreading of smoke

Luminance Safety colour > 10 cd/m²











DIN EN 1838 / DIN 4844



Viewing distances (5.5)

I = Viewing distance h = Height of sign

Backlit sign



z = Distance factor = 200 for backlit signs



France is regulated by Norm NF X 08-003 (acc. Appendix B)

DIN EN 1838 / DIN 4844



Viewing distances (5.5)

I = Viewing distance h = Height of sign



z = Distance factor = 100 for front lighted signs







Requirements for installation (4.1.1 / 5.5)

• If possible, the safety sign should not be mounted higher than 20° above the horizontal viewing of the maximum viewing distance of the sign.









b (Viewing distance)		а	ha (Higher viewer)	h (ha +a)	
0 m	20°	-	1 m		
12 m	20°	4,37 m	1 m	5,37 m	
17 m	20°	6,19 m	1 m	7,19 m	
18 m	20°	6,55 m	1 m	7,55 m	
20 m	20°	7,28 m	1 m	8,28 m	
22 m	20°	8,01 m	1 m	9,01 m	
24 m	20°	8,74 m	1 m	9,74 m	
28 m	20°	10,19 m	1 m	11,19 m	
30 m	20°	10,92 m	1 m	11,92 m	
32 m	20°	11,65 m	1 m	12,65 m	
60 m	20°	21,84 m	1 m	22,84 m	
$\tan \Box = \Box$					





EN 1838



Luminaire



In maintained mode



60 Minutes after power failure





For exiting illumination



60 Minutes after power failure





Specialities/special requirements for France (Appendix B)

- In France, illuminance and light density are not considered during planning.
- On escape routes, certified emergency lights must be placed at a distance of no more than 15m.
- The illuminance as a photometric aspect is not used in public buildings and workplaces.





Specialities/special requirements for Italy (Appendix B)

- For cinemas, theatres and similar venues, the illuminance near stairways and exits must be at least 5 lx, measured 1m above floor level.
- A minimum of 2 lx is required along escape routes.
- Provided illuminance values are specified by regulations, they are not to be regarded as planning values but must be measurable on location, including the reflection.



Preventative Fire Protection Integrity

Model EltBauVo 01 / 2009 Published 08 / 2009

MLAR 11 / 2005 Published 04 / 2006





Area of application §1

- EltBauVo 2009 applied to central battery systems that are used for legal building regulations prescribed safety systems and equipment installed in buildings.
- The term "central battery systems" includes both central- (CPS) and group battery systems (LPS).
- "In Building" as an exemptive rule for workplaces is no longer allowed.



Protection target: Functional integrity in the central battery system with separate electrical operation areas







Area of application §1

- Deviations from EltBauVo in individual states are only possible in isolated cases. The oblige of the required building documentation should be provided for each individual request for a deviation.
- Regardless of whether an emergency lighting system is required by the building regulations, the requirements of the workplace guidelines and accident prevention regulations of the statutory accident insurance must still be observed in the case of emergency lighting.



Model EltBauVo

Able to easy and safely exited from accessible areas to the outside in emergency situations

Requirements for electrical operating areas §4

- Able to be exited at any time without hindrance
- Not to be accessible from necessary ۲ Stairwells.
- The escape route to a safe area must not be longer than 35 m.









Model EltBauVo

Requirements for electrical operating areas §4

- Light height of minimum 2 m
- Passage height of minimum 1.80 m in service maintenance areas
- Any lines and equipment are not required for operation in electrical systems
- Able to be vented into the open immediately ٠ or by its own ventilation system









Additional requirements for battery rooms §7

Components (walls and doors, excluding external walls) with fire-resistance integrity in line with the required functional integrity.

In accordance with MLAR 11/2005; 5.1 (Model cable system regulation) all distributors providing emergency power must be separated from distributors for general power supplies with functional integrity (E30). Minimum volume: > 15m³

Model EltBauVo

(Comment with application recommendations to MLAR, 3rd edition)





Fire retardant = Fire resistance duration 30 Minutes



Additional requirements for battery rooms §7

- A sign must be attached to the door, stating 'Battery Area'.
- Floors must be conductive for electrostatic charges when closed cells are installed.

Model EltBauVo

VDE 0100 Part 729: Requirements for aisle wide and its height within electrical operation areas







Model EltBauVo / MLAR





In accordance with MLAR 11/2005; 5.1 (Model cable system regulation) all distributors providing emergency power must be separated from distributors for general power supplies with functional integrity (E30).



Model EltBauVo / MLAR



Sub-distribution







The duration of the cable system's functional integrity must be a minimum of 30 Minutes:

- Emergency lighting systems, with the exception of wiring systems, but including distributors serving as the power supply to the emergency lighting of a fire-zone on a floor or within a stairwell space.
 The base area per fire-zone shall not exceed 1600m².
- In NRW, the limitations of fire-zone size were forgone in LAR. Here, the maximum size of the fire- zone must be defined by fire protection concept.




Directive for structural fire protection in Industrial Constructions (09/90) NRW

2. Fire-fighting section/sector

2.1 In accordance with § 28 paragraph 1 sentence 1 Construction O NRW spacious buildings should be subdivided into fire-zones of maximum 40 m in length with the use of firewalls. If the distance of the firewalls is exceeded, the enlarged fire-zones of industrial buildings must be subdivided further into fire-fighting sections.





The function integrity of the cable is guaranteed, if the cable

- in line with DIN 4102-12 (E30 or E 90) or
- on bare floors beneath the ground-floor with a thickness of minimum 30 mm or
- laid below the ground in the earth
- The laying of the flush-mounted cable is not an adequate measure to maintain the functional integrity.



Fire safety / MLAR 11 / 2005





Separate cables and wires are to be used for every circuit of the emergency power supply. The separate cable routes are not required for laying the end circuit of the emergency lighting.



Fire safety / MLAR 11 / 2005



1 Fire compartment< 1600 qm



In service areas < 1600 m², the sub-distributor of the safety power supply may be placed unprotected, as long as nothing else is regulated in the LBO.



VDE 0100 - 729

Installation of low-voltage electrical installations -Requirements for special types of installations, areas and systems – Operations and maintenance areas

The standards contains the German interpretation of the European harmonisation document **HD 60364-7-729:2009** "Low-voltage systems installation - part 7-729: Requirements for special installations or locations - Operating or maintenance gangways".

The international standard **IEC 60364-7-729:2007** "Low-voltage electrical installations - Part 7-729: Requirements for special installations or locations - Operating or maintenance gangways "includes the common modifications from CENELEC.



VDE 0100 - 729



Requirements for aisle width and height within electrical operation areas







VDE 0100 - 729

Powering Business Worldwide

Additional requirements for areas with restricted access







Wiring dimensions



Wiring dimensions



The wiring system of the emergency lighting system must be dimensioned like all other wiring systems. The only difference is:

The dimensions must be carried out for mains operation as well as for battery operation.





Wiring dimensions



- Overload protection (Can the installed cable be used to max. feasible Load current or the rated current or the default value of the overload protection devices?)
- Voltage drop

(Is the calculated voltage drop across the network less than the maximum allowed voltage drop at the load?)

Short-circuit protection

 (Is the cable adequate dimensioned if there is a short-circuit by developing terminal loading under consideration of the short-circuit protection?)

Protection by shut-off

(Can the installed protective elements switch off during errors at the end of the cable length in the prescribed time? Those installed from CEAG carry safety fuses and trigger by 4-fold fuse rate within 5 seconds.)

Selectivity

(Is there selectivity between the installed protective elements?)





DIN VDE 0100-520, § 525.1 (June 2013)

The voltage drop between supply and consumption for lighting should not be higher than 3%.





For battery operation, it is important to note:

DIN EN 50171, § 6.12.5

At the end of the rated operating period, the output voltage must not be lower than 90% of the rated voltage: 216V * 0.9 = 194.4V DC

3% voltage drop of the battery (194,4V)

to the last luminaire => Δ u max. = 5,83V

194,4V - 5,83V = 188,57 V (188 V)







DIN VDE 0100-520 (Appendix G – informative)

• Voltage drops can be determined by the following equation:

$$u = b(p_1 \frac{L}{s} \cos \varphi + \lambda L \sin \varphi) L_B$$



Voltage drop



Key/This includes the following:

- u = Voltage drop in Volt;
- b = Coefficient 1 in three-phase circuits and 2 in single-phase circuits.
- p_1 = specific electrical resistance of the conductor during normal operation. This is referred to as the specific electrical resistance, the value of the existing temperature during normal operation, which is 1.25 times the resistance at 20 °C, or 0,0225 Ω mm²/m for copper and 0,036 Ω mm²/m for aluminium;
- L = straight length of cable and wire installation in Metres;
- S = Cross-section of the conductor, in mm²;
- **COS** ϕ = Power factor; if this is not know, a value of 0,8 (sin ϕ = 0,6) is assumed;
- λ = Reactance per unit length of the conductor. If this is not known, a value of 0.08 m Ω /m is assumed;
- I_B = Operating current (in Amp);
- the corresponding voltage drop in percent is made up of:
- U_0 = voltage between phase and neutral wires, in Volt.



 $\Delta \square = 100 * \square_0$



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