

# Electrical engineering in general: Design and construction. Electrotechnical buildings and rooms

## 1 Purpose and scope

The purpose with this clause is to state requirements for buildings and rooms related to electrical and constructional matters.

There are three categories of electrotechnical rooms:

- Kategori 1 Electrotechnical rooms for major stations (e.g. stations with junction) which contain critical electrotechnical systems related to the traction of trains and railway systems.
- Kategori 2 Electrotechnical rooms for minor stations
- Kategori 3 Electrotechnical rooms in kiosks (e.g. block post, radio kiosk etc.)

## 2 Constructional requirements

### 2.1 Location

#### 2.1.1 Building

Detached buildings shall be located outside the overhead contact line zone, e.g. at least 5 m away from the track.

A possible exception is technical room that are connected with platform and/or culvert beneath the tracks.

There should be an easy access to the building in order to bring equipment from transport vehicle and into the building.

#### 2.1.2 Internal in the building

Electrotechnical rooms shall be located in building to ease the transport of equipment into the room. Over electrotechnical rooms there shall be no rooms with access to water and sewer.

Electrotechnical rooms should not be installed in the basement, however, if electrotechnical rooms are located in the basement and there is a danger of flooding, the room shall be equipped with a drain and a valve blocking for ingress. If a new building is planned a location with less probability for flooding should be evaluated.

### 2.2 Construction

Dedicated (electrotechnical) houses / (electrotechnical) kiosks shall be build with common constructional materials, such as wood, concrete, bricks or other suitable materials for the housing of electrical/electronic equipment. The building should have an external non-electrical covering.

## 2.3 Electrotechnical room

There shall be no piping for water, gas, steam, sewer or access point to sewer in electrotechnical rooms.

Room directly above rooms with electrotechnical equipment shall not contain bath, kitchen or other room with plumbing. Extraneous objects should not be contained in the rooms.

### 2.3.1 Electrical installation

Electrical installations (light and heating) in the room shall be in accordance with [FEL]. There shall be proper lighting. Reflector luminaries used should be design to avoid collection of dust that are swirled into space by the air flows.

In electrotechnical rooms the cabling shall be performed with halogen free materials.

### 2.3.2 Space for documentation

In electrotechnical rooms of category 1 and 2 there shall always be dedicated space for a table with tray for the storage of descriptions and drawings, cabinet for spar parts, necessary chairs and shelf for binders. In electrotechnical rooms of category 3 there should be shelf for binders.

### 2.3.3 Fixtures

The internal of the room shall be fireproof covering. Concrete and bricks shall be covered with fireproof panels (see also [2.3.7](#)). The floor shall have antistatic flooring with bonding to earth, preferably 0,1—1,0 MΩ. Walls and roof shall be prepared with paint that is easily washable.

On the walls it should be possible to attach technical equipment. Horizontal anchoring should be prepared within the walls at a hight of 1,5 m. Molded floor shall be polished. Humidity from the ground shall not penetrate into the room and rodent shall not have access. Materials and liquid which can emit harmful gases to the electrical components shall not be used.

### 2.3.4 Size of room

When rooms are to be dimensioned future expansions with equipment shall be taken into account. Spare space shall be allocated to allow for data and communication equipment to be installed with access to both front and rear of cabinets. There shall be sufficient space for movement to access the technical equipment. The roof shall be at a hight not less than 2,40 m.

### 2.3.5 Temperature

In electrotechnical rooms of category 1 and 2 the temperature shall be kept at a nominal temperature of 18 °C. In the extreme the temperature shall be below 35 °C, but temperature deviations should be avoided. Se requirements temperature deviations given in [\[551\]](#). The room shall have heating by regulation (thermostat). Electrotechnical room of category 1 should be equipped with refrigeration unit(s) with heath exchange between the internal and outdoor air. In electrotechnical room of category 3 the temperature shall be limited to the temperature range of -15 °C to +45 °C.

### 2.3.6 Humidity

Recommended relative humidity is approximately 50 %.

### 2.3.7 Dust

Electrotechnical rooms shall be constructed to avoid dust to enter the room. Walls and roof shall be made with materials that does not emit dust into the room. Se also [\[510\], chapter 5](#) about cabling and cable ducts.

Examples of wall constructions with minimal emission of dust by supplementary installation of equipment:

- concrete with grouted zones for fastening (horizontal profiles in fireproof or wooden material) and painting to passivate dust.
- horizontal wooden material attached to the concrete wall and fireproof panels. Possible use of painting to passivate dust.

### 2.3.8 Strength of floor

Raised floor should sustain the following:

Load capacity with 2 mm deflection					
Spot load (N) without bearing element		Evenly distributed load	Spot load (N) with bearing element		Evenly distributed load
Border (N)	Center (N)	(N/m <sup>2</sup> )	Border (N)	Center (N)	(N/m <sup>2</sup> )
3700	4800	18000	4500	5200	22000

The design of raised floor depends of the following aspects:

- Requirements for resistance to earth
- Requirements for sealing against structures for cooling from below
- Requirements for floor loading capacity and rigidity
- Desired type of coating, and the developer shall be able to freely choose the colour
- Need for cut-outs
- Height of pedestal
- Requirements for fixing the pedestal
- Is there a need for stairs?
- Shall test results be submitted for the floor?
- Requirements to “FDV”-documentation
- Shall grids and electrical wiring be installed?
- Shall fire detection be installed in the under-floor?
- Shall water detectors be installed in the under-floor?
- NB! All installations in the under-floor should be adapted to the pedestal.
- Shall pathway systems and other equipment be fixed to the pedestal?

### 2.3.9 Markings

If electrotechnical rooms contains batteries this shall be stated on the door. Any fire extinguishing system shall as well be stated.

### 2.3.10 Windows

Windows should not be present in electrotechnical rooms, however, if present they shall have fire ratings in accordance with “brannklasse 3” (“plan- og bygningsloven”), block visual access and sun light to the room to facilitate the requirements for environmental climatic conditions.

## 2.4 Entrance

### 2.4.1 Major stations, room of category 1

Access to electrotechnical rooms of category 1 should be with a double-bladed door turning out of the room giving a minimum of 180 cm width and 210 cm high to facilitate transport of equipment either in to or out of the room. Any possible route to the room via other rooms or corridors etc. should not give more strict limitation of the transportation of equipment to the room. The entrance to the room should be secured by supervision to avoid access of unauthorized persons, and monitoring should be available at a central manned location. The room should have raised floor.

### 2.4.2 Minor stations, rooms of category 2 or 3

Access to electrotechnical rooms of category 2 and 3 should be with a double-bladed door turning out of the room giving a minimum of 180 cm width and 210 cm high. The room should have raised floor. Refer also to room of category 1.

## 2.5 Fire security

### 2.5.1 Detection

Electrotechnical rooms of category 1 and 2 shall be equipped with heat and smoke detectors. The need for smoke detectors in rooms of category 3 shall be evaluated in the particular case.

### 2.5.2 Fire fighting

All technical rooms in new buildings – if possible also in rooms equipment installations in existing buildings – shall be fitted with constructional materials in accordance with “brannklasse 3” (“plan- og bygningsloven” with additional regulations).

Cable pathways shall be fitted with fire barriers with materials that ensure the fire rating of the building is maintained, refer to [FEL].

Information about “brannklasser” is contained in [Byggeteknisk forskrift – TEK 10](#).

### 2.5.3 Fire extinguishing

Electrotechnical rooms of category 1 shall have automatic fire extinguishing facility. The fire extinguishing facility shall be constructed to minimize damage to the electrical installations when triggered. Any gas mixtures shall contain as little halogen as reasonable. If people are present in the room the gases shall not be toxic.

Automatic fire extinguishing facilities shall be proven by Jernbaneverket in every particular case.

Rooms in category 2 and 3 shall have manual fire extinguishing equipment within the vicinity.

If manual fire extinguishing equipment is stored at the door leading to such room, the maintenance of such equipment may be performed without physical access to the room. The risk of vandalism should be evaluated if the fire extinguishing equipment is stored on the outside.

### 2.5.4 Alert

In electrotechnical rooms of category 1 and 2 an alarm system shall be installed to ensure safety of

persons. The alarm system shall alert the local staff (local alert).

In electrotechnical rooms of category 3 alarm system should be evaluated according to the local matters.

## 2.6 Security of electrotechnical installations =

Access to rooms for technical equipment for signalling and telecommunications shall only be given to authorized persons. This staff shall have unrestricted access to equipment for secure operations of trains. The owner of the electrotechnical room authorizes access to the room. Others should only gain access together with authorized persons. To achieve this all rooms with technical equipment for the operations of trains shall be fitted with a closed key system. This is depicted in [\[551\]](#), [Generelle krav](#). Other system shall be approved by Jernbaneverket prior to installation.

## 2.7 Battery room

Batteries to be used should be maintenance-free, and should not emit gases and should not be harmful for electronic equipment. Batteries fulfilling this requirements may be installed in the same room together with the electrical installations.

Other batteries shall be separated from the rest of the electrical facility in its own room in accordance with requirements in [FEL].

For the location of batteries the requirements and notes in the regulations shall be observed. Only approved cable shall be used between battery and rectifier

The room shall have only one door. The door to the battery room shall always be closed, and the room shall be ventilated according to regulations.

In battery rooms there shall not be any tubes for damp or gases. Tubes not necessary for sewer or access to the sewer installation should be avoided. Storage of irrelevant objects is not allowed. It may be nice with access to water and washbasin (acid proof materials) and sink in the floor. If flooding is likely there should be a blocking valve associated with the sink.

# 3 Electrotechnical requirements

In general, refer to [\[510\]](#).

Electrotechnical requirements are not relevant for all-dielectric fibre optical cables.

## 3.1 Earthing

Some aspect of bonding and earthing are depicted in the following clauses in this chapter, see also [chapter 6](#) about earthing.

## 3.2 Building facility entry and over-voltage protection

Some requirements for electromagnetic compatibility is depicted in [chapter 4 Application of "Soneteorien"](#). Practical lay-out of a transient plate for EMC may have sections for each type of cable (e.g. telecommunications, signalling, low voltage etc.).

Over-voltage protection of incoming over-voltages from the energy source to technical equipment: The primary protection diverts the greater part of the transient while the secondary protection diverts the rest of the transient that is not fetched by the primary protection and is insufficiently

attenuated by the intermediate cable.

Primary protection shall be installed close to the connection of the external electricity provider. The primary protection devices should be doubled.

Secondary protection shall be installed in main distributions (substations), for all incoming lines/cables. The protection devices should be doubled.

Secondary protection shall be installed in the respective distributions for the provision to signalling and telecommunication equipment, see also clause 3.2.2.

### 3.2.1 Co-ordination between primary and secondary protection

See [chapter 7](#) for technical requirements for over-voltage protection.

Protection devices shall be installed to avoid touch voltages (IP20) or damage to other equipment. By installation the necessary clearing to other equipment, live parts or earthed parts shall be paid to avoid flash-over from protection devices that acts on and diverts over-voltages.

Plug-able protection devices with well visible alert should be used. Protection devices for important facilities should be fitted with an alert circuit (alarm) for remote monitoring.

Alarm should also be established for any fuses in front of over-voltage protection.

If fuses disconnects the protection device will not be operating, and an alarm will report it.

It is important that any separate protection devices for over-voltages are selective related to the common protection devices to avoid disconnection of all the facilities for one single minor failure.

### 3.2.2 Over-voltage protection for communication and signalling equipment

In addition to over-voltage protection at the energy supply side of the equipment, it is also necessary with separate protection devices for incoming and outgoing lines for signalling, telecommunications and remote control as depicted in the respective books of Teknisk regelverk [5XX].

In general over-voltage protection should be installed on any lines on all outgoing and incoming pairs for cables that are:

- routed along the railway tracks and is exposed to induced voltages from the traction power
- are connected to equipment in cabinets/closures connected to the track return circuit (see [\[510\], jording](#))
- connected to aerial lines close by the termination
- connected to equipment sensitive for lightning voltages (antenna mast and similar)

## 3.3 Cable routes in buildings

General principles for the vulnerability is depicted in [in chapter 4](#). Cables for telecommunications (copper and optical fibres) and cables for signalling shall be located away from cables vulnerable for heating and self ignition (fire precautions)

- Telecommunication cables shall not be positioned above energy cables.
- Telecommunication cables shall not be located above cables for signalling.
- Cables for signalling should not be installed above energy cables.

Energy cables and communication cables shall be separated in different compartments or in common ducts with metallic separation between the two types of cables.

Copper cables for telecommunications should be located with reasonable clearing to cables for signalling and energy cables for contact line with regards to EMC.

Cables for signalling should be located with reasonable clearing to cables for signalling and energy cables for contact line with regards to EMC.

All installation of metallic cables shall be metallic pathway systems. Cable ducts shall be electrical continuous and shall be bonded to earth in both ends and at arbitrary intervals if the length is more than 50 m.

Installed raised floor should have a grid for bonding purpose connected to the main earth bar. It is recommended with bonds at every third pedestal in each direction. Recommended cross-section of the bonds is 16 mm<sup>2</sup>.

### **3.4 IKT cabling with main purpose of office applications**

Prior to detailed design an installation specification shall be worked out (refer to EN 50174-1) with:

- anticipated external service providers and external telecommunication interfaces
- anticipated applications (actual interfaces for telephony, data, multi media etc.)
- technical requirements to the cabling (balanced cabling/categories, optical cabling/categories)
- anticipated number of outlets for the different categories of work areas
- volume (number of work areas distributed within the actual areas) with a life time span of at least five years
- installation (possible access restrictions / security of distributors and path ways)
- volume of measurements at the delivery
- documentation
- exception handling
- declaration of compliance with reference to standards (e.g. EN 50174 series, EN 50173 series, EN 50310, EN 50346 etc.)
- special conditions with regards to earthing on ground in the vicinity of railway installations – particular for electrical railways.

Examples of declaration of compliance can be found on Internet, e.g. Post- og teletilsynet or Nelfo.

The EN standards are also available in Norwegian.