

Regulations and general advice of the National Electrical Safety Board regarding the installation of electrical installations

decided on 21 April 2022.

The National Electrical Safety Board issues the following regulations¹ pursuant to Section 33 of the Electrical Safety Ordinance (2017:218)².

Chapter 1. General provisions

Scope

1 § These regulations contain provisions on the installation of electrical installations. Installation here refers to electrical installation work as specified in Section 4 of the Electrical Safety Act.

2 § These regulations apply to electrical installations as referred to in Section 3 of the Electrical Safety Act.

Definitions and abbreviations

3 § The definitions and abbreviations used in the Electrical Safety Act and the Electrical Safety Ordinance shall have the same meaning in these regulations.

For the purposes of these regulations, the following definitions shall apply.

<i>public distribution system</i>	a grid of transmission lines covered by a local grid concession; normally delimited by the feeding regional grid and the receiving consumption facility respectively.
<i>closed electrical operating area</i>	a room or other place for the operation of electrical installations or other electrical equipment which may involve a risk of damage due to electricity.
<i>operational building</i>	a building for the operation and functioning of a contact-line facility for the operation of a railway, tramway, underground railway or electric railway, such

¹ See Directive 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on Information Society services (codification)

² Last amended by 2021:700.

	as a technical building, lift and stairwell, shelter, maintenance hall, weighing house or break shed.
<i>electric shock</i>	physiological effect resulting from an electric current through a human or animal body.
<i>the Electrical Safety Ordinance</i>	the Electrical Safety Ordinance (2017:218), or a statute that has replaced it.
<i>the Electrical Safety Act</i>	the Electrical Safety Act (2016:732), or a statute that has replaced it.
<i>ELSÄK-FS 2022:3</i>	the regulations and general advice of the National Electrical Safety Board (2022:3) regarding checks of electrical installations and electrical equipment by the holder, or a statute that has replaced it.
<i>uninsulated overhead line</i>	overhead line with separately-suspended wires or covered conductors with accessories such as insulators and fasteners.
<i>obstacle</i>	a device that physically prevents accidental contact but not intentional contact.
<i>aerial insulated cable</i>	overhead line cables with wires with or without catenary in a common housing.
<i>bundle assembled aerial cable</i>	overhead line cable with conductors covered with basic insulation and with or without catenary and without a common housing. May also appear in double insulated version.
<i>high voltage</i>	nominal voltage exceeding 1000 volts AC / 1500 volts DC.
<i>contact line</i>	an aboveground conductor fixed to poles or other supports intended for the operation of railways, tramways, underground railways or electric roads, or a conductor in an underground power busbar for the operation of electric roads. Examples of contact lines are uninsulated overhead line, return line, by-pass line, feeder line, auxiliary power line and power busbar.
<i>overhead line</i>	general term for above-ground lines or cables placed on poles or other supports to achieve a certain height; divided into uninsulated lines, aerial insulated cable and bundle assembled aerial cable.
<i>low voltage</i>	nominal voltage up to and including 1000 volts AC / 1500 volts DC.
<i>nominal voltage</i>	value of the voltage by which the electrical installation or part of the electrical installation is designated and identified.
<i>maritime traffic area</i>	the general term for water areas that form part of the Swedish maritime territory according to the Swedish

	Sea Territory and Maritime Zones Act (2017:1272), with the exception of water areas where traffic is prohibited by their shallowness, smallness or strong current.
<i>PE conductor</i>	protective conductor intended for protective earthing.
<i>PEL conductor</i>	conductor with a combined function of both protective earthing conductor and line conductor.
<i>PEM conductor</i>	conductors that have a combined function of both protective earth conductor and mid-point conductor.
<i>PEN conductor</i>	conductor with a common function as protective earth conductor and neutral conductors.
<i>live part</i>	conductor or conductive part intended to be live in normal use, including neutral conductors but excluding PE, PEN, PEM and PEL conductors.
<i>TN system</i>	a distribution system where a point in the system is directly earthed at the power source and where exposed-conductive-parts are directly connected to this point.
<i>exposed-conductive-part</i>	a conductive part of electrical equipment that can be touched and that is not live under normal conditions, but which can become live when basic insulation fails.

Exemptions from the regulations

4 § The National Electrical Safety Board may grant exemptions from these regulations.

Chapter 2. Good electrical safety practice

1 § An electrical installation shall be designed and erected in accordance with good electrical safety practice so as to provide adequate protection against personal injury and damage to property caused by electricity.

Good electrical safety practice means the application of these regulations and of the practices established in the field of electrical safety by supplementary standards or other assessment criteria.

If the Swedish standard is applied as a supplement to the regulations, the installation is considered to have been installed in accordance with good electrical safety practice unless otherwise demonstrated. An installation may be installed in a manner that deviates wholly or partially from the Swedish standard, provided that equivalent safety is achieved. If the design and erection deviates from the Swedish standard, the assessments on which the installation is based shall be documented.

2 § Before a new, modified or expanded electrical installation is put into service, it shall be checked to ensure that it complies with good electrical safety practice.

An installation is considered to be put into service when it is energised at a voltage, current or frequency which may be dangerous to persons or property. This applies even if it has been energised temporarily, for example for test operation.

Chapter 3. Basic safety requirements

Requirements applying to all types of electrical installations

1 § An electrical installation shall be installed to provide adequate safety

- under normal conditions,
- in the event of one (1) failure of the installation, and
- in the event of reasonably foreseeable misuse.

2 § An electrical installation shall be so designed and erected that humans and domestic animals are protected against electric shock which may occur through direct contact with live parts or with exposed-conductive-parts which have become live through one (1) fault.

3 § An electrical installation shall be so designed and erected that it does not present a risk of personal injury or damage to property due to high temperatures, electric arcs or mechanical stress caused by current during normal operation or overcurrent.

4 § An electrical installation shall be designed and erected to withstand normal voltages which can be expected to occur in the installation and as a consequence of a fault between live parts of circuits supplied at different voltages.

5 § An electrical installation shall be designed and erected to meet the requirements of the external influences caused by the surrounding environment and the activities carried out in connection with the installation.

6 § An electrical installation shall be provided with the marking and documentation necessary to enable the various parts of the installation to be identified unambiguously for operation and maintenance purposes. The documentation shall be available in Swedish and the language appropriate for those who will receive the documentation.

7 § The holder shall prepare installation-specific instructions and directions for persons carrying out work on the electrical installation when the installation of the electrical installation and its intended use so require, in order to provide adequate protection against injury to persons and damage to property caused by electricity. Instructions and directions shall be available in Swedish and the language appropriate for those who will be performing work at the installation.

8 § Provisions on employer responsibility for producing work instructions are found in Section 7 of the Swedish Work Environment Authority's provisions on Systematic Work Environment Management (2001:1) and general advice on the application of the regulations, or the statute that has replaced these.

Requirements covering certain types or parts of electrical installations

9 § An overhead or contact line shall be so installed and routed that its design and location adequately prevent the risk of personal injury or damage to property due to electricity.

General advice

When locating an overhead or contact line, consideration should be given to the distance from, inter alia, the ground, vegetation, other lines, traffic routes and buildings.

10 § A *closed electrical operating area* shall be enclosed or restricted in a safe manner. Only qualified persons or persons who have been instructed about the risk of damage due to electricity shall have access to a *closed electrical operating area*.

Chapter 4. Specific safety requirements for low-voltage installations

1 § Public low-voltage distribution systems shall be designed as TN systems. The PE/PEN conductor of the system shall be earthed near the power source. In public distribution systems that are not part of interconnected earthing systems, the PE/PEN conductor shall also be earthed at appropriate locations at the periphery of the system.

2 § Connected sockets for public use in low-voltage installations shall meet the requirements of the National Electrical Safety Board's regulations (2019:1) on plugs and sockets for public use, or the statute that has replaced it. Sockets shall either be fitted with a child-safety shutters or be constructed or located so as to limit the risk of accidents to children.

Chapter 5. Specific safety requirements for high-voltage installations

Earthing and protection against contact with energized parts

1 § Exposed-conductive-parts of a high-voltage installation shall be earthed. This also applies to extraneous-conductive-parts which, in the event of failure, may become energized by induction or influence and present a risk of personal injury or damage to property.

Outside the *closed electrical operating area*, equipment and cables shall either have an earthed intermediate or be protected by their position against accidental contact. Earthed intermediate means metal enclosure for apparatus and screen for cables.

2 § In *closed electrical operating area*, protection against direct contact with a high-voltage installation may be provided by means of obstacles. Beams, chains and ropes are not considered to be obstacles.

3 § In the case of a low-voltage TN system connected to a power source from a high-voltage system, single-pole earth fault in the connecting high-voltage system shall not cause an earth potential rise of more than 100 volts in the exposed-conductive-parts of the low-voltage system. This only applies to TN systems leaving the high-voltage area of influence.

This provision shall not apply to high-voltage installations for the operation of railways.

Disconnection requirements

4 § In high voltage installations with line-to-earth short-circuit currents exceeding 500 A, line-to-earth short-circuit connections shall be disconnected within 0.5 s. In high voltage power installations containing high voltage overhead lines with line-to-earth short-circuit currents of less than 500 A, line-to-earth short-circuit connections shall be disconnected within 5 s.

5 § In high voltage installations with line-to-earth short-circuit currents of less than 500 A including

- an uninsulated overhead line (reinforced line type 2),
- an uninsulated overhead line with coated conductors, or
- an overhead line made of cable without a metal sheath or shield,

the earth-fault devices shall have the highest possible sensitivity in detecting earth faults. The relay function for disconnection shall be ensured for resistance values up to 5 kilohms.

6 § In high voltage installations with line-to-earth short-circuit currents of less than 500 A for a nominal voltage of 25 kilovolts or less, which includes overhead lines of any type other than those specified in Section 5, the relay function for disconnection shall be ensured for resistance values up to 3 kilohms for the earth-fault detection. In areas not covered by urban planning, such an installation may include several spans of uninsulated overhead lines with coated conductors.

7 § In high voltage installations, the voltage value shall be set to provide adequate safety in the event of a line-to-earth short-circuit. The value shall be adapted to the prevailing conditions of the site.

General advice

The prevailing conditions to be considered are:

- soil resistance,
- the surface of the soil, and

- whether people are expected to be on site.

For Swedish conditions, the following resistances in addition to a measurement resistance of 1 kilohm can be considered as good electrical safety practice regarding touch voltages:

- 0 ohms at bathing areas, playgrounds, camping areas, schoolyards or similar places where the body's contact with the environment can be expected to have low or no limitations,
- 4 kilohms in places where people are likely to be present, such as *closed electrical operating area*, streets, roads or car parks, or
- 7 kilohms for other locations.

In high voltage installations with line-to-earth short-circuit currents exceeding 500 A, adequate safety may be deemed to exist if the earth potentials rise due to the line-to-earth short-circuit current is limited to voltages not exceeding 220 V at a measured resistance of 1 kilohm.

Chapter 6. Specific safety requirements for overhead lines

Area with urban planning

1 § In areas with a urban planning, a high-voltage uninsulated overhead line shall be constructed as a reinforced line type 1. At a maximum nominal voltage of 25 kilovolts, the uninsulated overhead line may be of the reinforced line type 2.

Location and position of overhead lines

2 § Overhead lines belonging to different holders shall, if possible, be located on separate poles.

Provisions for coordination of inspection and maintenance, etc., regarding parallel lines has different holders and located at the same support can be found in Section 13 of ELSÄK-FS 2022:3.

3 § The conductor's minimum height above the ground shall not be less than the values shown in Table 1. The voltage dependent increment (S) shall be calculated at 7 mm for a high-voltage installation with line-to-earth short-circuit currents below 500 A and 5 mm for a high voltage installation with line-to-earth short-circuit currents above 500 A for each kilovolt by which the highest voltage for installation exceeds 55 kilovolts.

Exceptions to the first paragraph may be made as follows: When introducing a low voltage overhead line to a building, the height above ground may be reduced to at least 3.5 m for uninsulated overhead lines and cables. The height above ground of a high voltage overhead line may be reduced when entering a building, if the line is made of metal-sheathed or shielded cable.

Table 1. Minimum height above ground in metres.

Line type and nominal voltage	Area with urban planning	Rural areas
Overhead line \leq 1 kilovolt	4.5	4.5
Overhead line without metal-sheathed or shielded cable $>$ 1 kilovolt	6*	6
Overhead line with metal-sheathed or shielded cable $>$ 1 kV	6*	4.5
Line conductor in uninsulated overhead line $>$ 1 and \leq 55 kilovolt $>$ 55 kilovolt	7 7 + S	6 6 + S
Parallel earth continuity conductor	6*	4.5*

The values marked with * apply to free space in all loading cases. Other values apply at maximum conductor temperature and no wind. S refers to voltage dependent increment.

4 § A low voltage overhead line may be located over or near a building provided that it can be reached only by special means from windows, balconies or roofs.

5 § A high voltage overhead line shall not be extended over a building. Provided that adequate security can still be achieved, exceptions apply to

- metal-sheathed or shielded cables,
- uninsulated overhead lines within a closed electrical operating area, and
- uninsulated overhead lines over smaller, non-electrified buildings.

When assessing whether adequate safety is achieved, the size of the building, the distance to the nearest line conductor and the nominal voltage and installation of the line shall be taken into account.

6 § A high voltage overhead line shall be so arranged that the horizontal distance between the conductors and a building or any part of a building is not less than the values given in Table 2. Exceptions apply to overhead lines made with metal-sheathed or shielded cable.

Table 2. Minimum horizontal distance in metres between the line conductor and the nearest building element.

Area	Nominal voltage	No-wind conditions	At the greatest amount of oscillation
Area with urban planning	>1 and ≤ 55 kilovolt	5	3
	>55 kilovolts	10	3 + S
Rural areas	>1 and ≤ 55 kilovolt	5	3
	>55 kilovolts	5 + S	3 + S

This Table does not apply to building entry. S refers to voltage dependent increment, see Section 3.

Location of overhead lines at traffic routes

7 § Provisions on overhead lines in maritime traffic areas are contained in Section 12 of the Electrical Safety Ordinance. Section 6 of the same Ordinance also contains provisions on the obligation to notify the Swedish Maritime Administration of the commencement or completion of work on power lines in an area used for maritime traffic.

8 § The minimum height of an overhead line above road, rail or maritime traffic shall not be less than the values shown in Table 3.

Table 3. Minimum clearance to lines crossing traffic route in metres.

Line type and nominal voltage	Road traffic		Rail traffic		Maritime traffic
	Public road	Other road	Rails for non-electrified railways	Rails for electrified railways	Medium water surface
Overhead line ≤ 1 kilovolt	6*	6*	8*	Not permitted	6*
Overhead line > 1 kilovolt	6*	6*	8*	Minimum height to be determined on a case-by-case basis in consultation	7
Line conductors in uninsulated overhead line	7	6*	8		7

>1 and ≤ 55 kilovolts				with the railway holder	
Line conductors in uninsulated overhead line > 55 kilovolts	7 + S	(6 + S)*	8 + S		7 + S
Parallel earthing conductor	6*	6*	7*		7

The values marked with * apply to free space in all loading cases. Other values apply at maximum conductor temperature and no wind. S refers to voltage dependent increment, see Section 3.

9 § If an overhead line crosses an electrified railway, it shall be hung at a height decided by the National Electrical Safety Board after consultation with the holder of the railway.

10 § A power line, a low voltage line or a mechanical line crossing a contact line for the operation of a railway, tramway, underground railway or electric road shall be routed under the traffic route.

When the crossing line is a high-voltage line, it may be pulled over the contact line if the high-voltage line's crossing voltage is of reinforced line type 1.

Where the crossing is a low-voltage line, it may be laid over a contact wire for the operation of tramways, underground railways or electric roads at a nominal DC voltage not exceeding 750 volts if the low voltage line at the crossing point is provided with reinforced insulation for 750 volts and is suspended from a supporting cable of insulating material.

Further provisions on low voltage power lines in areas of railways, which are open to public traffic, or for tramways or underground railways, which are under the supervision of the Swedish Transport Administration, are contained in Section 5 of the Order (1972:463) with certain provisions on low-voltage power lines.

Location of overhead high-voltage lines at certain sites

11 § A high-voltage overhead line, other than a metal-sheathed or shielded cable, shall be routed at a safe distance from places where large numbers of people congregate outdoors.

An overhead line may be run over areas for recreational activities which do not normally have spectator seating provided that damage to the line has been prevented and the line is constructed as a reinforced line type 1, at a nominal voltage of 25 kilovolts or less, as a line of reinforced line type 2.

General advice

The horizontal distance of an energized conductor from the site should not be less than 20 m.

12 § A high voltage overhead line, other than a metal-sheathed or shielded cable, shall be routed at a safe vertical and horizontal distance from parking areas.

In assessing the distance necessary to provide adequate safety in parking areas, account shall be taken of the type of vehicle for which the parking area is intended and whether it is permissible to park vehicles intended for the transport of explosives or flammable goods.

General advice

In assessing the horizontal distance required to provide adequate safety at parking places, guidance can be obtained from Table 2 for distances to buildings and from Table 4 for distances to vehicles carrying flammable or explosive goods.

Distance to certain areas

13 § An uninsulated overhead line shall be installed at a safe distance from storage areas with flammable materials and areas with an explosion risk.

General advice

The dimensions given in Table 4 may provide guidance in assessing what may be considered an adequately safe distance from an area of explosion risk.

Table 4. Minimum horizontal clearance in metres from live conductors to an area of explosion risk.

Highest voltage for equipment in kilovolts	Clearance to a hazardous area with flammable goods taking into account the risk of capacitive coupling	Clearance from a storage facility containing explosives
12.0 - 72.5	15	50
82.5	30	50
145 - 170	30	100
245	45	100
420	60	100

Highest voltage for equipment refers to the maximum operating voltage of the installation and equipment.

14 § An overhead line shall be deployed at a safe distance from shooting ranges.

In assessing the distance necessary to provide adequate safety at shooting ranges, account shall be taken of the design and use of the shooting range. The distance assessment shall include the lateral distance, the horizontal distance behind the firing point and behind the bullet trap and the visibility of the line from the firing point.

Chapter 7. Specific safety requirements for overhead contact lines for the operation of railways, tramways, underground railways or electric roads

Contact wire for the operation of railways, tramways, underground railways or electric roads

1 § In the case of a road or footbridge over a contact wire, protective devices shall be provided to shield the contact wire, if the distance between the bridge deck and the contact wire is less than 5 m.

2 § A contact line shall be installed to reasonably prevent damage to cables, pipes and metal objects caused by the effects of leakage currents.

3 § A contact line shall be installed at a safe distance from storage areas with flammable materials or areas with an explosion risk.

General advice

The dimensions given in Chapter 6, Section 13, Table 4 may provide guidance in assessing what may be considered a safe distance from an area with an explosion risk.

4 § A contact line shall be routed so that the horizontal clearance between the energized part and a building or any part of a building into which the wire is not to be inserted is at least 5 m in windless conditions.

However, a contact wire which is an uninsulated overhead line for a nominal voltage not exceeding 750 V volts may be routed closer to buildings, provided that it can be reached only by special means from windows, balconies or roofs.

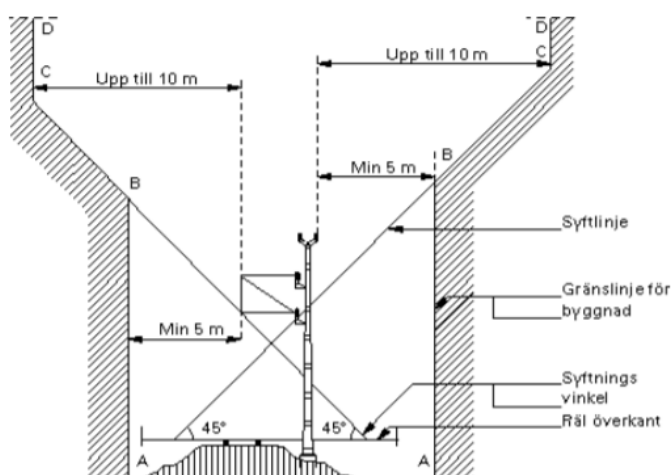
Notwithstanding the first paragraph, the horizontal clearance may be reduced

- at operational buildings to 3 m,
- in the case of operational buildings with a base area of 10 m² or less, to 0.5 m from the uninsulated overhead line, provided that the building has a lateral clearance of at least 4 m from the contact line and a horizontal clearance from the nearest pole of at least 4 m,
- on platform roofs, to the distance which can be regarded as providing adequate safety, provided that access to the platform roof is restricted to unauthorised persons and taking into account the vehicle pantographs and work which may have to be carried out on the roof; or
- in the case of insulated outriggers in combination with a protective screen with a minimum width of 1 m mounted on either side of the contact line pole as protection if no energized parts other than outriggers are present, provided that the building has a lateral distance of at least 5.4 m from the centre of the track.

General advice

If a contact line is installed in the vicinity of a building that is significantly higher than the contact line, special safety measures may sometimes be required.

However, no special protection measures are normally needed if any building component is not closer to the contact wire than indicated by the boundary lines A-B-C-D in the figure below showing a section of track with a contact wire for a nominal voltage above 750 volts.



Up to 10 m	Sight line
Min 5 m	Building boundary line
Up to 10 m	Sighting angle
Min 5 m	Rail top edge

Contact line for railway operation

5 § A contact line for the operation of a railway shall be located so that the minimum height above the top of the rail is not less than 5 m.

Under road bridges, tunnels and the like, the minimum height of the overhead contact line may be reduced to 4.8 m for a high-voltage installation and 4.2 m for a low-voltage installation.

6 § A contact line for railway operation shall be routed in such a way that the horizontal clearance between the energized part and the roadway edge is at least 4 m.

In the case of overhead contact line for railway operation, the horizontal clearance may be reduced provided that insulated outriggers are used in combination with protective shields with a minimum width of 1 m. These shall be installed as protection on either side of the contact line pole. The exemption applies only if there are no edge parts other than the outriggers and provided that the roadway edge has a lateral distance of at least 4.4 m from the centre of the track. The lateral distance

shall be measured from the track centre to the nearest roadway edge. Roadway edge normally means the edge of the carriageway. In the case of a paved shoulder, parking lot or bus bay, the asphalt edge shall be considered as the roadway edge.

7 § At level crossings between a railway contact line and a busy public road, there shall be overhead sign gantries on both sides of the railway with the lower edge at least 4.7 m above the road surface. The contact wire shall be laid at least 0.5 m higher than the bottom edge of the overhead sign gantry for low voltage or at least 0.8 m for high voltage.

In the event of temporary work, the distance 0.8 m may be reduced to 0.5 m.

If there are special reasons and the highway authority so permits, the height of the contact wire above the top of the rails may be reduced to not less than 5 m and the vertical distance between the bottom of the overhead sign gantry and the road surface may be reduced to not less than 4.2 m.

Contact line for underground railway operation

8 § A track area for underground railways with power busbars shall be enclosed or restricted in a safe manner. Only qualified persons or persons who have been instructed about the risk of damage due to electricity may have access to the track area.

Contact wire for operation of electric road

9 § A contact wire for the operation of an electric road shall be located so that the minimum height above the road surface on a public road is not less than 5 m.

10 § A contact wire for the operation of an electric road shall be completely terminated at least 4 m before the crossing contact wire in level crossing with rail-bound traffic.

11 § The provisions of Section 1 and Sections 3 through 9 shall not apply to contact-line installations for the operation of an electric road with conductors in underground power busbars. Nor shall Section 3 apply to other types of contact-line installations for the operation of an electric road.

Entry into force and provisional regulations

These regulations will enter into force on 1 December 2022, when the National Electrical Safety Board's Regulations and general advice regarding the installation of electrical installations (ELSÄK-FS 2008:1) will expire.

Installations put into service before the entry into force may be constructed in accordance with previous regulations. However, if the use or conditions of such an installation change in a way that has a significant impact on electrical safety, the new regulations shall apply.

In the event of the conversion or expansion of an installation, the new regulations shall apply to the conversion or extension irrespective of when the installation was originally put into service. The following exceptions may be made to:

- the requirements of good electrical safety practice in Chapter 2, Section 1:
 - when expanding a low-voltage installation within an existing dry room in dwellings with insulating floors, the exposed-conductive-parts do not need to be earthed if the already existing exposed-conductive-parts are not earthed and the installation was built before 1 January 1994,
 - when expanding a low-voltage installation within an existing dry room in a dwelling, additional protection in the form of a residual current device need not be installed if the existing installation is designed in accordance with ELSÄK-FS 1994:7 or equivalent older regulations, and
- requirements for the sensitivity of earth-fault protection in Chapter 5, Section 6:
 - such overhead lines may be extended or expanded with uninsulated conductors without changing the sensitivity requirement of the earth-fault protection.

ANDERS PERSSON

Peter Lindberg

**ELSÄK-FS
2022:1**

THIS IS NOT LEGAL/JUDICIAL TEXT. This document contains a rough translation of National Electrical Safety Board's regulations. Its contents is not legal text and it should only be used for readers who wish to get a general understanding of the contents in the Swedish regulations concerning electrical safety and electromagnetic compatibility. The texts are not necessarily comprehensive, complete, accurate or up-to-date.

For legal text - please use the link below.

Section of legislation: Execution of electrical installations

Number: ELSÄK-FS 2022:1

Title: Regulations and general advice of the National Electrical Safety Board regarding the installation of electrical installations

Legal titel: Elsäkerhetsverkets föreskrifter och allmänna råd om hur starkströmsanläggningar ska vara utförda.

Link to regulations: <https://www.elsakerhetsverket.se/globalassets/foreskrifter/elsak-fs-2022-1.pdf>