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Titre : CEI 60364-1, Ed. 5: Installations électriques des bâtiments - Partie 1: Domaine d'application, objet et principes fondamentaux

Title : IEC 60364-1, Ed. 5: Electrical installations of buildings - Part 1: Fundamental principles, assessment of general characteristics, definitions

Note d'introduction

Introductory note

ATTENTION	ATTENTION
CDV soumis en parallèle au vote (CEI) et à l'enquête (CENELEC)	Parallel IEC CDV/CENELEC Enquiry

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICAL INSTALLATIONS OF BUILDINGS –
Part 1: Fundamental principles, assessment of
general characteristics, definitions**

FOREWORD

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International Standard IEC 60364-1 has been prepared by technical committee 6 : Electrical installations and protection against electric shock

This fifth edition cancels and replaces the fourth edition, published in 2001. It constitutes a technical revision.

The text of this standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until _____. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

ELECTRICAL INSTALLATIONS OF BUILDINGS – Part 1: Fundamental principles, assessment of general characteristics, definitions

11 Scope¹

IEC 60364 gives the rules for the design, erection, and proper functioning of electrical installations. The rules are intended to provide for the safety of persons, livestock and property against dangers and damage which may arise in the reasonable use of electrical installations.

11.1 IEC 60364 applies to the design, erection and verification of electrical installations such as those of:

- a) residential premises;
- b) commercial premises;
- c) public premises;
- d) industrial premises;
- e) agricultural and horticultural premises;
- f) prefabricated buildings;
- g) caravans, caravan sites and similar sites;
- h) construction sites, exhibitions, fairs and other installations for temporary purposes;
- i) marinas
- j) external lighting and similar installations (see however 11.3 e))
- k) medical locations
- l) mobile or transportable units
- m) photovoltaic systems

NOTE Premises covers the land and all facilities including buildings belonging to it.

11.2 IEC 60364 covers:

- a) circuits supplied at nominal voltages up to and including 1 000 V a.c. or 1 500 V d.c.;
For a.c., the preferred frequencies which are taken into account in this standard are 50 Hz, 60 Hz and 400 Hz. The use of other frequencies for special purposes is not excluded.
- b) circuits, other than the internal wiring of apparatus, operating at voltages exceeding 1 000 V and derived from an installation having a voltage not exceeding 1 000 V a.c., e.g. discharge lighting, electrostatic precipitators;
- c) wiring systems and cables not specifically covered by the standards for appliances;
- d) all consumer installations external to buildings;
- e) fixed wiring for information and communication technology, signalling, control and the like (excluding internal wiring of apparatus);
- f) the extension or alteration of the installation and also parts of the existing installation affected by the extension or alteration.

NOTE The rules of IEC 60364 are intended to apply to electrical installations generally but in certain cases they may need to be supplemented by the requirements or recommendations of other IEC standards (e.g. for installations in explosive gas atmospheres).

¹ The numbering system is explained in annex A.

11.3 The standard does not apply to:

- a) electric traction equipment, including rolling stock and signaling equipment;
- b) electrical equipment of motor vehicles, except those covered in part 7;
- c) electrical installations on board ships, mobile and fixed offshore platforms;
- d) electrical installations in aircraft;
- e) public street-lighting installations which are part of the public power grid;
- f) installations in mines and quarries;
- g) radio interference suppression equipment, except so far as it affects safety of the installation;
- h) electric fences;
- i) lightning protection of buildings.

NOTE Atmospheric phenomena are covered, however, in so far as effects on the electrical installations are concerned (e.g. with respect to selection of lightning arresters).

- j) certain aspects of lift installations
- k) electrical equipment of machines

11.4 This standard is not intended to apply to:

- systems for distribution of energy to the public, or
- power generation and transmission for such systems.

NOTE 1 Countries wishing to do so may, however, use this standard in whole or in part for that purpose.

NOTE 2 According to IEC 61936 which provides common rules for the design and the erection of electrical power installations in systems with nominal voltages above 1kV a.c. and nominal frequency up to and including 60 Hz, low-voltage a.c. and d.c. protection and monitoring systems are to be designed in accordance with IEC 60364.

11.5 Electrical equipment is dealt with only as far as its selection and application in the installation are concerned.

This applies also to assemblies of electrical equipment complying with the relevant standards.

12 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60364. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60364 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(826): 2004, *International Electrotechnical Vocabulary – Chapter 826: Electrical installations of buildings*

IEC 60364-4-41:2001, *Electrical installations of buildings – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-42:2001, *Electrical installations of buildings – Part 4-42: Protection for safety – Protection against thermal effects*

IEC 60364-4-43:2001, *Electrical installations of buildings – Part 4-43: Protection for safety – Protection against overcurrent*

IEC 60364-4-44:2001, *Electrical installations of buildings – Part 4-44: Protection for safety – Protection against electromagnetic and voltages disturbances*

IEC 60364-5-51:2001, *Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules*

IEC 60364-5-52:2001, *Electrical installations of buildings – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

IEC 60364-5-53:2001, *Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control*

IEC 60364-5-54:2002, *Electrical installations of buildings – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements, protective conductors and protective bonding conductors*

IEC 60364-5-55:2001, *Electrical installations of buildings – Part 5-55: Selection and erection of electrical equipment – Other equipment*

IEC 60446:1999, *Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or numerals*

IEC 60617:1996, *Graphical symbols for diagrams*

IEC 60721 series, *Classification of environmental conditions*

13 Fundamental principles

NOTE 1 Where countries not yet having national regulations for electrical installations deem it necessary to establish legal requirements for this purpose, it is recommended that such requirements be limited to fundamental principles which are not subject to frequent modification on account of technical development. The contents of clause 13 may be used as a basis for such legislation.

NOTE 2 This clause contains basic requirements. In other parts of this standard (see table A.2) more detailed requirements may be given.

131 Protection for safety

131.1 General

The requirements stated in 131.2 to 131.7 are intended to provide for the safety of persons, livestock and property against dangers and damage which may arise in the reasonable use of electrical installations. The requirements to provide for the safety of livestock are applicable in locations intended for them.

NOTE In electrical installations, the following hazards may arise:

- shock currents;
- excessive temperatures likely to cause burns, fires and other injurious effects;
- ignition of a potentially explosive atmosphere;
- undervoltages, overvoltages and electromagnetic influences likely to cause or result in injury or damage;
- power supply interruptions and/or interruption of safety services;
- arcing, likely to cause blinding effects, excessive pressure, and/or toxic gases;
- mechanical movement of electrically activated equipment.

131.2 Protection against electric shock

131.2.1 Basic protection (protection against direct contact)

NOTE For low-voltage installations, systems and equipment, basic protection generally corresponds to protection against direct contact.

Protection shall be provided against dangers that may arise from contact with live parts of the installation by persons or livestock.

This protection can be achieved by one of the following methods:

- preventing a current from passing through the body of any person or any livestock;
- limiting the current which can pass through a body to a non-hazardous value.

131.2.2 Fault protection (protection against indirect contact)

NOTE For low-voltage installations, systems and equipment, fault protection generally corresponds to protection against indirect contact, mainly with regard to failure of basic insulation.

Protection shall be provided against dangers that may arise from contact with exposed-conductive-parts of the installation by persons or livestock.

This protection can be achieved by one of the following methods:

- preventing a current resulting from a fault from passing through the body of any person or any livestock;
- limiting the magnitude of a current resulting from a fault, which can pass through a body, to a non-hazardous value;
- limiting the duration of a current resulting from a fault, which can pass through a body, to a non-hazardous time period.

131.3 Protection against thermal effects

The electrical installation shall be so arranged to minimize the risk of damage or ignition of flammable materials due to high temperature or electric arc. In addition, during normal operation of the electrical equipment, there shall be no risk of persons or livestock suffering burns.

131.4 Protection against overcurrent

Persons and livestock shall be protected against injury and property shall be protected against damage due to excessive temperatures or electromechanical stresses caused by any overcurrents likely to arise in live conductors.

This protection can be achieved by limiting the overcurrent to a safe value or duration.

131.5 Protection against fault currents

Conductors, other than live conductors, and any other parts intended to carry a fault current shall be capable of carrying that current without attaining an excessive temperature. Electrical equipment, including conductors shall be provided with mechanical protection against electromechanical stresses of fault currents as necessary to prevent injury or damage to persons, livestock or property.

Live conductors shall be protected against overcurrents arising from faults by the methods in 131.4.

NOTE Particular attention should be given to PE conductor and earthing conductor currents.

131.6 Protection against voltage disturbances and measures against electromagnetic influences

131.6.1 Persons and livestock shall be protected against injury and property shall be protected against any harmful effects as a consequence of a fault between live parts of circuits supplied at different voltages.

131.6.2 Persons and livestock shall be protected against injury and property shall be protected against damage as a consequence of overvoltages such as those originating from atmospheric events or from switching.

NOTE For protection against direct lightning strikes, see IEC 61024

131.6.3 The installation shall have an adequate level of immunity against electromagnetic disturbances so as to function correctly in the specified environment. The installation design shall take into consideration the anticipated electromagnetic emissions, generated by the installation or the installed equipment, which shall be suitable for the current-using equipment used with or connected to the installation.

131.7 Protection against power supply interruption

Where danger or damage is expected to arise due to an interruption of supply, suitable provisions shall be made in the installation or installed equipment.

132 Design

132.1 General

For the design of the electrical installation, the following factors shall be taken into account to provide:

- the protection of persons, livestock and property in accordance with clause 131;
- the proper functioning of the electrical installation for the use intended;

The information required as a basis for design is listed in 132.2 to 132.5. The requirements with which the design shall comply are stated in 132.6 to 132.12.

132.2 Characteristics of available supply or supplies

When designing electrical installations in accordance with IEC 60364, it is necessary to know the characteristics of the supply. Relevant information from the network operator is necessary to design a safe installation according to IEC 60364. The characteristics of the power supply should be included in the documentation to show conformity with IEC 60364. If the network operator changes the characteristics of the power supply this may affect the safety of the installation.

132.2.1 Nature of current: a.c. and/or d.c.

132.2.2 Nature and number of conductors:

- for a.c.: line conductor(s);
neutral conductor;
protective conductor.
- for d.c.: line conductor (s);
midpoint conductor;
protective conductor.

NOTE The function of some conductors may be combined in a single conductor.

132.2.3 Values and tolerances:

- voltage and voltage tolerances;
- voltage interruptions, voltage fluctuations and voltage dips;
- frequency and frequency tolerances;
- maximum current allowable;
- earth fault loop impedance upstream of the origin of the installation;
- prospective short-circuit currents.

For standard voltages and frequencies, see IEC 60038.

132.2.4 Protective provisions inherent in the supply, e.g. system earthing or mid-point earthing.

132.2.5 Particular requirements of the supply undertaking**132.3 Nature of demand**

The number and type of circuits required for lighting, heating, power, control, signaling, information and communication technology, etc. shall be determined by:

- location of points of power demand;
- loads to be expected on the various circuits;
- daily and yearly variation of demand;
- any special conditions such as harmonics;
- requirements for control, signalling, information and communication technology, etc;
- anticipated future demand.

132.4 Electric supply systems for safety services or standby electric supply systems

- Source of supply (nature, characteristics).
- Circuits to be supplied by the electric source for safety services or the standby electrical source.

132.5 Environmental conditions

The design of the electrical installation shall take into account the environmental conditions to which it will be subjected, see IEC 60364-5-51 and IEC 60721.

132.6 Cross-section of conductors

The cross-section of conductors shall be determined for both normal operating conditions and for fault conditions according to:

- a) their admissible maximum temperature;
- b) the admissible voltage drop;
- c) the electromechanical stresses likely to occur due to earth fault and short circuit currents;;
- d) other mechanical stresses to which the conductors can be subjected;
- e) the maximum impedance with respect to the functioning of the protection against fault currents;
- f) the method of installation.

NOTE The above-listed items concern primarily the safety of electrical installations. Cross-sectional areas greater than those required for safety may be desirable for economic operation.

132.7 Type of wiring and methods of installation

For the choice of the type of wiring and the methods of installation the following shall be taken into account:

- the nature of the locations;
- the nature of the walls or other parts of the building supporting the wiring;
- accessibility of wiring to persons and livestock;
- voltage;
- the electromagnetic stresses likely to occur due to earth fault and short circuit currents;
- electromagnetic interference;
- other stresses to which the wiring can be subjected during the erection of the electrical installation or in service.

132.8 Protective equipment

The characteristics of protective equipment shall be determined with respect to their function which may be, e.g., protection against the effects of:

- overcurrent (overload, short-circuit);
- earth-fault current;
- overvoltage;
- undervoltage and no-voltage.

The protective devices shall operate at values of current, voltage and time which are suitably related to the characteristics of the circuits and to the possibilities of danger.

132.9 Emergency control

Where, in case of danger, there is necessity for immediate interruption of supply, an interrupting device shall be installed in such a way that it can be easily recognized and effectively and rapidly operated.

132.10 Disconnecting devices

Disconnecting devices shall be provided so as to permit disconnection of the electrical installation, circuits or individual items of apparatus as required for operation, inspection and fault detection, testing, maintenance and repair.

132.11 Prevention of mutual detrimental influence

The electrical installation shall be arranged in such a way that no mutual detrimental influence will occur between electrical installations and non-electrical installations.

132.12 Accessibility of electrical equipment

The electrical equipment shall be arranged so as to afford as may be necessary:

- sufficient space for the initial installation and later replacement of individual items of electrical equipment;
- accessibility for operation, inspection and fault detection, testing, maintenance and repair.

132.13 Documentation of electrical installation

Every electrical installation shall be provided with appropriate documentation.

133 Selection of electrical equipment

133.1 General

Every item of electrical equipment used in electrical installations shall comply with such IEC standards as are appropriate. In the absence of an IEC standard the equipment shall comply with the appropriate national standards. Where there are no applicable standards the item of equipment concerned shall be selected by special agreement between the person specifying the installation and the installer.

133.2 Characteristics

Every item of electrical equipment selected shall have suitable characteristics appropriate to the values and conditions on which the design of the electrical installation (see clause 132) is based and shall, in particular, fulfil the following requirements.

133.2.1 Voltage

Electrical equipment shall be suitable with respect to the maximum steady voltage (r.m.s. value for a.c.) likely to be applied, as well as overvoltages likely to occur.

NOTE For certain equipment, it may be necessary to take account of the lowest voltage likely to occur.

133.2.2 Current

All electrical equipment shall be selected with respect to the maximum steady current (r.m.s. value for a.c.) which it has to carry in normal service, and with respect to the current likely to be carried in abnormal conditions and the period (e.g. operating time of protective devices, if any) during which it may be expected to flow.

133.2.3 Frequency

If frequency has an influence on the characteristics of electrical equipment, the rated frequency of the equipment shall correspond to the frequency likely to occur in the circuit.

133.2.4 Load factor

All electrical equipment which is selected on the basis of its power characteristics shall be suitable for the duty demanded of the equipment taking into account the design service conditions, see IEC 60364-1-10-02.

133.3 Conditions of installation

All electrical equipment shall be selected so as to withstand safely the stresses and the environmental conditions (see 132.5) characteristic of its location and to which it may be subjected. If, however, an item of equipment does not have by design the properties corresponding to its location, it may be used on condition that adequate additional protection is provided as part of the completed electrical installation.

133.4 Prevention of harmful effects

All electrical equipment shall be selected so that it will not cause harmful effects on other equipment or impair the supply during normal service including switching operations. In this context, the factors which can have an influence include, e.g.:

- power factor;
- inrush current;
- asymmetrical load;
- harmonics;
- transient overvoltages generated by equipment in the installation.

134 Erection and verification of electrical installations

134.1 Erection

134.1.1 Good workmanship by competent persons and proper materials shall be used in the erection of the electrical installation. Electrical equipment shall be installed in accordance with the instructions provided by the manufacturer of the equipment.

134.1.2 The characteristics of the electrical equipment, as determined in accordance with clause 133, shall not be impaired during erection.

134.1.3 Conductors shall be identified in accordance with IEC 60446. Where identification of terminals is necessary, they shall be identified in accordance with IEC 60445.

134.1.4 Connections between conductors and between conductors and other electrical equipment shall be made in such a way that safe and reliable contact is ensured.

134.1.5 All electrical equipment shall be installed in such a manner that the designed heat dissipation conditions are not impaired.

134.1.6 All electrical equipment likely to cause high temperatures or electric arcs shall be placed or guarded so as to minimize the risk of ignition of flammable materials. Where the temperature of any exposed parts of electrical equipment is likely to cause injury to persons, those parts shall be so located or guarded as to prevent accidental contact therewith.

134.1.7 Where necessary for safety purposes, suitable warning signs and/or notices shall be provided.

134.1.8 Where an installation is erected by using new materials, inventions or methods leading to deviations from the rules of IEC 60364, the resulting degree of safety of the installation shall not be less than that obtained by compliance with IEC 60364.

134.1.9 In the case of an addition or alteration to an existing installation, it shall be determined that the rating and condition of existing equipment, which will have to carry any additional load is adequate for the altered circumstances. Furthermore, the earthing and bonding arrangements, if necessary for the protective measure applied for the safety of the addition or alteration, shall be adequate.

134.2 Initial verification

Electrical installations shall be verified before being placed in service and after any important modification to confirm proper execution of the work in accordance with this standard.

134.3 Periodic verification

It is recommended that every electrical installation is subjected to periodic verification.

20 Definitions

In the scope of this standard the definitions of IEC 60050-826 apply. For further explanations to several terms of IEC 826 see Annex B.

30 Assessment of general characteristics

An assessment shall be made of the following characteristics of the installation in accordance with the clauses indicated:

- the purposes for which the installation is intended to be used, its general structure and its supplies (clauses 31, 35 and 36);
- the external influences to which it is to be exposed (clause 32);
- the compatibility of its equipment (clause 33);
- its maintainability (clause 34).

Those characteristics shall be taken into account in the choice of methods of protection for safety (see IEC 60364-4-41 to IEC 60364-4-44) and the selection and erection of equipment (see IEC 60364-5-51 to IEC 60364-5-55).

NOTE For other types of installation e.g. for telecommunication installations or Home and Building Electronic Systems (HBES) etc. account should be taken of IEC standards relevant to the type of installation concerned. For telecommunication installations also publications of the ITU-T and ITU-R are to be taken into account.

31 Purposes, supplies and structure

311 Maximum demand and diversity

For economic and reliable design of an installation within thermal and voltage drop limits, a determination of maximum demand is essential. In determining the maximum demand of an installation, or part thereof, diversity may be taken into account.

312 Conductor arrangement and system earthing

The following characteristics shall be assessed:

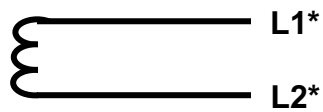
- arrangements of current carrying conductors under normal operating conditions;
- types of system earthing.

312.1 Current carrying conductors depending on kind of current

NOTE The conductor arrangements described in this clause are not exhaustive. They are included as examples of typical arrangements. It is recommended to report other arrangements to IEC.

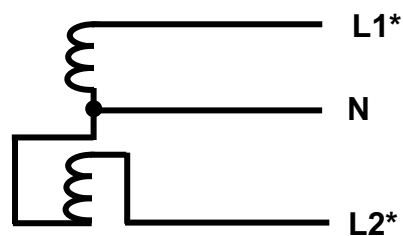
The following arrangements of current carrying conductors under normal operating conditions are taken into account in this standard:

312.1.1 Current carrying conductors in AC-circuits



* numbering of conductors optional

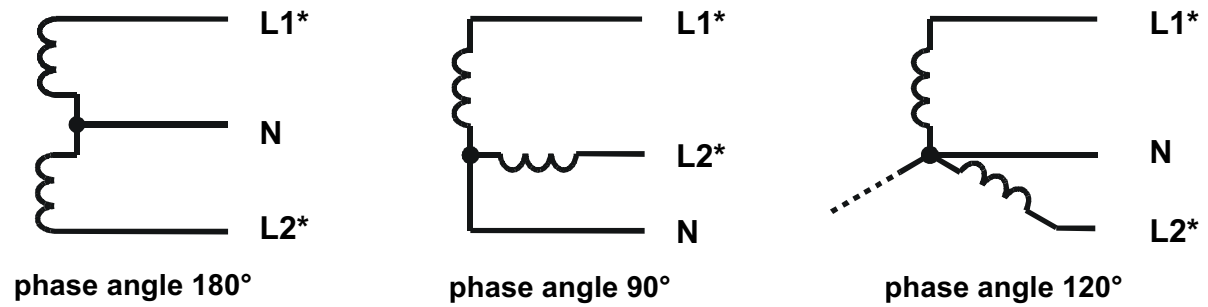
Figure 1: single-phase 2-wire



Phase angle 0°

* numbering of conductors optional

Figure 2: single-phase 3-wire



* numbering of conductors optional

Figure 3: two-phase 3-wire



Figure 4: three-phase 3-wire

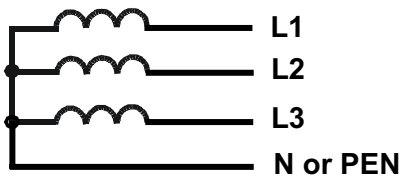


Figure 5: three-phase 4-wire

Three-phase, four-wire with neutral conductor or PEN conductor. By definition, the PEN is not a live conductor, but a conductor carrying an operating current.

NOTE 1 In case of single-phase 2-wire-arrangement, which are derived from a three-phase 4-wire-arrangement the two conductors are either two line conductors or line conductor and neutral conductor or line conductor and PEN-conductor.

NOTE 2 In installations with all loads connected between phases, the installation of the neutral conductor may not be necessary.

312.1.2 Current carrying conductors in DC-circuits



Figure 6: 2-wire

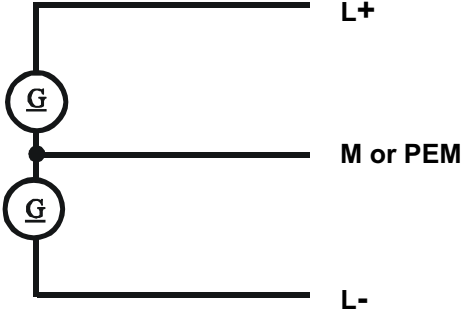


Figure 7: 3-wire

NOTE PEL and PEM conductors are not live conductors although they carry operating current. Therefore the designation 2-wire-arrangement respectively 3-wire-arrangement applies.

312.2 Types of system earthing

The following types of system earthing are taken into account in this standard.

NOTE 1 Figures 31A1 to 31G2 show examples of commonly used three-phase systems. Figures 31H to 31M show examples of commonly used d.c. systems.

NOTE 2 The dotted lines indicate the parts of the system that are not covered by the scope of the standard, whereas the solid lines indicate the part that is covered by the standard

NOTE 3 For private systems, the source and/or the distribution system may be considered as part of the installation within the meaning of this standard. For this case, the figures may be completely shown in solid lines.

NOTE 4 The codes used have the following meanings:

First letter – Relationship of the power system to earth:

T = direct connection of one point to earth;

I = all live parts isolated from earth, or one point connected to earth through a high impedance.

Second letter – Relationship of the exposed-conductive-parts of the installation to earth:

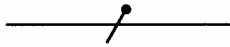
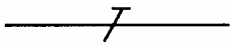

T = direct electrical connection of exposed-conductive-parts to earth, independently of the earthing of any point of the power system;

N = direct electrical connection of the exposed-conductive-parts to the earthed point of the power system (in a.c. systems, the earthed point of the power system is normally the neutral point or, if a neutral point is not available, a line conductor).

Subsequent letter(s) (if any) – Arrangement of neutral and protective conductors:

S = protective function provided by a conductor separate from the neutral conductor or from the earthed line (or in a.c. systems, earthed phase) conductor.

C = neutral and protective functions combined in a single conductor (PEN conductor).

Explanation of symbols for figures 31A1 to 31M according to IEC 60617-11	
	Neutral conductor (N); mid-point conductor (M)
	Protective conductor (PE)
	Combined protective and neutral conductor (PEN)

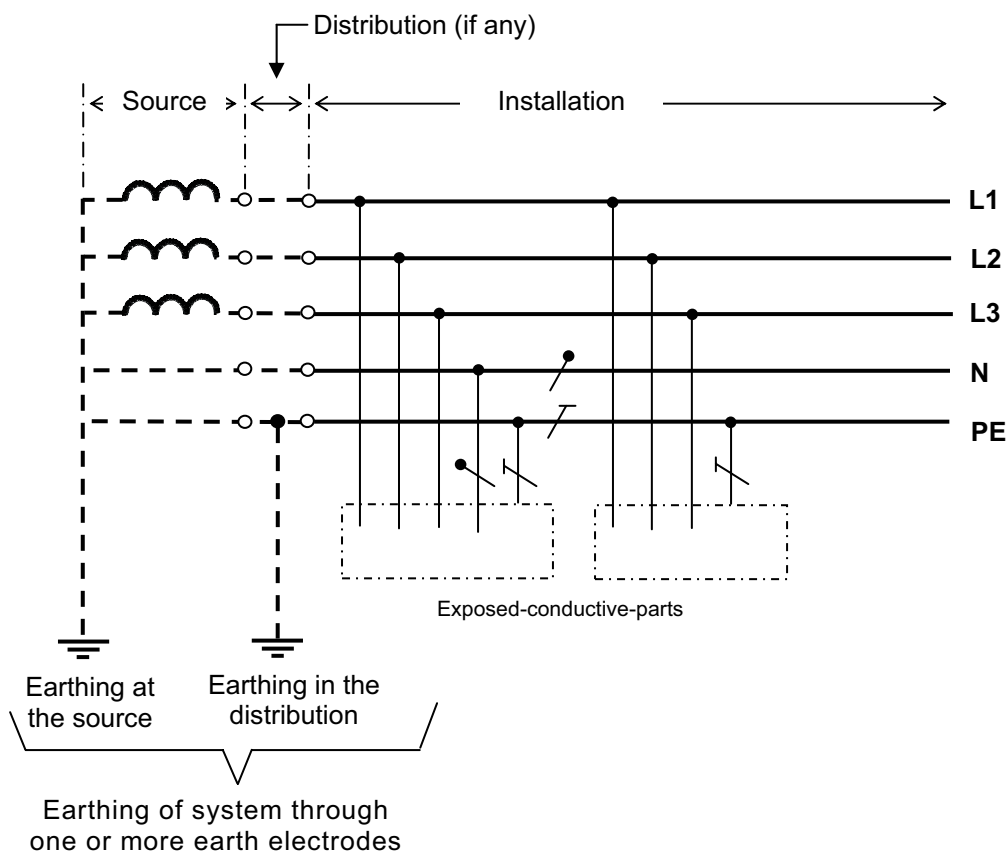
312.2.1 TN systems

312.2.1.1 Single source systems

TN power systems have one point directly earthed at the source, the exposed-conductive-parts of the installation being connected to that point by protective conductors. Three types of TN system are considered according to the arrangement of neutral and protective conductors, as follows:

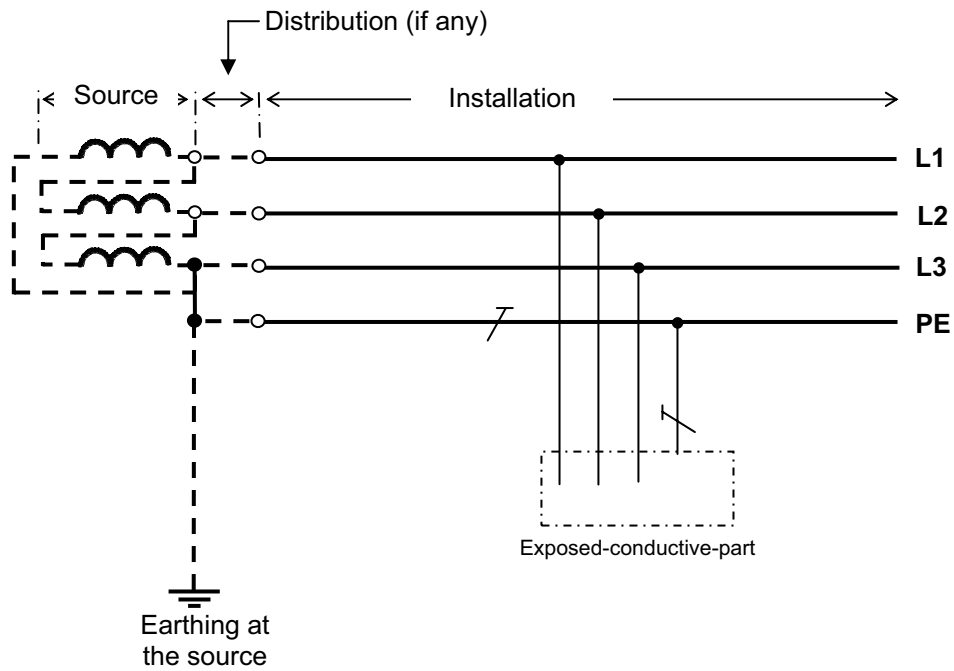
- TN-S system in which throughout the system, a separate protective conductor is used (Figures 31A1, 31A2 and 31A3 below)

NOTE For symbols see explanation given in 312.2



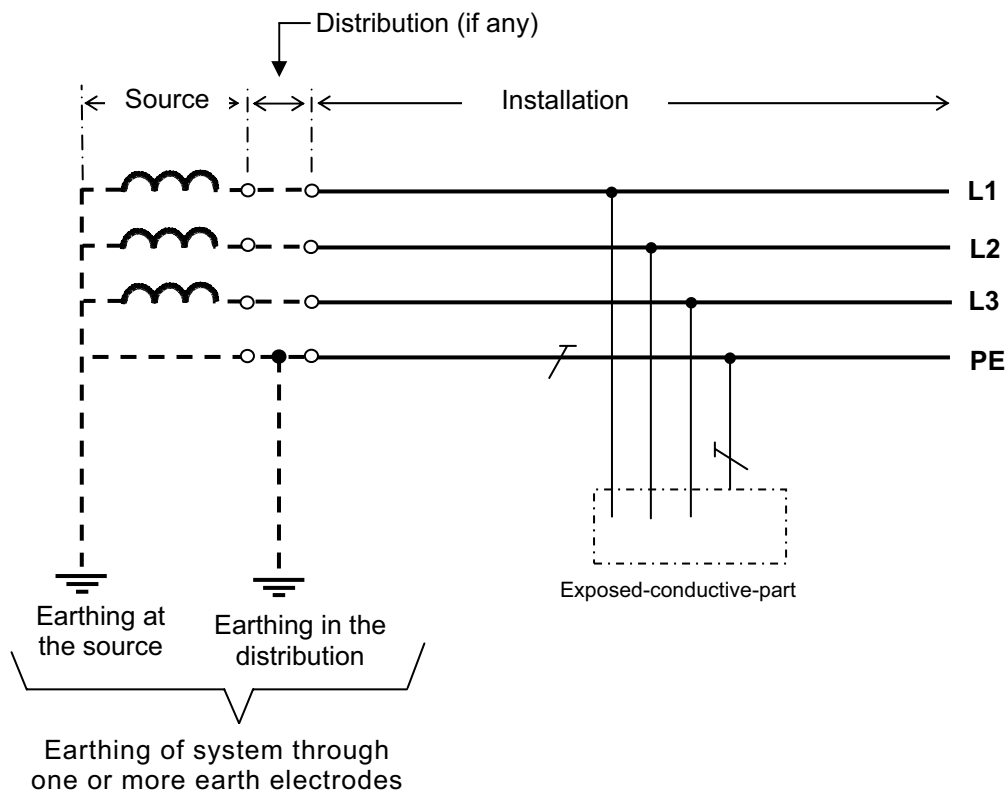
NOTE Additional earthing of the PE in the installation may be provided

Figure 31A1 – TN-S system with separate neutral conductor and protective conductor throughout the system



NOTE Additional earthing of the PE in the distribution and in the installation may be provided

Figure 31A2 – TN-S system with separate earthed line conductor and protective conductor throughout the system

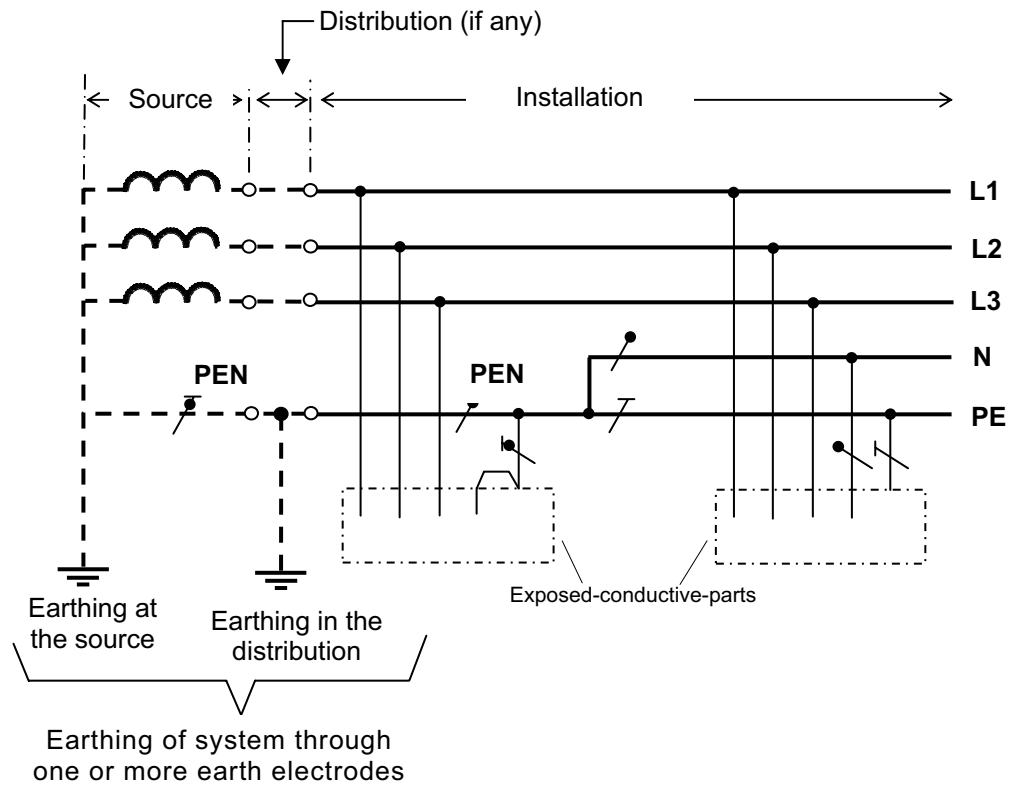


NOTE Additional earthing of the PE in the installation may be provided

Figure 31A3 – TN-S system with earthed protective conductor and no distributed neutral conductor throughout the system

- TN-C-S system in which neutral and protective conductor functions are combined in a single conductor in a part of the system (Figures 31B1, 31B2 and 31B3 below):

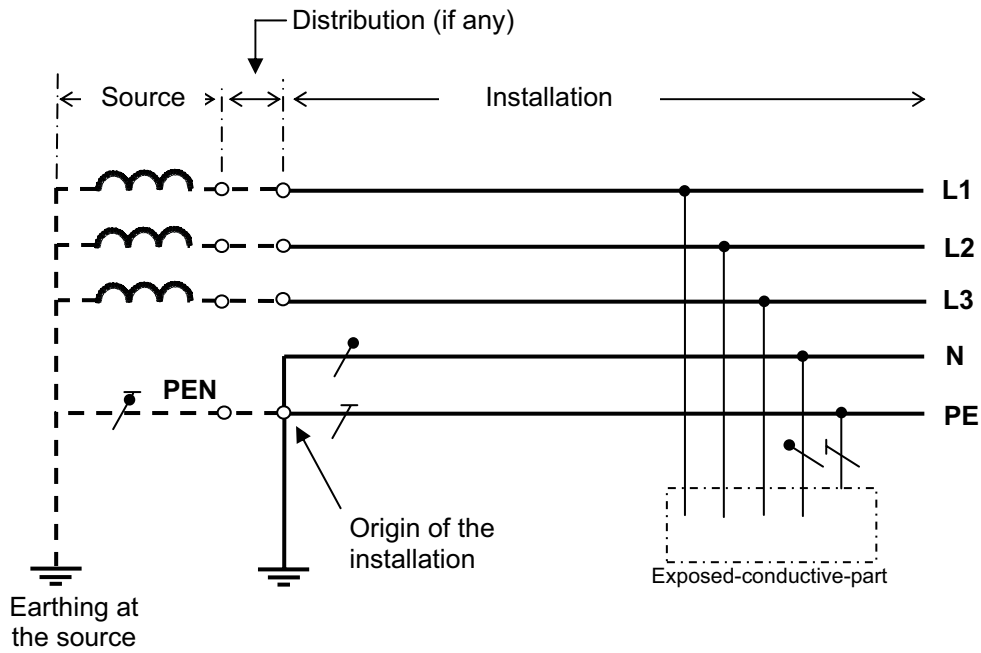
NOTE For symbols see explanation given in 312.2



Neutral and protective conductor functions combined in a single conductor in a part of the system

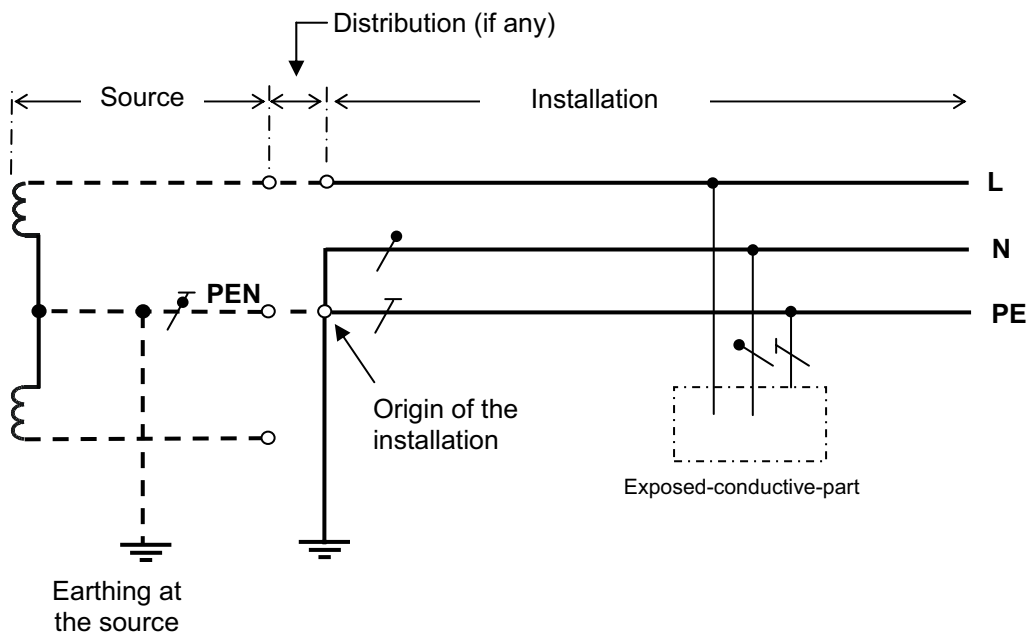
NOTE Additional earthing of the PEN or PE in the installation may be provided

Figure 31B1 – TN-C-S system 3-phase, 4-wire, where the PEN is separated into PE and N elsewhere in the installation



NOTE Additional earthing of the PEN in the distribution and of the PE in the installation may be provided

Figure 31B2 - TN-C-S system 3-phase, 4-wire where the PEN is separated into PE and N at the origin of the installation



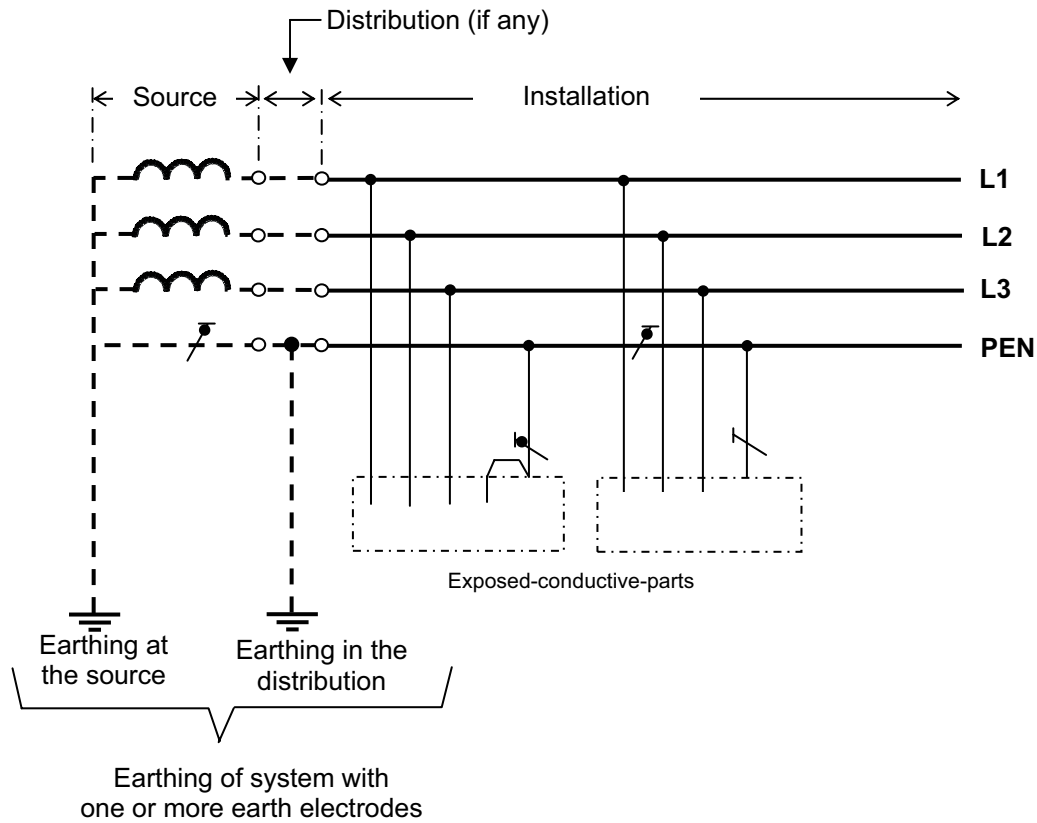
Neutral and protective conductor functions combined in a single conductor in a part of the system

NOTE Additional earthing of the PEN in the distribution and of the PE in the installation may be provided

Figure 31B3 -TN-C-S system – single-phase, 2-wire where the PEN is separated into PE and N at the origin of the installation

- TN-C system in which neutral and protective conductor functions are combined in a single conductor throughout the system (Figure 31C below) :

NOTE For symbols see explanation given in 312.2



NOTE Additional earthing of the PEN in the installation may be provided

Figure 31C – TN-C system with neutral and protective conductor functions combined in a single conductor throughout the system

312.2.1.2 Multiple source systems

NOTE The multiple source system is shown for the TN system with the only aim to provide EMC. The multiple source system is not shown for IT and TT systems because these systems are generally compatible with regard to EMC.

In the case of an inappropriate design of an installation forming part of a TN system with multiple sources some of the operating current may flow through unintended paths. These currents may cause:

- fire
- corrosion
- electromagnetic interference.

The system shown in Figure 31D is a system where minor partial operating currents are flowing as currents through unintended paths. The essential design rules shown in Figure 31D from a) to d) are the following:

The marking of the PE conductor shall be in accordance with IEC 60446.

Any extension of the system shall be taken into account with regard to the proper functioning of the protective measures.

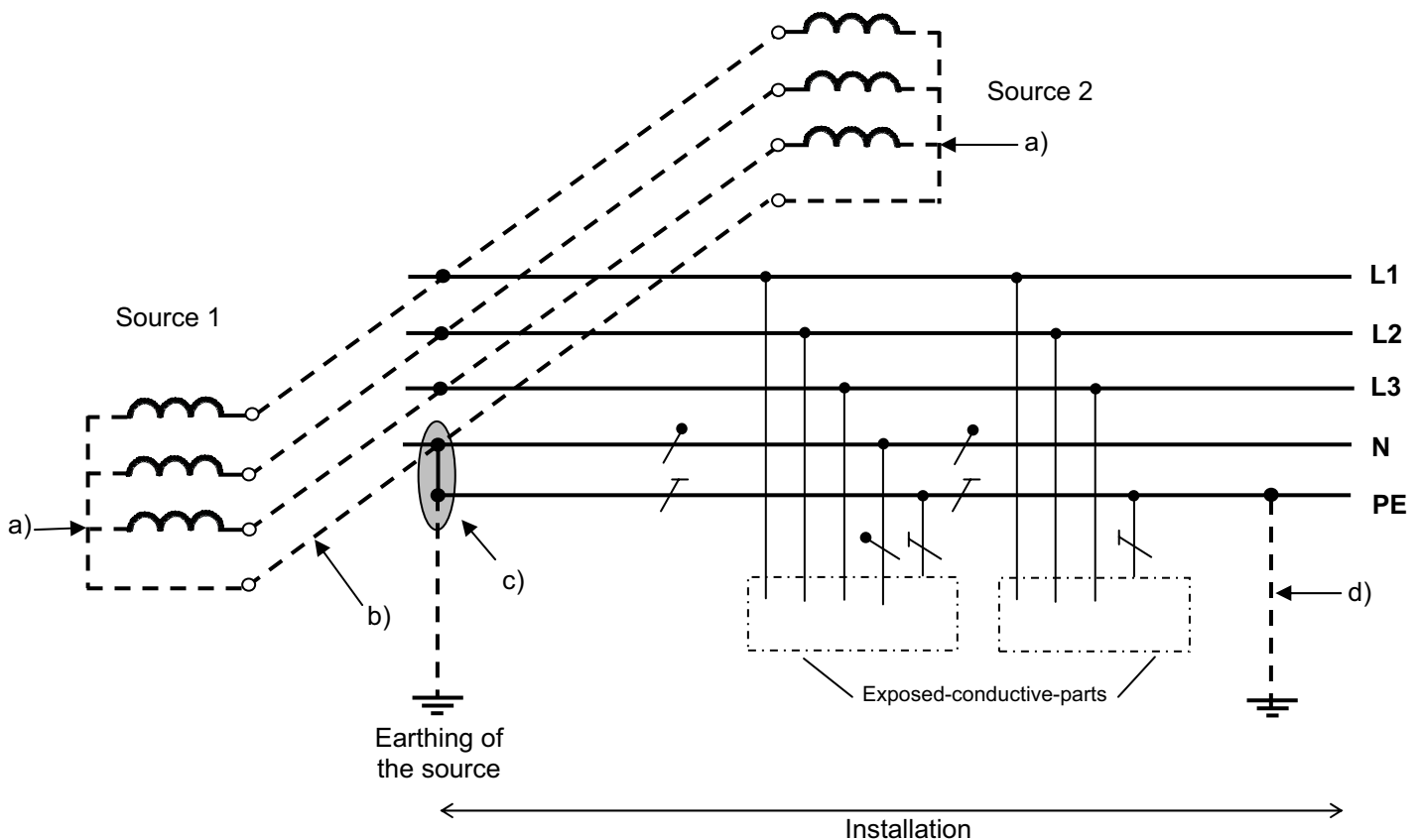


Figure 31D – TN-C-S multiple source system with separate protective conductor and neutral conductor to current using equipment

Legend to Figures 31D and 31E:

- a) No direct connection from either the transformer neutral point or the generator star point to earth is permitted.
- b) The interconnection conductor between either the neutral points of the transformers or the generator star points shall be insulated. The function of this conductor is like a PEN, however it may not be connected to current-using equipment.
- c) Only one connection between the interconnected neutral points of the sources and the PE shall be provided. This connection shall be located inside the main switchgear assembly.
- d) Additional earthing of the PE in the installation may be provided.

In industrial plants with only 2-phase loads and 3-phase loads between line conductors it is not necessary to provide a neutral conductor (see Figure 31E).In this case the protective conductor should have multiple connections to earth.

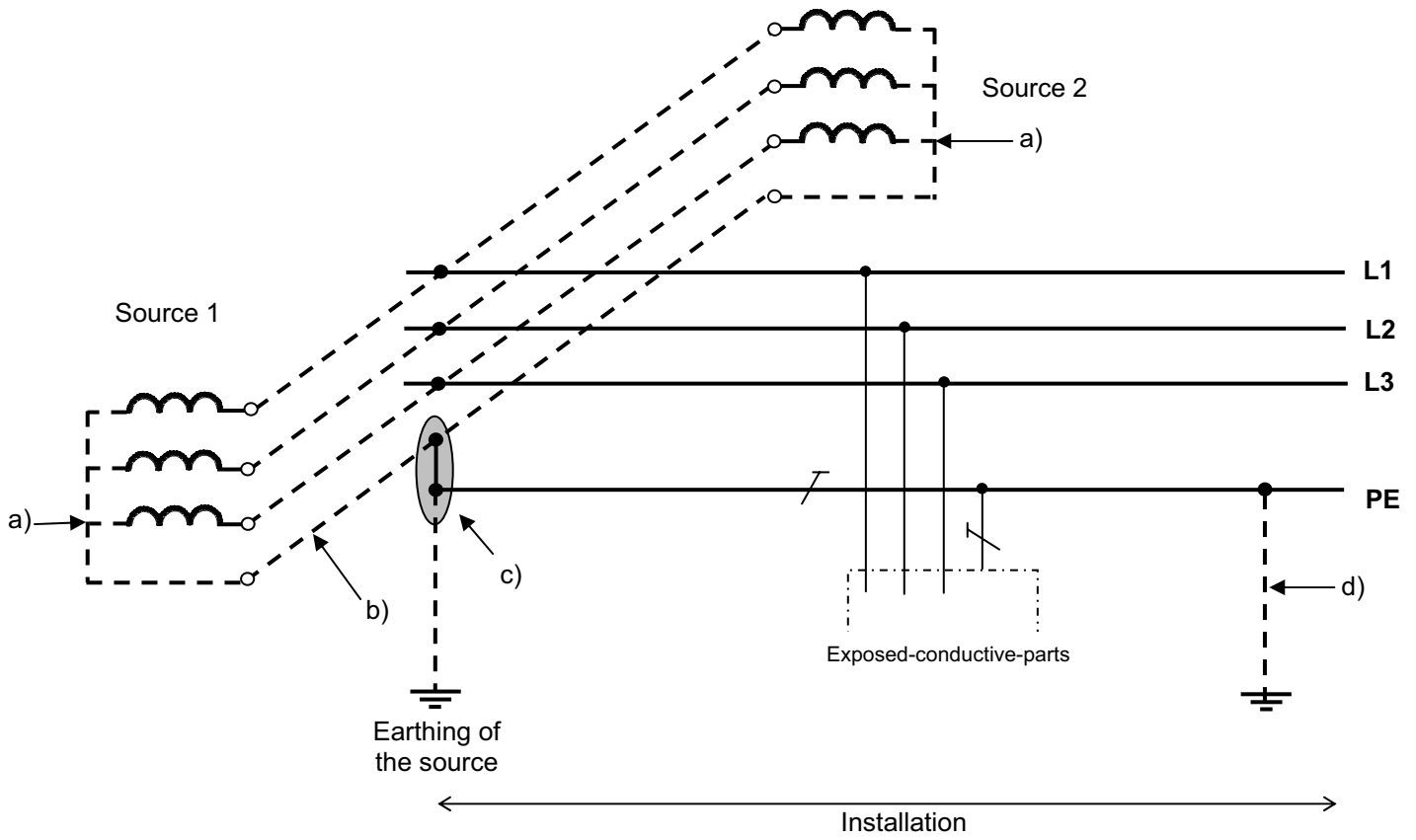
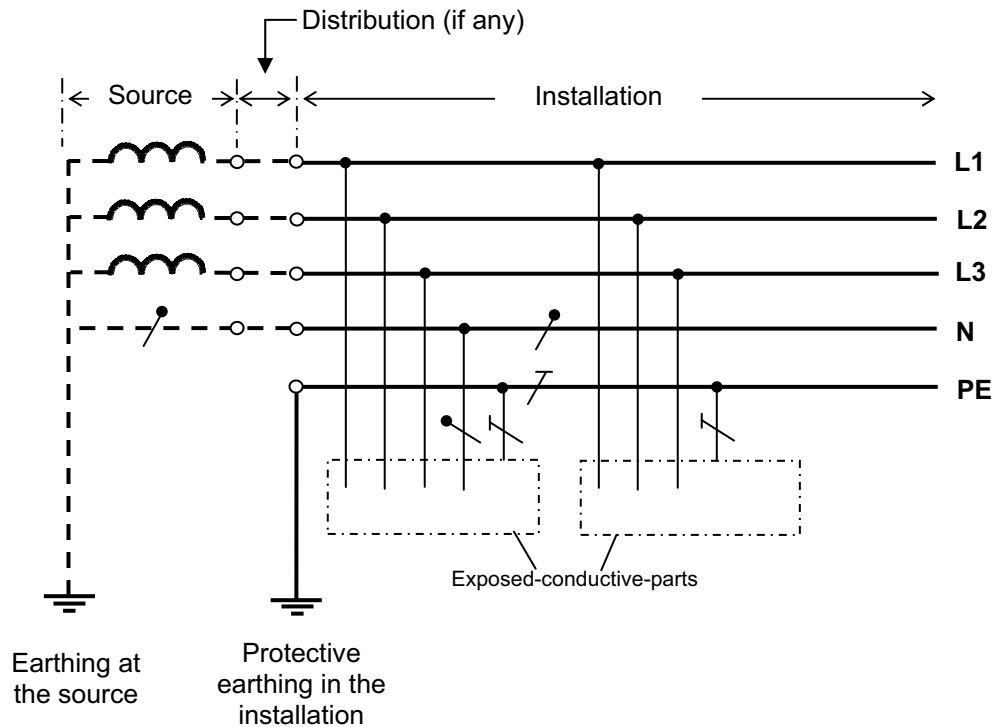


Figure 31E – TN multiple source system with protective conductor and no neutral conductor throughout the system for 2- or 3-phase load

312.2.2 TT system

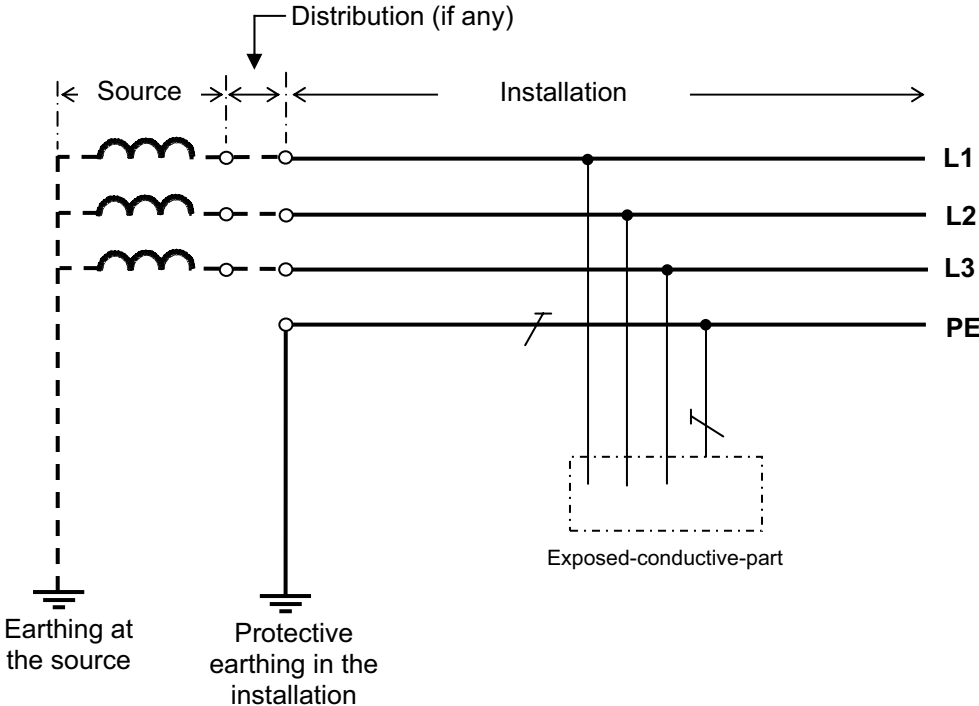
The TT system has only one point directly earthed and the exposed-conductive-parts of the installation are connected to earth electrodes electrically independent of the earth electrode of the system (Figures 31F1 and 31F2 below):

NOTE In Sweden TT systems are only allowed under special conditions.



NOTE Additional earthing of the PE in the installation may be provided.

Figure 31F1 – TT system with separate neutral conductor and protective conductor throughout the installation

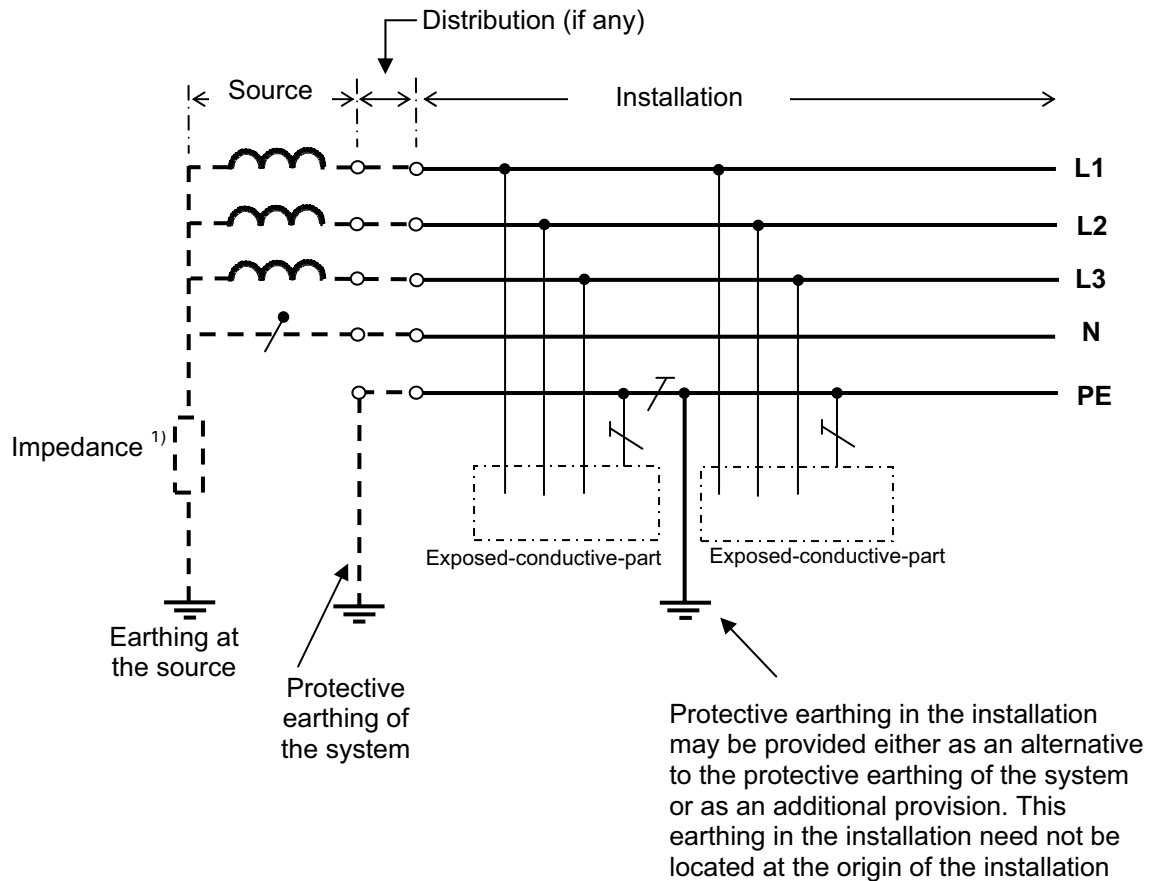


NOTE Additional earthing of the PE in the installation may be provided.

Figure 31F2 – TT system with earthed protective conductor and no distributed neutral conductor throughout the installation

312.2.3 IT system

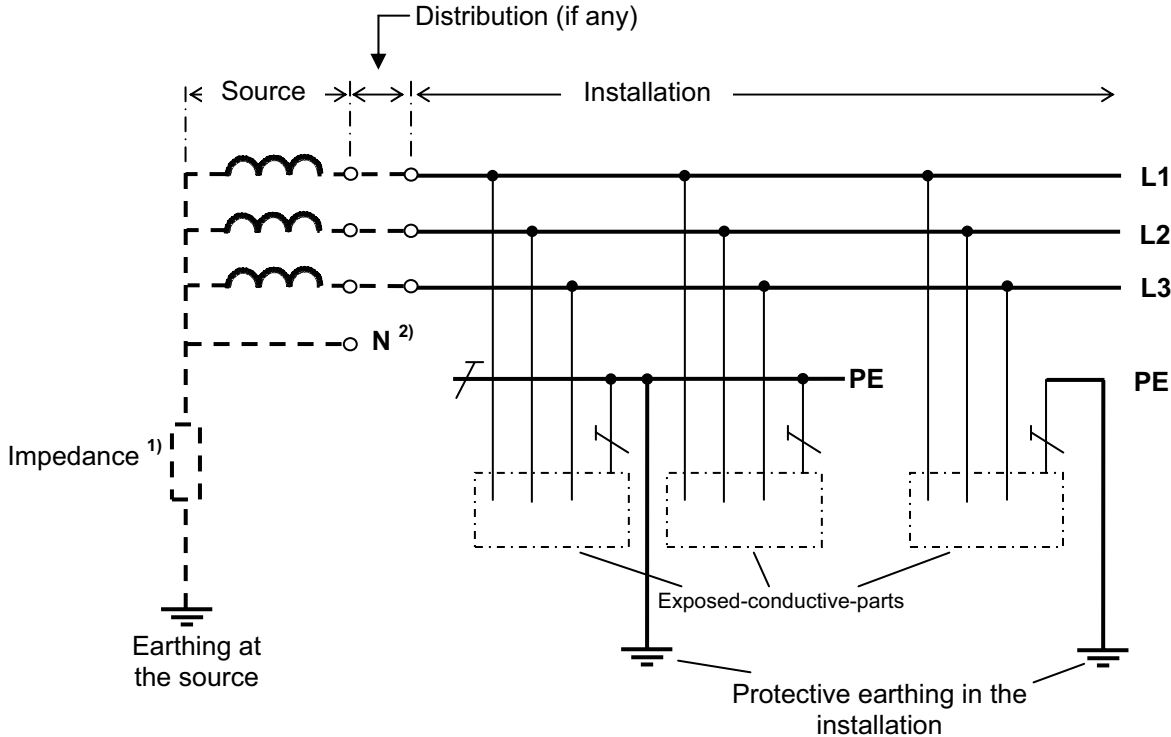
The IT power system has all live parts isolated from earth or one point connected to earth through an impedance. The exposed-conductive-parts of the electrical installation are earthed independently or collectively or to the earthing of the system according to 413.1.5 of IEC 60364-4-41 (Figures 31G1 and 31G2 below):



NOTE Additional earthing of the PE in the installation may be provided.

1) The system may be connected to earth via a sufficiently high impedance.

Figure 31G1 – IT system with all exposed-conductive-parts interconnected by a protective conductor which is collectively earthed



NOTE – Additional earthing of the PE in the installation may be provided

- 1) The system may be connected to earth via a sufficiently high impedance.
- 2) The neutral conductor may or may not be distributed.

Figure 31G2 – IT system with exposed-conductive-parts earthed in groups or individually

312.2.4 DC systems

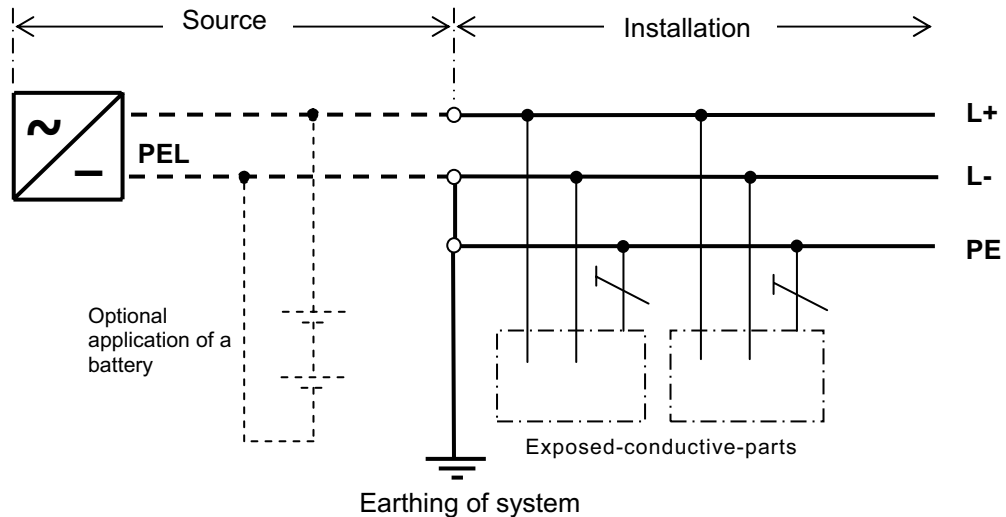
Type of system earthing for direct current (d.c.) systems.

Where the following figures 31H to 31M show earthing of a specific pole of a two-wire d.c. system, the decision whether to earth the positive or the negative pole shall be based upon operational circumstances or other considerations, e.g. avoidance of electrochemical corrosion.

312.2.4.1 TN-S-system

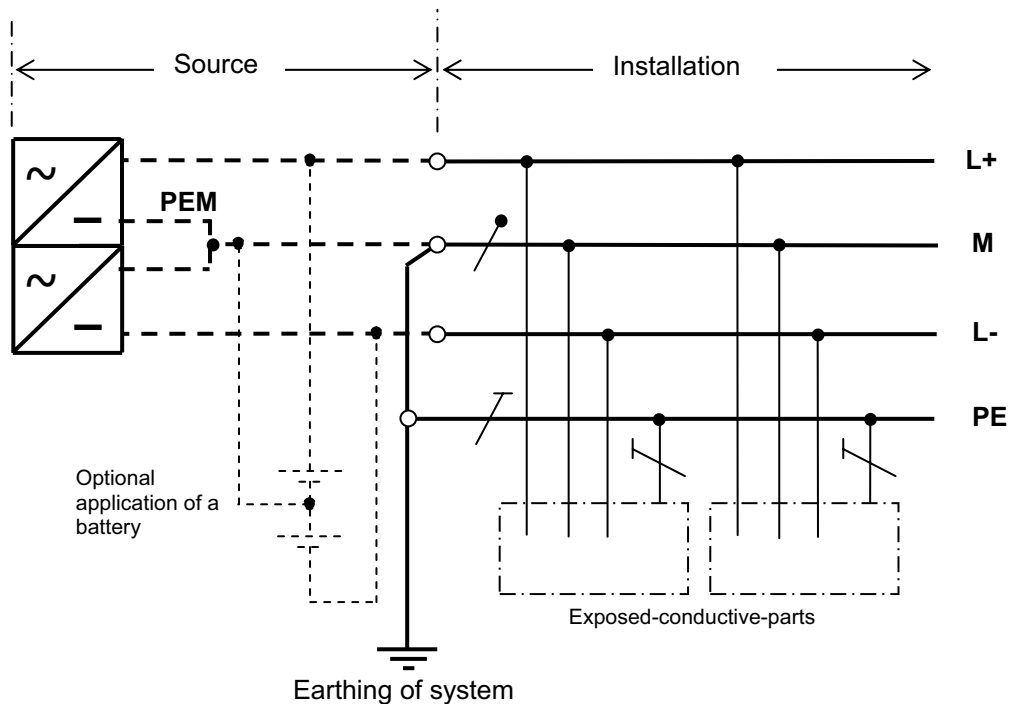
The earthed line conductor for example L- in type a) or the earthed mid-point conductor M in type b) is separated from the protective conductor throughout the installation.

Type a)



NOTE Additional earthing of the PE in the installation may be provided

Type b)



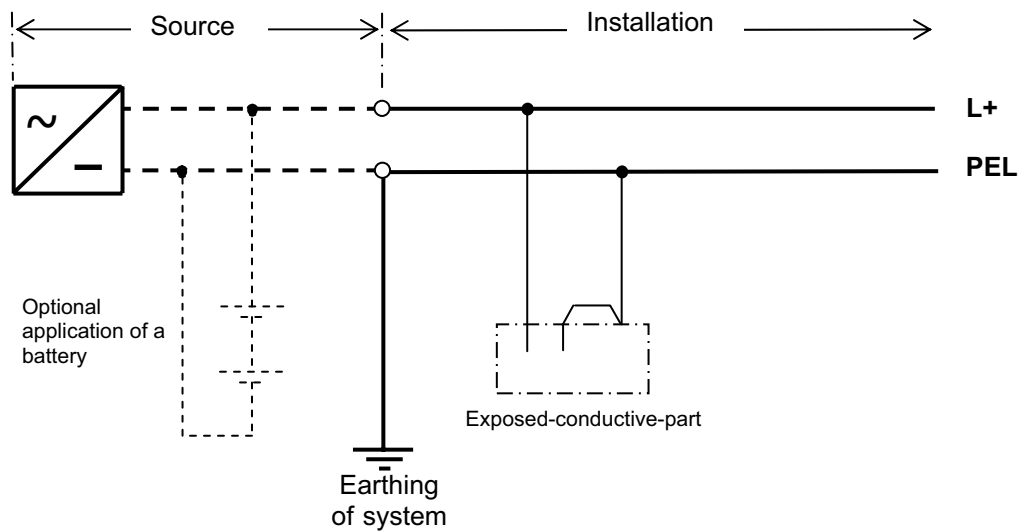
NOTE Additional earthing of the PE in the installation may be provided.

Figure 31H – TN-S d.c. system

312.2.4.2 TN-C-system

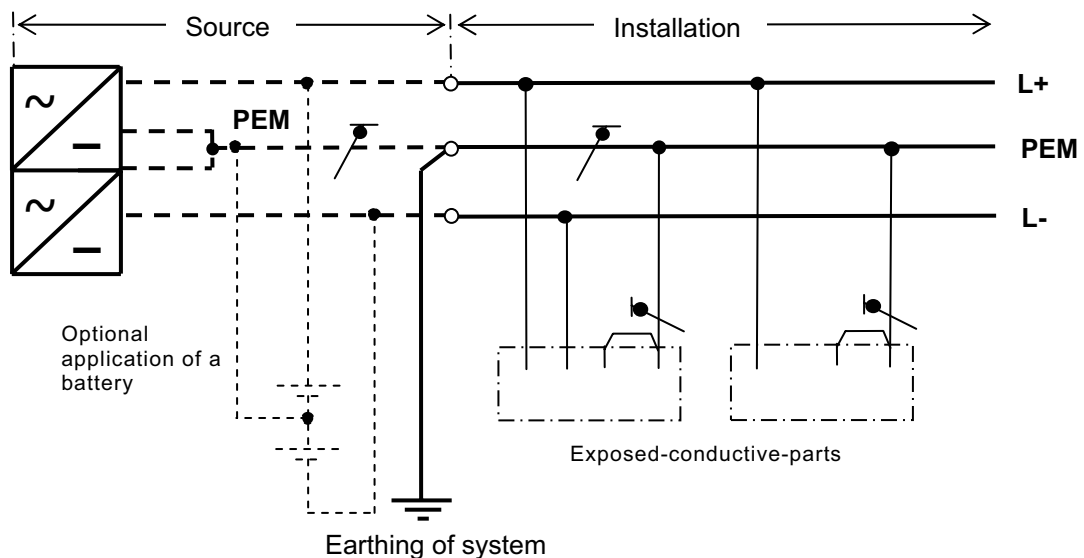
The functions of the earthed line conductor for example L– and of the protective conductor are in type a) combined in one single conductor PEL throughout the installation, or the earthed mid-point conductor M and the protective conductor are combined in one single conductor PEM throughout the installation.

Type a)



NOTE Additional earthing of the PEL in the installation may be provided.

Type b)



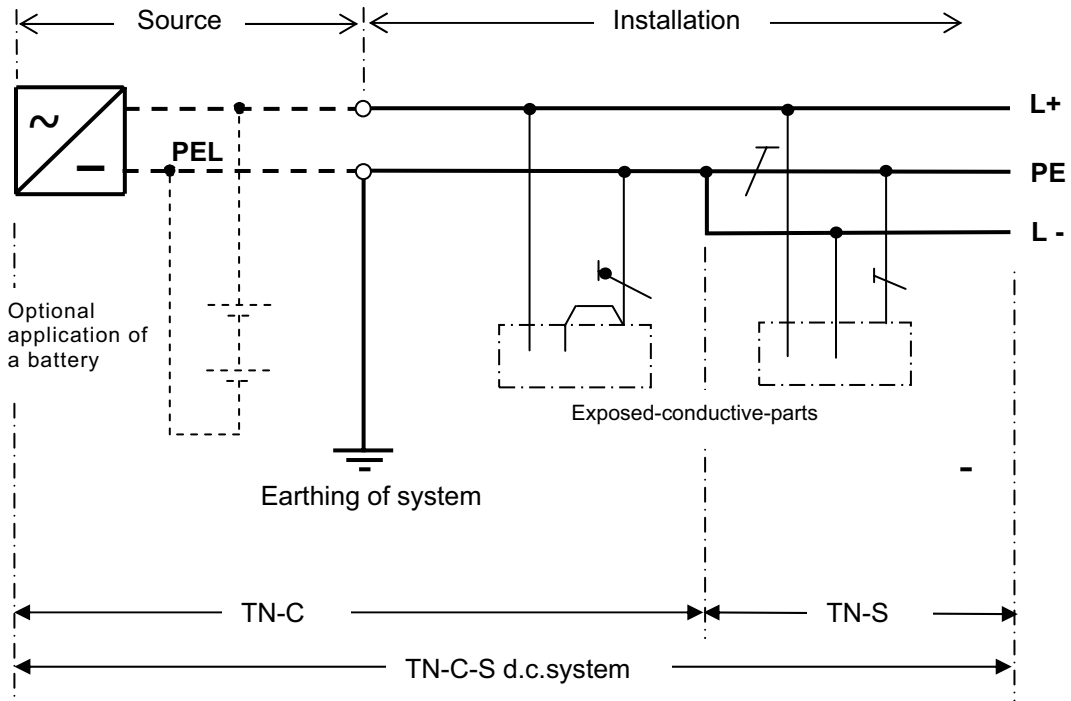
NOTE Additional earthing of the PEM in the installation may be provided.

Figure 31J – TN-C d.c. system

312.2.4.3 TN-C-S-system

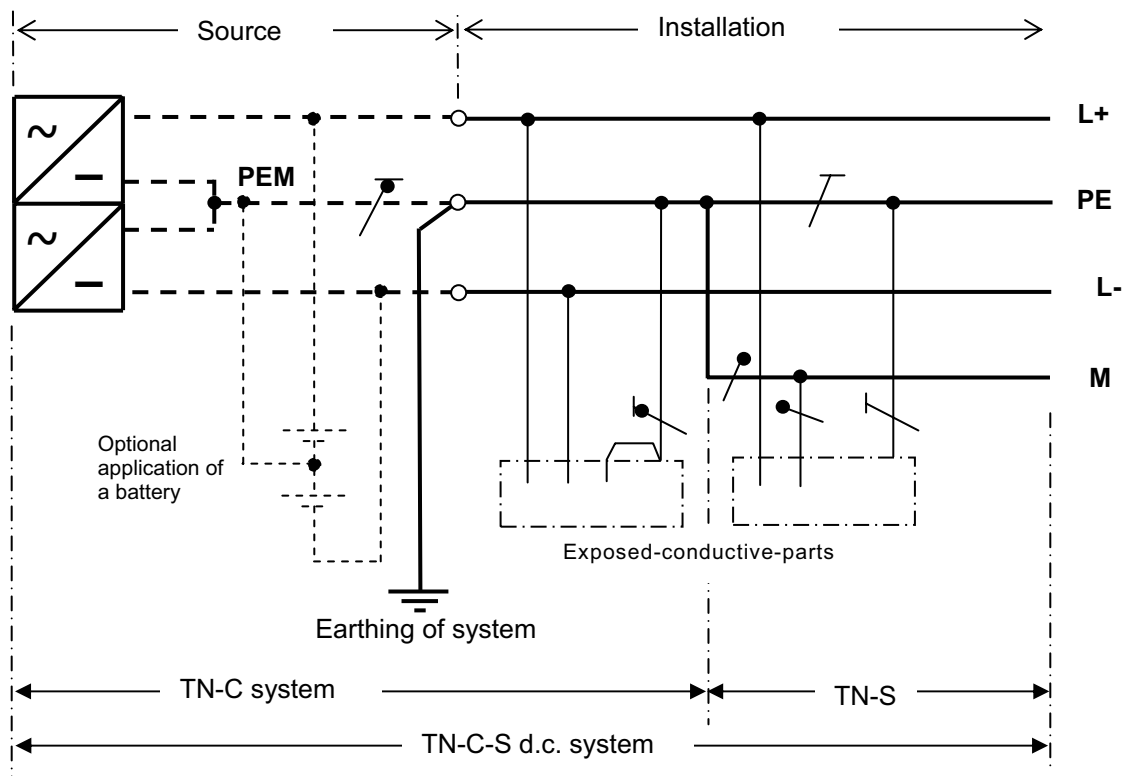
The functions of the earthed line conductor for example L- in type a) and of the protective conductor are combined in one single conductor PEL in a part of the installation, or the earthed mid-wire conductor M in type b) and the protective conductor are combined in one single conductor PEM in a part of the installation.

Type a)



NOTE Additional earthing of the PE in the installation may be provided

Type b)

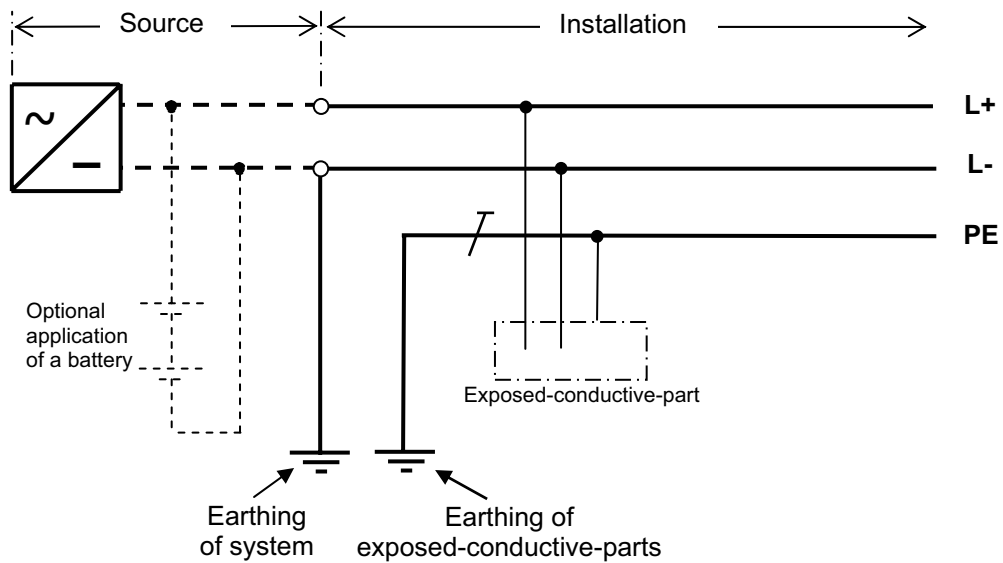


NOTE Additional earthing of the PE in the installation may be provided.

Figure 31K – TN-C-S d.c. system

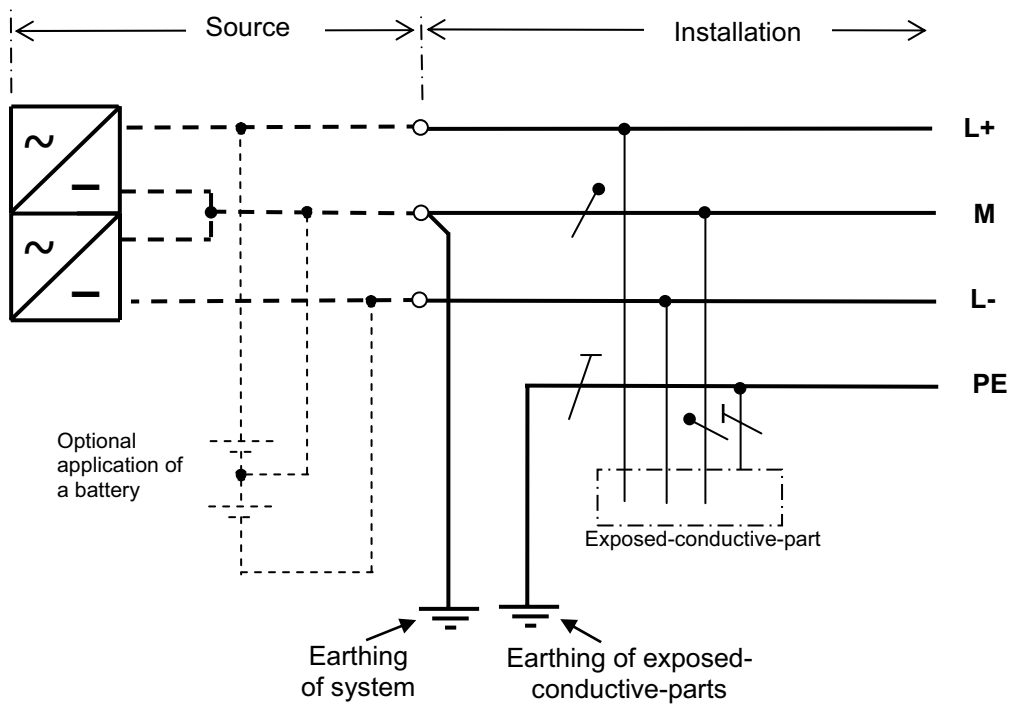
312.2.4.3 TT-system

Type a)



NOTE Additional earthing of the PE in the installation may be provided

Type b)

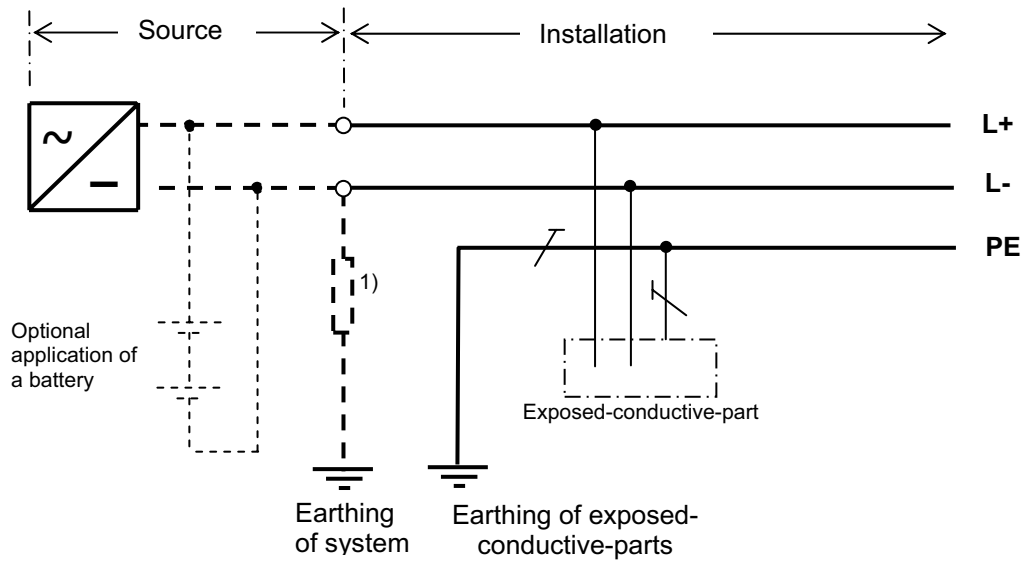


NOTE Additional earthing of the PE in the installation may be provided.

Figure 31L – TT d.c. system

312.2.4.4 IT-systems

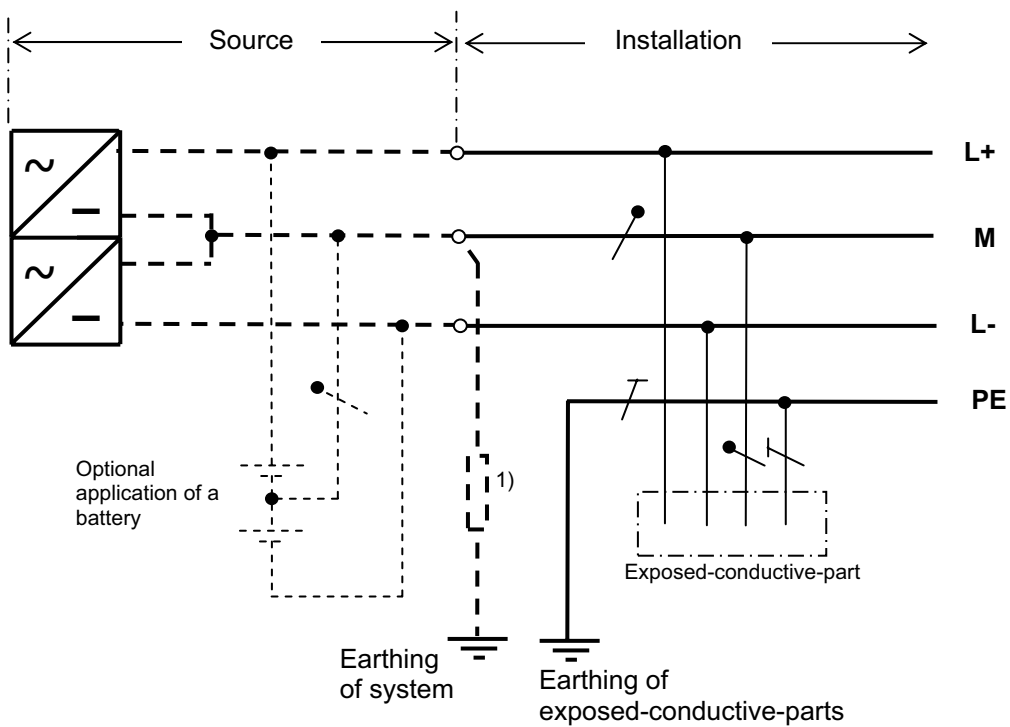
Type a)



1) The system may be connected to earth via a sufficiently high impedance.

NOTE Additional earthing of the PE in the installation may be provided

Type b)



1) The system may be connected to earth via a sufficiently high impedance.

NOTE Additional earthing of the PE in the installation may be provided.

Figure 31M – IT d.c. system

313 Supplies

313.1 General

313.1.1 The following characteristics of the supply or supplies, from whatever source, and the normal range of those characteristics where appropriate, shall be determined by calculation, measurement, enquiry or inspection:

- the nominal voltage(s)
- the nature of the current and frequency
- the prospective short-circuit current at the origin of the installation
- the earth fault loop impedance of that part of the system external to the installation
- the suitability for the requirements of the installation, including the maximum demand, and
- the type and rating of the overcurrent protective device acting at the origin of the installation.

These characteristics shall be ascertained for an external supply and shall be determined for a private source. These requirements are equally applicable to main supplies and to safety services and standby supplies.

313.2 Supplies for safety services and standby systems

Where the provision of safety services is required, e.g. by the authorities concerned with fire precautions and other conditions for emergency evacuation of the premises, and/or where the provision of standby supplies is required by the person specifying the installation, the characteristics of the sources of supply for safety services and/or standby systems shall be separately assessed. Such supplies shall have adequate capacity, reliability and rating and appropriate change-over time for the operation specified.

For further requirements for supplies for safety services see clause 35 hereafter and clause 556 of IEC 60364-5-55. For standby systems there are no particular requirements in this standard.

314 Division of installation

314.1 Every installation shall be divided into circuits, as necessary, to

- avoid danger and minimize inconvenience in the event of a fault;
- facilitate safe inspection, testing and maintenance (see also IEC 60364-5-53);
- take account of danger that may arise from the failure of a single circuit such as a lighting circuit;
- reduce the possibility of unwanted tripping of RCDs due to excessive PE conductor currents not due to a fault;
- mitigate the effects of EMI;
- prevent the indirect energizing of a circuit intended to be isolated.

314.2 Separate distribution circuits shall be provided for parts of the installation which need to be separately controlled, in such a way that those circuits are not affected by failure of other circuits.

32 Classification of external influences

NOTE This clause has been transferred to IEC 60364-5-51.

33 Compatibility

33.1 Compatibility of characteristics

An assessment shall be made of any characteristics of equipment likely to have harmful effects upon other electrical equipment or other services or likely to impair the supply, e.g. for coordination with concerned parties. Those characteristics include, for example:

- transient overvoltages;
- undervoltage;
- unbalanced loads;
- rapidly fluctuating loads;
- starting currents;
- harmonic currents;
- d.c. feedback;
- high-frequency oscillations;
- earth leakage currents;
- necessity for additional connections to earth;
- excessive PE conductor currents not due to a fault.

33.2 Electromagnetic compatibility

All electrical equipment shall meet the appropriate electromagnetic compatibility (EMC) requirements, and shall be in accordance with the relevant EMC standards.

Consideration shall be given by the planner and designer of the electrical installations to measures reducing the effect of induced voltage disturbances and electromagnetic interferences (EMI).

Measures are given in IEC 60364-4-44.

34 Maintainability

An assessment shall be made of the frequency and quality of maintenance the installation can reasonably be expected to receive during its intended life. Where an authority is responsible for the operation of the installation, that authority shall be consulted. Those characteristics are to be taken into account in applying the requirements of parts 4 to 6 of IEC 60364 so that, having regard to the frequency and quality of maintenance expected:

- any periodic inspection and testing, maintenance and repairs likely to be necessary during the intended life can be readily and safely carried out, and
- the effectiveness of the protective measures for safety during the intended life shall remain, and
- the reliability of equipment for proper functioning of the installation is appropriate to the intended life.

35 Safety services

35.1 General

NOTE 1 The need for safety services and their nature are frequently regulated by statutory authorities whose requirements have to be observed.

NOTE 2 Examples of safety services are: emergency escape lighting, installations for fire pumps, fire brigade lifts, smoke and heat extraction equipment.

The following sources for safety services are recognized:

- storage batteries;
- primary cells;
- generator sets independent of the normal supply;
- a separate feeder of the supply network effectively independent of the normal feeder (see 556.4.4 of IEC 60364-5-55).

35.2 Classification

A safety service is either :

- a non-automatic supply, the starting of which is initiated by an operator, or
- an automatic-supply, the starting of which is independent of an operator.

An automatic supply is classified as follows according to change-over time :

- no-break : an automatic supply which can ensure a continuous supply within specified conditions during the period of transition, for example as regards variations in voltage and frequency ;
- very short break : an automatic supply available within 0,15 s ;
- short break : an automatic supply available within 0,5 s ;
- medium break : an automatic supply available within 15 s ;
- long break : an automatic supply available in more than 15 s.

36 Continuity of service

An assessment shall be made for each circuit of any need for continuity of service considered necessary during the intended life of the installation. The following characteristics should be considered:

- selection of the system earthing,
- selection of the protective device in order to achieve discrimination,
- separation of the circuits.

Annex A (informative)

Numbering system and plan of IEC 60364

Table A.1 – Numbering system of IEC 60364

Arabic numerals only are used (except for tables and figures, see below). The various divisions and subdivisions of the publication are identified as follows:		Examples
Parts	Sequentially by a single number (one or two digits)	41
Clauses	Sequentially within each part by the part number followed by a single number, with no points	413
Subclauses	Sequentially within each clause followed by a point and then the subclause number	413.5
Further subclauses (if necessary)	Sequentially within each subclause by a further point and subclause number	542.1.1
Unnumbered subclauses	Where introductory or general clauses appear before the start of a given clause, zeros are used in the positions normally occupied by the clause numbers	400.1
Tables and figures	By the part number in which they appear, followed alphabetically by a capital letter	Table 41A

Table A.2 – Plan of IEC 60364: Electrical installations of buildings

Part Nos	Title
Part 1	Fundamental principles, assessment of general characteristics, definitions
11	Scope
12	Normative references
13	Fundamental principles
30	Assessment of general characteristics
31	Purposes, supplies and structure
33	Compatibility
34	Maintainability
35	Safety services
Annex A	Numbering system and plan of IEC 60364
Annex B	Definitions
Annex C	IEC 60364 to parts 1-6: Restructuring
Part 4	Protection for safety
Part 4-41	Protection against electric shock (protection against direct and indirect contact)
Part 4-42	Protection against thermal effects (of equipment during normal operation)
Part 4-43	Protection against overcurrent (for conductors and cables)
Part 4-44	Protection against voltages disturbances and electromagnetic disturbances
Part 5	Selection and erection of electrical equipment
Part 5-51	Common rules (e.g. principles for selection and erection)
Part 5-52	Wiring systems
Part 5-53	Isolation, switching and control
Part 5-54	Earthing arrangements, protective conductors and protective bonding conductors
Part 5-55	Other equipment
Part 6	Verification and testing
Part 6-61	Initial verification

Part Nos	Title
Part 7	Requirements for special installations or locations
NOTE Part 7 deviates from parts 1 to 6 in that it is divided into clauses in order to have more than nine clauses available for these additional regulations.	
Part 7-701	Location containing a bath tub or shower basin
Part 7-702	Swimming pools
Part 7-703	Location containing sauna heaters
Part 7-704	Construction and demolition site installation
Part 7-705	Electrical installations of agricultural and horticultural premises
Part 7-706	Restrictive conducting locations
Part 7-707	Earthing requirements for the installation of data processing equipment
Part 7-708	Electrical installations in caravan parks and caravans
Part 7-709	Electrical installations in marinas and pleasure craft
Part 7-710	Medical locations and associated areas
Part 7-711	Electrical installations in exhibitions, shows, stands and funfairs
Part 7-712	Solar photovoltaic (PV) power supply systems
Part 7-713	Furniture
Part 7-714	External lighting installations
Part 7-715	Extra-low-voltage lighting installations
Part 7-717	Mobile or transportable units
Part 7-740	Temporary electrical installations for structures, amusement devices and booths at fairgrounds, amusement parks and circuses

Annex B (informative)

Definitions - Application guide and explanations to selected terms of

IEC 60050–826 (IEV 826 – Electrical Installations)

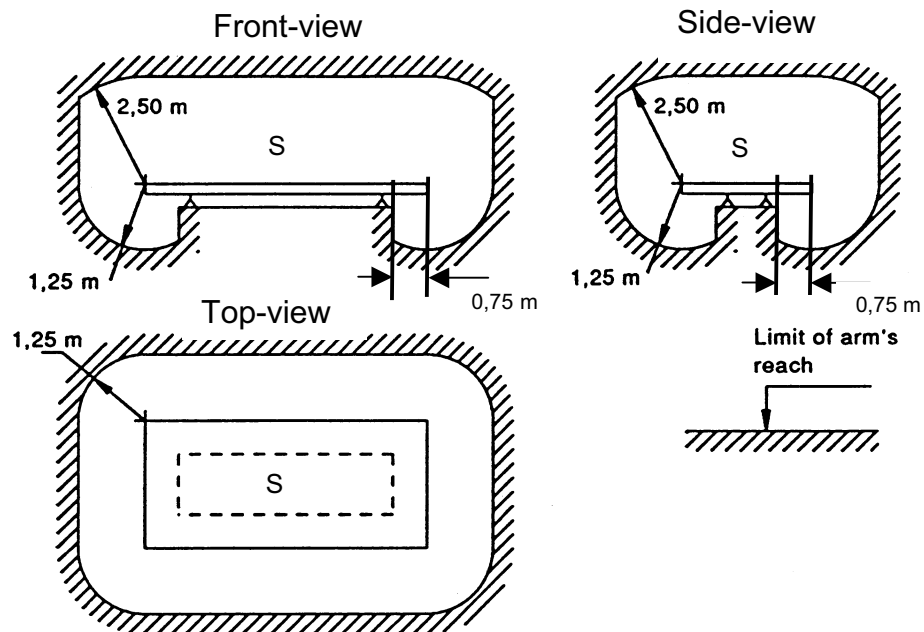
NOTE For IEC 60364 the definitions of IEC 60050-826: "International Electrotechnical Vocabulary" –Part 826: "Electrical Installations" apply.

B.1.0 (21.0) Scope

This guide is applicable to electrical installations of buildings. It contains explanatory notes on terms used in IEC 60364, listed in sections 01 to 08 of IEC 60050(826). The notes are intended to facilitate the application of terms.

	Term	Note
B.1.1	Characteristics of electrical installations (section 826-01)	
B.1.1.1	origin of the electrical installation; (826-01-02)	An electrical installation may have more than one origin
B.1.1.2	neutral conductor (826-05-07)	The neutral point (of a polyphase system) is defined in IEV 601-02-22 as follows: "Common point of the <i>n</i> -windings in a star-connected power transformer or earthing transformer, in a substation." In certain instances, and under specified conditions, the functions of neutral conductor and protective conductor may be combined in a single conductor (see definition of PEN conductor (826-04-25))
B.1.1.3	ambient temperature (826-01-03)	It is assumed that the ambient temperature includes the effects of all other equipment installed in the same location. The ambient temperature to be considered for the equipment is the temperature at the place where the equipment is to be installed resulting from the influence of all other equipment and heat sources in the same location, when operating, not taking into account the thermal contribution of the equipment to be installed.
B.1.1.4	electric supply system for safety services; (826-01-04)	Safety services are often a statutory requirement in premises open to the public, in very high buildings and in certain industrial premises.
B.1.1.5	standby electric supply system (826-01-07)	Standby supplies are necessary, for example, to avoid interruption of continuous industrial processes or data processing.
B.1.2	Voltages and currents (section 826-02)	
B.1.2.1	nominal voltage (of an electrical installation) (826-02-01)	Transient overvoltages, due for example to switching operations, and temporary variations in the voltage due to abnormal conditions, such as faults in the supply system, are ignored.
B.1.3	Electric shock and protective measures (section 826-03)	
B.1.3.1	extraneous-conductive-part (826-03-11)	Extraneous-conductive-parts may be – metallic parts of the building structure; – metal pipe systems for gas, water, heating, etc.; – non-insulating floors and walls.

	Term	Note
B.1.3.2	simultaneously accessible parts (826-03-12)	<p>In the context of basic protection (protection against direct contact), a live part may be accessible with</p> <ul style="list-style-type: none"> – another live part; or – an exposed-conductive-part; or – an extraneous-conductive-part; or – a protective conductor. <p>The following may constitute simultaneously accessible parts in the context of fault protection (protection against indirect contact):</p> <ul style="list-style-type: none"> – exposed-conductive-parts; – extraneous-conductive-parts; – protective conductors. <p>In relation to the definition of IEV 826-03-12, it should be noted that the word 'touched' signifies any contact with any part of the body (hand, foot, head, etc.)</p>
B.1.3.3	arm's reach (826-03-19)	This space is by convention limited as shown in figure B.1 (21a)



IEC 1034/01

S = surface expected to be occupied by persons

Figure B.1 (21a) – Zone of arm's reach

B.1.4	Earthing and bonding (section 826-04)	
B.1.4.1	(local) earth, (local) ground (US) (826-04-02)	In the proximity of earth electrodes the potential may not be zero.
B.1.4.2	earthing conductor grounding conductor (US) (826-04-12)	The non-insulated parts of earthing conductors which are buried in the ground are regarded as forming part of the earth electrode.
B.1.4.3	equipotential bonding (826-04-19)	Distinction is made between – the main equipotential bonding; – supplementary equipotential bonding; – earth-free equipotential bonding. Supplementary equipotential bonding is also known as local bonding.
B.1.5	Electric circuits (section 826-05)	
B.1.5.1	(electric) circuit (of an electrical installation) (826-05-01)	A circuit comprises live conductors, protective conductors (if any) and associated switchgear, controlgear and accessories. A protective conductor may be common to several circuits.
B.1.5.2	design current (of an electric circuit) (826-02-10)	The design current is determined taking into account diversity. When conditions are variable, the design current is the continuous current which would bring the circuit components to the same temperature. This current is denoted I_B
B.1.5.3	(continuous) current-carrying capacity ampacity (US) (826-02-13)	This current is denoted I_Z
B.1.5.4	overcurrent (826-02-14)	An overcurrent may or may not have harmful effects, depending on its magnitude and duration. Overcurrents may be the result of overloads in current-using equipment or faults such as short-circuits or earth faults.
B.1.5.5	conventional operating current (of a protective device) (826-02-17)	The conventional operating current is greater than the rated current or current setting of the device, and the conventional time varies according to the type and rated current of the protective device. For fuses this current is called the "conventional fusing current". For circuit-breakers this current is called the "conventional operating current"
B.1.7	Other equipment (section 826-07)	
B.1.7.1	hand-held equipment (826-07-05)	This means equipment whose functioning relies on constant manual support or guidance.
B.1.7.2	stationary equipment (826-07-06)	Example: The value of this mass is 18 kg in IEC standards relating to household appliances.
B.1.8	Isolation and switching (section 826-08)	
B.1.8.1	isolation (826-08-01)	The function of isolation contributes to provide the safety of personnel prior to the execution of work, repairs, fault location or the replacement of equipment.