



BSI Standards Publication

Safe management and operation of electrical installations

National foreword

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Safe management and operation of electrical installations



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Safe management and operation of electrical installations

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The text of this Technical Specification is based on the following documents:

Draft	Report on voting
128/59/DTS	128/60/RVDTS

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

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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- reconfirmed,
- withdrawn, or
- revised.

1 Scope

This document is applicable to the safe management and [operation \(3.1.2\)](#) of and [work activity \(3.4.1\)](#) on, with, or near electrical installations operating at voltage levels from, and including, extra-low voltage up to and including high voltage.

This latter term includes those levels commonly referred to as medium and extra-high voltage.

These electrical installations are designed for the generation, transmission, conversion, distribution and use of electrical power. Some of these electrical installations are permanent and fixed, such as a distribution installation in a factory or office complex. Others are temporary, such as on construction sites, and some are mobile or capable of being moved either whilst energized or whilst not energized nor charged, examples are electrically driven excavating machines in quarries or open-cast coal sites.

This document sets out the requirements for the safe management and [operation \(3.1.2\)](#) of and [work activity \(3.4.1\)](#) on, with, or near these electrical installations. The requirements apply to all operational, working and maintenance procedures. They apply to all [non-electrical work \(3.4.3\)](#) such as building work near to overhead lines or underground cables as well as [electrical work \(3.4.2\)](#), when there is a [risk \(3.1.3\)](#) of [electrical danger \(3.1.5\)](#).

This document does not apply to [ordinary persons \(3.2.7\)](#) when using installations and equipment, provided that the installations and equipment comply with relevant standards and are designed and installed for use by [ordinary persons \(3.2.7\)](#).

This document has not been developed specifically to apply to the electrical installations listed below. However, if there are no other rules or procedures, the principles of this document could be applied to them:

- on any aircraft and hovercraft moving under its own power, (international aviation laws can apply);
- on any sea going ship moving under its own power, or under the direction of the master, (international marine laws can apply);
- electronic telecommunications and information systems;
- electronic instrumentation, control and automation systems;
- at coal or other mines;
- on off-shore installations (international marine laws can apply);
- on vehicles;
- on electric traction systems;
- on experimental electrical research work.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-195:2021, *International Electrotechnical Vocabulary (IEV) - Part 195: Earthing and protection against electric shock*

IEC 60364-1, *Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-4-41, *Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock*

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

IEC 61219, *Live working - Earthing or earthing and short-circuiting equipment using lances as a short-circuiting device - Lance earthing*

IEC 61230, *Live working - Portable equipment for earthing or earthing and short-circuiting*

IEC 61243-1, *Live working - Voltage detectors - Part 1: Capacitive type to be used for voltages exceeding 1 kV AC*

IEC 61243-2, *Live working - Voltage detectors - Part 2: Resistive type to be used for voltages of 1 kV to 36 kV a.c.*

IEC 61243-3, *Live working - Voltage detectors - Part 3: Two-pole low-voltage type*

IEC 61243-5, *Live working - Voltage detectors - Part 5: Voltage detecting systems (VDS)*

IEC 61472:2013, *Live working - Minimum approach distances for a.c. systems in the voltage range 72,5 kV to 800 kV - A method of calculation*

IEC 61472-2:2021, *Live working - Minimum approach distances - Part 2: Method of determination of the electrical component distance for AC systems from 1,0 kV to 72,5 kV*

IEC 61936-1, *Power installations exceeding 1 kV AC and 1,5 kV DC - Part 1: AC*

IEC 61936-1:2021, *Power installations exceeding 1 kV AC and 1,5 kV DC - Part 1: AC*

IEC 62271-1, *High-voltage switchgear and controlgear - Part 1: Common specifications for alternating current switchgear and controlgear*

IEC 62271-102, *High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches*

IEC 62271-213, *High-voltage switchgear and controlgear - Part 213: Voltage detecting and indicating system*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 General

3.1.1

electrical installation

assembly of electrical equipment which is used for the generation, transmission, conversion, distribution and use of electrical energy

Note 1 to entry: The [electrical installation \(3.1.1\)](#) includes energy sources such as batteries, capacitors and all other sources of stored electric energy.

[SOURCE: [IEC 60050-651:2014 \[1\]](#), 651-26-01, modified – Note 2 to entry was removed.]

3.1.2

operation

combination of activities including *work activities* necessary to permit an [electrical installation \(3.1.1\)](#) to function

Note 1 to entry: The [operation \(3.1.2\)](#) includes such matters as switching, controlling, monitoring, verification of the [electrical installation \(3.1.1\)](#), inspection and maintenance as well as both [electrical work \(3.4.2\)](#) and [non-electrical work \(3.4.3\)](#).

[SOURCE: [IEC 60050-651:2014 \[1\]](#), 651-26-02 modified, the term “verification of the electrical installation” was added in Note 1 to entry , Note 2 to entry was removed.]

3.1.3

risk

combination of the probability of occurrence of harm and the severity of that harm

Note 1 to entry: The term “harm” in this context relates to damage to either persons and/or electrical installations.

[SOURCE: [IEC 60050-351:2013 \[2\]](#), 351-57-03 modified, Note 1 to entry was added.]

3.1.4

electrical hazard

potential source of harm when electric energy is present in an [electrical installation \(3.1.1\)](#)

Note 1 to entry: The term “harm” in this context relates to damage to either persons and/or electrical installations.

Note 2 to entry: This entry was numbered 651-01-30 in [IEC 60050-651:2014 \[1\]](#). It has been modified to follow the new translation of ISO/IEC Guide 51 and to precise the term “harm”.

[SOURCE: [IEC 60050-651:2014 \[1\]](#), 651-26-05]

3.1.5

electrical danger

[risk \(3.1.3\)](#) of electrical injury when electrical energy is present in an [electrical installation \(3.1.1\)](#)

[SOURCE: [IEC 60050-651:2014 \[1\]](#), 651-26-07]

3.2 Personnel, organization and communication

3.2.1

installation manager

IM

designated person with the overall responsibility to ensure the safe [operation \(3.1.2\)](#) of the [electrical installation \(3.1.1\)](#) by setting rules and organization or framework

Note 1 to entry: This person can be the owner, employer, proprietor or a delegated person or legal entity represented by a natural person.

Note 2 to entry: Some of these duties can be delegated to others as required. For large or complex electrical installations or networks, the duties can be delegated for parts of the installations or the network (see [4.3](#)).

Note 3 to entry: See [Figure B.1](#), classification a).

3.2.2

operation controller

OC

designated person who is responsible during work activities for the safe [operation \(3.1.2\)](#) of the [electrical installation \(3.1.1\)](#)

Note 1 to entry: This person has to judge the possible effects of the work activities on the [electrical installation \(3.1.1\)](#) or parts of it which are under their responsibility and the effects of the [electrical installation \(3.1.1\)](#) on persons carrying out the work activities. Some of these duties can be delegated to others as required (see [4.3](#)).

Note 2 to entry: See [Figure B.1](#), classification b).

3.2.3

work controller

WC

designated person with direct management responsibility for the [work activity \(3.4.1\)](#) at [work location \(3.3.1\)](#)

Note 1 to entry: Parts of this responsibility can be delegated to others as required.

Note 2 to entry: See [Figure B.1](#), classification c).

3.2.4

worker

W

person carrying out work activities

Note 1 to entry: See [Figure B.1](#), classification d).

3.2.5

skilled person

qualified person (US)

<electricity> person with relevant education, knowledge and experience to enable them to analyse risks and to avoid hazards which electricity can create

[SOURCE: [IEC 60050-651:2014 \[1\]](#), 651-26-11 modified, the term "training" was deleted, "perceive" was replaced by "analyse"; "danger" was replaced by "hazard", Note 1 to entry was removed.]

3.2.6

instructed person

trained person (US)

<electricity> person adequately advised by a [skilled person \(3.2.5\)](#) to enable them to perceive risks as instructed and to avoid hazards which electricity can create

[SOURCE: [IEC 60050-651:2014 \[1\]](#) 651-26-12 modified, the term "supervised" was deleted, "electrically" was deleted "danger" was replaced by "hazard" and added "as instructed."]

3.2.7

ordinary person

<electricity> person who is neither a [skilled person \(3.2.5\)](#) nor an [instructed person \(3.2.6\)](#)

[SOURCE: [IEC 60050-195:2021 \[3\]](#), 195-04-03]

3.2.8

notification

message or instruction which is either verbal or in writing associated with [operation \(3.1.2\)](#) of any [electrical installation \(3.1.1\)](#)

3.2.9

electrical safety rules

set of rules and associated procedures and forms used by the [installation manager \(3.2.1\)](#) to ensure the safe [operation \(3.1.2\)](#) of the [electrical installation \(3.1.1\)](#)

3.3 Working zone

3.3.1

work location

site, place or area where a [work activity \(3.4.1\)](#) is to be, is being, or has been carried out

[SOURCE: IEC 60050-651:2014 [1], 651-26-03, modified – Note 1 to entry was removed.]

3.3.2

live working zone

space around [live \(3.4.14\)](#) parts in which the insulation level to prevent [electrical danger \(3.1.5\)](#) is not assured when reaching into or entering it without protective measures

Note 1 to entry: The outer limit of the [live working zone \(3.3.2\)](#) is denoted as the distance D_L (see [Figure 1](#), [Figure 2](#) and [Figure 3](#)).

3.3.3

vicinity zone

limited space outside the [live working zone \(3.3.2\)](#)

Note 1 to entry: The outer limit of the [vicinity zone \(3.3.3\)](#) is denoted as the distance D_V (see [Figure 1](#), [Figure 2](#) and [Figure 3](#)).

Note 2 to entry: In this zone, specific precautions are taken to avoid encroaching into the [live working zone \(3.3.2\)](#).

3.4 Working

3.4.1

work activity

form of [electrical work \(3.4.2\)](#) or [non-electrical work \(3.4.3\)](#) where there is the possibility of an [electrical hazard \(3.1.4\)](#)

3.4.2

electrical work

work on, with or near an [electrical installation \(3.1.1\)](#) such as testing and measurement, repairing, replacing, modifying, extending, erecting, maintaining and inspecting

[SOURCE: IEC 60050-651:2014 [1], 651-26-04, modified - The definition was reworded by combining the definition and the Note 1 to entry. Note 2 to entry and Note 3 to entry were removed.]

3.4.3

non-electrical work

work near to an [electrical installation \(3.1.1\)](#) such as construction, excavation, cleaning, painting, etc.

3.4.4

live working

work in which a [worker \(3.2.4\)](#) deliberately makes contact with [live \(3.4.14\)](#) parts or reaches into the [live working zone \(3.3.2\)](#) with either parts of their body or with tools, equipment or devices being handled

Note 1 to entry: At low voltage, [live working \(3.4.4\)](#) is carried out by the [worker \(3.2.4\)](#), when making contact with bare [live \(3.4.14\)](#) parts. At high voltage, [live working \(3.4.4\)](#) is carried out by the [worker \(3.2.4\)](#), when entering the [live working zone \(3.3.2\)](#), regardless of whether contact is made with bare [live \(3.4.14\)](#) parts or not.

[SOURCE: IEC 60050-651:2014 [1], 651-21-01, modified - The definition was reworded; the three Notes to entry have been replaced by a new Note 1 to entry.]

3.4.5**working within the vicinity zone**

[work activity \(3.4.1\)](#) in which a [worker \(3.2.4\)](#) with part of their body, with a tool or with any other object enters into the [vicinity zone \(3.3.3\)](#) without encroaching into the [live working zone \(3.3.2\)](#)

3.4.6**isolate**

disconnect completely a device or an electric circuit from other devices or electric circuits

[SOURCE: IEC 60050-151:2001 [4], 151-15-37]

3.4.7**dead**

qualifies a conductive part when it is not energized

Note 1 to entry: The part is considered [dead \(3.4.7\)](#) if it is [isolated \(3.4.6\)](#) in accordance with [6.2](#).

[SOURCE: IEC 60050-151:2001 [4], 151-15-59, modified – Note 1 to entry was added.]

3.4.8**dead working**

[work activity \(3.4.1\)](#) on [electrical installations \(3.1.1\)](#) which are neither [live \(3.4.14\)](#) nor charged, carried out after having taken all measures to prevent [electrical danger \(3.1.5\)](#)

3.4.9**authorization**

formal approval to perform specific roles, operations and tasks

Note 1 to entry: See [4.12](#).

3.4.10**permission to start work**

direct instruction to the [workers \(3.2.4\)](#) at [work location \(3.3.1\)](#) to commence work after all safety measures are taken

3.4.11**supervision**

task to apply electrical safety control to the [work activity \(3.4.1\)](#)

3.4.12**management instruction**

written instruction giving effect to additional arrangements approved by the installation manager to account for situations in exceptional circumstances which are not covered by the [electrical safety rules \(3.2.9\)](#) or where the application of these safety rules would not achieve adequate safety

3.4.13**transfer of control**

specific framework to ensure safety when control of the [electrical installation \(3.1.1\)](#) or part thereof is transferred by the installation manager to a third party for the duration of planned work

3.4.14**live**

energized

at an electric potential different from that of earth at the worksite and which presents an [electrical hazard \(3.1.4\)](#)

Note 1 to entry: A part is energized or live when it is electrically connected to a source of electric energy. It can also be energized when it is electrically charged and/or under the influence of an electric or magnetic field.

[SOURCE: [IEC 60050-651:2014 \[1\]](#), 651-21-08, Note 2 to entry was removed]]

3.5 Protective devices

3.5.1

screen

device, which can be insulated or not, which is used to prevent approach to any equipment or part of [electrical installation \(3.1.1\)](#) which presents [electrical danger \(3.1.5\)](#)

3.5.2

barrier

part providing protection against direct contact from any usual direction of access

[SOURCE: [IEC 60050-826:2004 \[16\]](#), 826-12-23, modified - by deleting the words “(electrically)” and “protective”]

3.5.3

protective cover

rigid, flexible or supple device made of insulating material used to cover energized and/or [dead \(3.4.7\)](#) parts and/or adjacent earthed parts

Note 1 to entry: Protective covers are intended to protect against inadvertent contact.

[SOURCE: [IEC 60050-651:2014 \[1\]](#), 651-22-11, with Note 2 to entry removed in full]]

3.5.4

enclosure

part providing protection of equipment against certain external influences and, in any direction, protection against direct contact

3.5.5

voltage detector

portable device used to detect reliably the presence or the absence of the [operating voltage \(3.6.4\)](#) and used to verify that the [electrical installation \(3.1.1\)](#) is ready for earthing

Note 1 to entry: These devices are generally described as either capacitive types or resistive types.

[SOURCE: [IEC 60050-651:2014 \[1\]](#), 651-24-02, modified - by replacing “diagnostic” by “portable” and by completing the definition with the following words: “and used to verify that the electrical installation is ready for earthing”, Note 2 to entry and Note 3 to entry have been omitted.]

3.5.6

portable equipment for earthing and short-circuiting

equipment which is portable and is connected by insulating tool(s) to parts of an [electrical installation \(3.1.1\)](#) for earthing, short-circuiting or earthing and short-circuiting purposes

Note 1 to entry: The [portable equipment for earthing and short-circuiting \(3.5.6\)](#) comprises earthing tools, short-circuiting tools and one or more insulating tools, for instance earthing sticks.

[SOURCE: [IEC 60050-651:2014 \[1\]](#), 651-25-01, modified - Note 2 to entry was omitted.]

3.5.7

personal protective equipment

PPE

device or appliance designed to be worn by an individual for protection against one or more health and safety hazards

[SOURCE: IEC 60050-651:2014 [1], 651-23-01, modified - "whilst performing live working" was deleted, Note 1 to entry and Note 2 to entry have been omitted.]

3.6 Voltages

3.6.1

extra-low voltage

ELV

voltage normally not exceeding 50 V alternating current AC or 120 V ripple free direct current DC whether between conductors or to earth

Note 1 to entry: This definition includes SELV, PELV and FELV (see IEC 60364-4-41).

3.6.2

low voltage

LV

voltage normally not exceeding 1 000 V AC or 1 500 V DC

3.6.3

high voltage

HV

voltage normally exceeding 1 kV AC or 1,5 kV DC

3.6.4

operating voltage

value of the voltage under normal conditions, at a given instant and a given point of the system or an [electrical installation](#) (3.1.1)

Note 1 to entry: This value can be expected, estimated or measured.

[SOURCE: IEC 60050-601:1985 [5], 601-01-22, modified - by adding: "or an electrical installation"]

3.7 Distances

3.7.1

live working limit distance

D_L

distance in air defining the outer limit of the [live working zone](#) (3.3.2)

3.7.2

vicinity limit distance

D_V

distance in air defining the outer limit of the [vicinity zone](#) (3.3.3)

3.7.3

minimum approach distance for live working

D_A

minimum distance in air for [live working](#) (3.4.4) to be maintained between any part of the body of a [worker](#) (3.2.4), including any object (except tools appropriate for [live working](#) (3.4.4)) being handled directly, and any part(s) at different electric potential(s)

Note 1 to entry: The minimum approach distance for [live working](#) (3.4.4) is the sum of the electrical distance appropriate for the maximum nominal voltage and of the selected ergonomic distance.

[SOURCE: IEC 60050-651:2014 [1], 651-21-11, modified - "for live working" has been added to the term and the definition.]

3.7.4 minimum working distance

D_W

minimum distance in air (including tools, objects and equipment) to be maintained between any part of the body of a worker (including tools, objects and equipment) and bare [live \(3.4.14\)](#) parts when working near a bare [live part \(3.8.5\)](#) during work activities within or outside the [vicinity zone \(3.3.3\)](#)

Note 1 to entry: For minimum working distance within the [vicinity zone \(3.3.3\)](#) the symbol is D_{WL}

Note 2 to entry: For minimum working distance outside the [vicinity zone \(3.3.3\)](#) the symbol is D_{WV}

3.7.5 electrical distance

D_U

distance in air required to prevent a disruptive discharge between energized parts or between energized parts and earthed parts during [live working \(3.4.4\)](#)

[SOURCE: IEC 60050-651:2014 [1], 651-21-12, modified - Note 1 to entry has been omitted.]

3.7.6 ergonomic distance

D_E

<live working> distance in air, to take into account inadvertent movement and errors in judgement of distances while performing [live working \(3.4.4\)](#)

Note 1 to entry: This distance is not fixed because it is necessary to make an evaluation for different situations of work.

[SOURCE: IEC 60050-651:2014 [1], 651-21-13, modified - "added to the electrical distance" was added to the definition, "working" was replaced by "live working", the existing Note 1 to entry was replaced by a new Note 1 to entry.]

3.7.7 ergonomic distance

E

<vicinity> distance in air, to account for normal and unintentional movement and errors in judgement of distances while performing work within or outside the [vicinity zone \(3.3.3\)](#)

Note 1 to entry: This distance is not fixed because it is necessary to make an evaluation for different situations of work.

3.7.8 floating conductive distance

F

<live working> sum of all lengths, in the direction of the gap axis, of all floating conductive objects in the air gap

[SOURCE: IEC 61472:2013, 4.3.1, modified by adding after the domain "live working"]

3.7.9 distance of the equipment

L

<vicinity> distance in air corresponding to longitudinal dimensions of equipment, objects or tools, while performing work within or outside the [vicinity zone \(3.3.3\)](#)

3.8 Miscellaneous

3.8.1

safety documents

suite of forms dedicated to an [electrical installation \(3.1.1\)](#) or a part of an [electrical installation \(3.1.1\)](#) in which all the safety aspects are described and respected during a [work activity \(3.4.1\)](#)

3.8.2

competence

<electricity> level of electrical knowledge, experience and training specific to a chosen task or role that is considered as being essential for an individual to undertake the task or role in accordance with national legislation, international standards and industry best practice

3.8.3

switching plan

list of sequential logical operations to ensure and record a safe change in status of electrical equipment including de-energization, earthing, application of locks to securing against reconnection, removal of earths, removal of locks, re-energization or first energization of electrical equipment

3.8.4

incident energy

heat energy Q resulting from an electric arc received at a unit surface area at a specified distance from the electric arc

[SOURCE: IEC 60050-651:2014 [1], 651-27-11]

3.8.5

live part

conductive part intended to be energized under normal operating conditions, including the neutral conductor and mid-point conductor, but excluding the PEN conductor, PEM conductor and PEL conductor

[SOURCE: IEC 60050-195:2021, 195-02-19]

3.8.6

hazardous-live-part

[live part \(3.8.5\)](#) that, under certain conditions, can give a harmful electric shock

Note 1 to entry: A hazardous voltage can be present on the accessible surface of solid insulation. In such a case, this surface is considered to be a [hazardous-live-part \(3.8.6\)](#).

Note 2 to entry: If the part is made [dead \(3.4.7\)](#) according to 6.2, the part is not considered as [hazardous-live-part \(3.8.6\)](#).

[SOURCE: IEC 60050-195:2021, 195-06-05, modified by adding the Note 2 to entry.]

3.9 Symbols

The following symbols are used in the document:

ALARP	as low as reasonable practical
ATPV	arc thermal performance value
CHP	combined heat and power device
D_A	minimum approach distance for live working (3.7.3)
D_E	ergonomic distance, <live working> (3.7.6)
D_L	live working limit distance (3.7.1)

D_U	electrical distance (3.7.5)
D_V	vicinity limit distance (3.7.2)
D_W	minimum working distance (3.7.4)
D_{WL}	minimum working distance within the vicinity zone (3.7.4)
D_{WV}	minimum working distance outside the vicinity zone (3.7.4)
E	ergonomic distance, <vicinity> (3.7.7)
EBT	energy breakopen threshold
ELIM	incident energy limit
ELV	extra low voltage (3.6.1)
F	floating conductive distance, <live working> (3.7.8)
FELV	functional extra-low voltage
HV	high voltage (3.6.3)
IM	installation manager (3.2.1)
IR	infrared
L	distance of the equipment, <vicinity> (3.7.9)
LV	low voltage (3.6.2)
OC	operation controller (3.2.2)
PELV	protective extra-low voltage
PPE	personal protective equipment (3.5.7)
PV	solar photovoltaic
RAMS	risk assessment method statement
SELV	separated extra-low voltage
UV	ultraviolet
W	worker (3.2.4)
WC	work controller (3.2.3)

4 Basic principles

4.1 Safe operation (3.1.2)

Before carrying out any [operation \(3.1.2\)](#) on an [electrical installation \(3.1.1\)](#), the [installation manager \(3.2.1\)](#) shall provide [electrical safety rules \(3.2.9\)](#) for the installation as described in [4.14](#) and confirm that the installation is safe to operate. Confirmation of being safe to operate includes but is not limited to:

- confirmation of design and installation in accordance with relevant standards;
- confirmation that maintenance is being carried out in accordance with best practice;
- assessment of the electric shock;
- assessment of arc flash [risk \(3.1.3\)](#);
- confirmation of the protective measures applied.

If this cannot be confirmed, [operation \(3.1.2\)](#) shall not be carried out.

In addition, an assessment of the electrical risks shall be made. This assessment shall specify how the [operation \(3.1.2\)](#) shall be carried out and which safety measures and precautions are to be implemented to ensure safety. If it is determined, that the work cannot be carried out as planned work shall be stopped immediately or not be started.

If defects or any failure are observed on or in [electrical installations \(3.1.1\)](#), which can result in an [electrical hazard \(3.1.4\)](#), the [installation manager \(3.2.1\)](#) for this [electrical installation \(3.1.1\)](#) shall immediately be notified and necessary measures shall be taken.

4.2 Personnel

Additional responsibilities placed upon persons for the safety of those engaged in a [work activity \(3.4.1\)](#) and those who are or can be affected by the [work activity \(3.4.1\)](#) can be subject to national legislation.

All personnel involved in a [work activity \(3.4.1\)](#) on, with, or near an [electrical installation \(3.1.1\)](#) shall be instructed in the safety requirements, safety rules and company instructions applicable to their work. These instructions shall be repeated during the course of the work where the [work activity \(3.4.1\)](#) is of long duration or is complex. The personnel involved shall be required to comply with these requirements, rules and instructions.

Personnel shall wear clothing suitable for the locations and conditions where they are working. This could include the use of close-fitting clothing or additional [personal protective equipment \(3.5.7\)](#).

Before any [work activity \(3.4.1\)](#) is started and during that [work activity \(3.4.1\)](#), the [work controller \(3.2.3\)](#) shall ensure that all relevant requirements, rules and instructions are complied with.

The [work controller \(3.2.3\)](#) shall instruct all persons engaged upon the work activities of all reasonably foreseeable dangers that are not immediately apparent to them.

No person shall undertake a [work activity \(3.4.1\)](#) or carry out a nominated role where specific [competence \(3.8.2\)](#) including technical knowledge or experience is needed to prevent [electrical danger \(3.1.5\)](#) or injury, unless that person has been authorized as having the required [competence \(3.8.2\)](#) (see [4.12](#)), or is under such [supervision \(3.4.11\)](#) (see [4.10](#)) as is necessary for the work undertaken.

National legislation can apply regarding the minimum age and the criteria for [competence \(3.8.2\)](#) of persons.

Where there are no national requirements for [competence \(3.8.2\)](#), the following criteria shall be used in determining the [competence \(3.8.2\)](#) required for specific tasks and roles including exchange of [safety documents \(3.8.1\)](#):

- knowledge of electricity;
- experience of [electrical work \(3.4.2\)](#);
- understanding of the [electrical installation \(3.1.1\)](#) to be worked on and practical experience of that work;
- understanding the hazards which can arise during the work and the precautions to be observed;
- ability to recognize at all time whether it is safe to continue working.

The complexity of the [work activity \(3.4.1\)](#) shall be assessed before the activity starts such that the appropriate choice of skilled, instructed, or [ordinary person \(3.2.7\)](#) is made for carrying out the [work activity \(3.4.1\)](#).

4.3 Organization

4.3.1 General

Each [electrical installation \(3.1.1\)](#) shall be placed under the responsibility of the [installation manager \(3.2.1\)](#).

Each part of an [electrical installation \(3.1.1\)](#) which is subject of a [work activity \(3.4.1\)](#) shall be placed under the responsibility of an [operation controller \(3.2.2\)](#).

Each [work activity \(3.4.1\)](#) shall be under the responsibility of a [work controller \(3.2.3\)](#).

The duties of the [installation manager \(3.2.1\)](#), the [operation controller \(3.2.2\)](#) and [work controller \(3.2.3\)](#) can be carried out by in a single person.

4.3.2 The [installation manager \(3.2.1\)](#)

The [installation manager \(3.2.1\)](#) is a designated person with the overall responsibility to ensure the safe [operation \(3.1.2\)](#) of the [electrical installation \(3.1.1\)](#) by setting rules and an organization or framework.

The [installation manager \(3.2.1\)](#) can be a natural person from the own organization or a third-party organization. In the case that the person is from another organization, it is recommended to document the nomination, the part of the installation the person is responsible for and the timescale of nomination in writing.

The [installation manager \(3.2.1\)](#) can delegate a part of their duties to other persons. This should be documented.

Where two or more electrical installations or organizations come together, it is essential that there are formal arrangements for consultation and cooperation between the [installation manager \(3.2.1\)](#) of each of those installations or organizations to ensure safety.

Access to all places where [ordinary persons \(3.2.7\)](#) are exposed to [electrical hazards \(3.1.4\)](#) shall be regulated. The method of regulation and control of access shall be the responsibility of the [installation manager \(3.2.1\)](#).

NOTE National requirements can apply to the method of regulation and control of access.

4.3.3 The [operation controller \(3.2.2\)](#)

The [operation controller \(3.2.2\)](#) shall control their part of the [electrical installation \(3.1.1\)](#) and give [authorization \(3.4.9\)](#) to the [work controller \(3.2.3\)](#).

The [operation controller \(3.2.2\)](#) can for assistance delegate some of their duties to other persons as required. The [operation controller \(3.2.2\)](#) shall be a skilled person.

4.3.4 The [work controller \(3.2.3\)](#)

The [work controller \(3.2.3\)](#) has the responsibility for the [work activity \(3.4.1\)](#).

Where the [work activity \(3.4.1\)](#) is subdivided, it can be necessary to nominate a person for each subdivision to be responsible for the safety, all under the responsibility of the [work controller \(3.2.3\)](#) as the coordinating person.

The [work controller \(3.2.3\)](#) and the [operation controller \(3.2.2\)](#) shall agree both the arrangements of the electrical system to allow the work to take place and a description of the [work activity \(3.4.1\)](#) on, with or near the [electrical installation \(3.1.1\)](#) before any changes to the arrangements of the [electrical installation \(3.1.1\)](#) are made or work takes place (see 4.13). The work controller shall be an [instructed person \(3.2.6\)](#) or [skilled person \(3.2.5\)](#).

4.3.5 The [worker \(3.2.4\)](#)

Each [worker \(3.2.4\)](#) has the responsibility to obey the instructions received with the [permission to start work \(3.4.10\)](#) and to confirm their understanding of the received instructions and corresponding safety measures of the planned working procedure.

If the situation arises where the instructions or safety measures become unclear or a [worker \(3.2.4\)](#) has any doubts on the safe continuation of the work, they have the obligation to stop the work to get clarification from the [work controller \(3.2.3\)](#). If necessary, the [work controller \(3.2.3\)](#) shall inform the [operation controller \(3.2.2\)](#).

The working team ([Figure B.1](#)) consists of workers who can be [skilled persons \(3.2.5\)](#), [instructed persons \(3.2.6\)](#) and [ordinary persons \(3.2.7\)](#).

4.3.6 Skilled person in electricity

Where a task or role ([4.2](#)) requires a specific [competence \(3.8.2\)](#) ([4.12](#)) to prevent [electrical danger \(3.1.5\)](#) or injury a suitably skilled person can be authorized to carry out that specific task or nominated to carry out a specific role including [operation controller \(3.2.2\)](#) or [work controller \(3.2.3\)](#) required by operational procedures ([Clause 5](#)) or working procedures ([Clause 6](#)).

4.3.7 Instructed person in electricity

An [instructed person \(3.2.6\)](#) maybe an [ordinary person \(3.2.7\)](#), or a skilled person in training who has specific [competence \(3.8.2\)](#) but has not received [authorization \(3.4.9\)](#), to carry out the specific task or nominated role. The instructed person may only carry out the task or role under the [supervision \(3.4.11\)](#) of a [skilled person \(3.2.5\)](#).

4.3.8 Ordinary person (3.2.7) in electricity

An [ordinary person \(3.2.7\)](#) does not possess [competence \(3.8.2\)](#) in electricity and so may only carry out tasks which do not require this [competence \(3.8.2\)](#), or if this [competence \(3.8.2\)](#) is required, the [ordinary person \(3.2.7\)](#) may only carry out the task under the [supervision \(3.4.11\)](#) of a skilled person.

4.3.9 Complexity of work activity (3.4.1)

4.3.9.1 Where the [work activity \(3.4.1\)](#) or the [electrical installation \(3.1.1\)](#) is complex, and in any case where specified by the [electrical safety rules \(3.2.9\)](#), the [work activity \(3.4.1\)](#) shall be planned and prepared in accordance with [4.13](#). The [electrical safety rules \(3.2.9\)](#) issued by the [installation manager \(3.2.1\)](#) shall adequately define complex activities. The safety rules shall also provide a process to assess if a particular task or part of the installation should be considered complex or non-complex.

4.3.9.2 Where the [work activity \(3.4.1\)](#) is non-complex, no written preparation is necessary. Features of a non-complex [work activity \(3.4.1\)](#) can be where:

- the [electrical installation \(3.1.1\)](#) or part of an [electrical installation \(3.1.1\)](#) is non-complex;
- circumstances and surroundings are clear and obvious to understand.

Any [skilled person \(3.2.5\)](#) can specify by basic knowledge and experience, how a [work activity \(3.4.1\)](#) shall be carried out safely where the [work activity \(3.4.1\)](#) is specified as:

- either non-complex [work activity \(3.4.1\)](#),

or

- non-complex maintenance work, which is permitted by the [electrical safety rules \(3.2.9\)](#) to be carried out according to standard procedures approved by the [installation manager \(3.2.1\)](#).

4.3.10 Objections for safety

There shall be arrangements in place such that any [worker \(3.2.4\)](#) who objects for reasons of safety to carry out any instruction or [work activity \(3.4.1\)](#) can report those objections immediately to the [work controller \(3.2.3\)](#), who shall have the matters investigated, and if

necessary, consult a nominated person with higher authority for a decision. These arrangements shall be adequately described in the [electrical safety rules \(3.2.9\)](#).

4.4 Communication (transmission of information)

This includes every way in which information is passed or exchanged between persons i.e. by spoken word (including telephone, personal radio, and face-to-face), in writing (including e.g. email), and visually (including visual display units, warning panels, lights etc.).

Before any [work activity \(3.4.1\)](#) starts, the [operation controller \(3.2.2\)](#) shall be informed of the intended work.

All necessary information such as network arrangements, the status of switchgear (on, off, earthed), and the position of safety devices, to permit safe [operation \(3.1.2\)](#) of the [electrical installation \(3.1.1\)](#) shall be transmitted by a [notification \(3.2.8\)](#).

Where it is necessary to use other means of transmitting information, for example radio signals, computers, lights, etc. such means shall only be used when precautions are taken and are in place to ensure that the information path is reliable and that no misunderstandings can arise or false signals are given.

All [notifications \(3.2.8\)](#) shall include the name and, if necessary, the location of the person providing the information.

To avoid errors when information is transmitted verbally the recipient shall repeat the information back to the sender, who shall confirm it has been correctly received and understood.

[permission to start work \(3.4.10\)](#) and re-energizing of the [electrical installation \(3.1.1\)](#) on completion of work that is controlled by signals or prearranged understanding after an agreed interval of time shall not be permitted.

In the case of the personnel in a [work location \(3.3.1\)](#) speaking different languages, to ensure understanding and comprehensibility, the agreed language that relevant parties understand shall be granted in advance.

4.5 Work location

The [work location \(3.3.1\)](#) shall be defined and marked clearly. Adequate working space, means of access and lighting shall be provided at all parts of an [electrical installation \(3.1.1\)](#) on, with, or near which any [work activity \(3.4.1\)](#) is to be carried out. Where necessary, the safe access to the [work location \(3.3.1\)](#) shall be clearly marked.

Suitable precautions shall be taken to prevent injury to persons from other hazards that are present in the [work location \(3.3.1\)](#) and [work activity \(3.4.1\)](#) such as mechanical or pressure systems or falls.

Objects which impede access and flammable materials shall not be placed adjacent to nor in or on access ways, escape routes to and from electrical switchgear and controlgear nor in those areas where personnel may operate that equipment. Flammable materials stored next to or adjacent to electrical installations shall be kept away from all sources of ignition.

4.6 Tools, equipment and devices

Examples of tools, equipment and devices are:

- insulating boots, gloves and overshoes;
- eye or face protection;
- head protection;

- suitable protective clothing;
- arc flash PPE displaying an arc rating ATPV/EBT/ELIM values or APC class;
- insulating mats, platforms and stands;
- insulating flexible or rigid screening materials;
- insulated or insulating tools;
- conductive clothing (high voltage working);
- operating sticks and rods;
- locks, notices, signs;
- voltage detectors and voltage detecting systems;
- cable locating and cable selection devices;
- earthing and short-circuiting equipment;
- barriers, flags, marking supports.

Tools, equipment and devices shall be used in accordance with the instructions and guidance provided by the manufacturer or supplier. These instructions and guidance shall be in the language or languages of the country of use.

Any tools, equipment and devices provided for the purpose of safe [operation \(3.1.2\)](#) of, or work on, with, or near electrical installations shall be suitable for that use, be maintained in a condition suitable for that use, and be properly used.

NOTE 1 "Maintained in a condition suitable for use" means periodic visual inspections and electrical testing where necessary including after repairs or modification to verify the electrical integrity and mechanical properties of the tools, equipment and devices.

NOTE 2 Equipment includes [personal protective equipment \(3.5.7\)](#).

NOTE 3 [screen \(3.5.1\)](#), [barriers \(3.5.2\)](#), [protective cover \(3.5.3\)](#) and [enclosure \(3.5.4\)](#) described in this document do not provide protection against arc flash unless they are designed for this purpose.

All special tools, equipment and devices used during [operation \(3.1.2\)](#) of or work on, with, or near an [electrical installation \(3.1.1\)](#) shall be properly stored.

4.7 Drawings and records

There shall be up-to-date drawings and records for the [electrical installation \(3.1.1\)](#) available on site. Each [electrical installation \(3.1.1\)](#) should have an [operation \(3.1.2\)](#) manual describing the normal, emergency, and maintenance procedures as well as safety instructions for the [operation \(3.1.2\)](#) of the [electrical installation \(3.1.1\)](#), in accordance with IEC 61936-1 for high voltage installations and IEC 60364-1 and IEC 60364-5-51 for low voltage installations.

If the manuals and drawings are not available, a careful [risk \(3.1.3\)](#) assessment shall be made before starting the work.

4.8 Signs

During any work or operations adequate signs shall be displayed to draw attention to any relevant hazard.

4.9 Emergency arrangements

Emergency arrangements shall be developed and implemented by the [installation manager \(3.2.1\)](#) for the case an electrical accident or incident takes place. For guidelines, see [Clause B.6](#).

The persons who are required to work on with or near an [electrical installation \(3.1.1\)](#) shall be provided with training and information so that they are able to give appropriate first aid treatment

for electric shock and burns. It is recommended that guidance on first aid is provided on posters or charts displayed at the [work location \(3.3.1\)](#) or in leaflets or [safety documents \(3.8.1\)](#) issued to [workers \(3.2.4\)](#) as appropriate to the circumstances.

4.10 Types of supervision (3.4.11)

The type of [supervision \(3.4.11\)](#) should correspond to the complexity of the [work activity \(3.4.1\)](#) and the voltage level.

[Supervision \(3.4.11\)](#) shall be performed by a [skilled person \(3.2.5\)](#) or [instructed person \(3.2.6\)](#), both with the ability and [competence \(3.8.2\)](#) to directly intervene on [work activity \(3.4.1\)](#). This person shall be continuously available at the location where the [work activity \(3.4.1\)](#) is in progress and shall attend the [work location \(3.3.1\)](#) as necessary for the safe performance of the [work activity \(3.4.1\)](#).

There are two types of [supervision \(3.4.11\)](#) that can be deployed as a result of a [risk \(3.1.3\)](#) assessment:

- [work location \(3.3.1\) supervision \(3.4.11\)](#);
In this case the supervising person may only carry out work activities themselves if these activities do not impair [supervision \(3.4.11\)](#).
- personal [supervision \(3.4.11\)](#);
In this case no other activities shall be performed by the supervising person at the same time.

4.11 Determination of distances

4.11.1 General

Whatever the working conditions are, knowledge and control of air distances to [live \(3.4.14\)](#) parts are essential items to guarantee the safety of workers.

Two types of distances exist:

- limit distances (see [4.11.2](#));
- working distances if any (see [4.11.3](#)).

Most countries have their specific rules to determine safety distances. The majority of them have distances which are compulsory (law, decree, professional agreement) (see also [EN 50110-2 \[6\]](#)). Values and formulae given in [4.11](#) and the [Annex A](#) are informative for these countries.

This document provides the minimum safety distances which shall be respected in the surrounding of a bare [live \(3.4.14\)](#) part and proposes a method to determine the working distances. National rules can also apply.

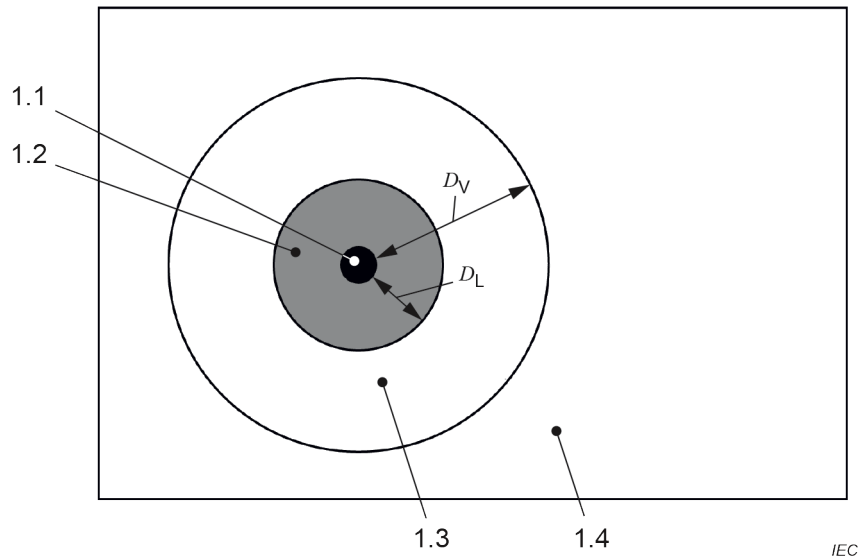
4.11.2 Limit distances

4.11.2.1 General

Limit distances give the size of concentric zones around a bare [live \(3.4.14\)](#) part. These distances are only defined related to a nominal system voltage. These distances are administrative or often regulatory distances which are not in direct relationship with the minimal physical electrical distance related to the voltage.

The space around a bare [live \(3.4.14\)](#) part is divided into three sections (see [Figure 1](#), [Figure 2](#) and [Figure 3](#)) from the bare energized part to the outside. The corresponding distances defining [Figure 1](#), [Figure 2](#) and [Figure 3](#) are given in [Table 1](#):

- the **live working zone (3.3.2)**: the inner limit is the bare part, the outer limit is the distance D_L ;
- the **vicinity zone (3.3.3)**: the inner limit is the distance D_L , the outer limit is the distance D_V ;
- the surrounding outside the **vicinity zone (3.3.3)**. (beyond the outer limit distance D_V).



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Key

- D_L live working limit distance (3.7.1), defining the outer limit of the live working zone (3.3.2)
- D_V vicinity limit distance (3.7.2), defining the outer limit of the vicinity zone (3.3.3)
- 1.1 bare live (3.4.14) part
- 1.2 live working zone (3.3.2)
- 1.3 vicinity zone (3.3.3) of hazardous-live-parts (3.8.6)
- 1.4 outside the vicinity zone (3.3.3)

Figure 1 – Distances in air and zones