

STANDARDS SOUTH AFRICA

Amendment No. 5 : May 2006

to

SANS 10142-1:2006 (Ed 1.5)

THE WIRING OF PREMISES

PART 1: LOW-VOLTAGE INSTALLATIONS

Approved in accordance with procedures of Standards South Africa.

Scope of amendment

This part of SANS 10142 has been amended to

- a) exclude caravans from the scope of the standard, and to delete annex A,
- b) update referenced standards for socket-outlets and stove couplers,
- c) clarify the accessibility of live parts and distribution boards, and the requirements for open wiring, busbars, protective short-circuit current, and voltage drop calculations,
- d) add information on the applicability of the values in the current rating and voltage drop tables for cables, and conditions for conductors under screed, buried cables, and inaccessible joints, and
- e) amend the requirements for underfloor heating, telecommunication d.c. power systems, and marking and labelling.

Instructions for page replacement

Remove the following pages from your copy of SANS 10142-1:2006:

cover, 1-3(b), 11, 19-32, 52, 61(b)-64, 67-69, 74, 101, 102, 105-113, 118, 119, 144-148, 156, 156(a), 156(b), 158-161, 168, 169, 176, 176(a), 176(b), 187, 188, 191-200, 206, 227, 253, 267, 268, 271, 274, 275, 282, 293-300, 303-311, 353.

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Insert the following new pages attached:

cover, 1-3(b), 11, 19-32, 52, 61(b)-64, 67-69, 74, 101, 102, 105-113, 118, 119, 144-148, 148(a), 148(b), 156, 158-161, 168, 169, 176, 187, 188, 191-195, 195(a), 195(b), 196-200, 206, 227, 253, 267, 268, 268(a), 268(b), 271, 274, 275, 282, 293-300, 303-311, 353.

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Any reference to SABS 0142 is deemed
to be a reference to this standard
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SOUTH AFRICAN NATIONAL STANDARD

The wiring of premises

Part 1: Low-voltage installations

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Table of changes

Change No.	Date	Scope
Amdt 1	Jan. 2003	Amended to change the number of the standard and the numbers of referenced standards, include a Regulator's Compliance Certificate (RCC) and specially tested assemblies (STA) as proof of compliance, clarify the requirements for distribution boards by adding definitions and a new annex (annex S), amend the requirements for surge protection, and change them to recommendations (included in annex L), amend the requirements for the bonding of antennas, delete the requirements for electric fences, change the requirements for extra low voltage lighting and delete the determination of earth resistance.
Tech corr. 1	March 2003	Changed to correct errors in the introduction, in 5.5.2 and in 6.6.1.21(a).
Amdt 2	Aug. 2003	Amended to remove the implementation date for proof of compliance of distribution boards.
Amdt 3	Dec. 2003	Amended to delete implementation requirements and references to specific national legislation from the normative part of the standard, rearrange the requirements for distribution boards, clarify the rating requirements for earth leakage units, add requirements for the connection of flexible cords and the indication of the position of the main switch, and to update normative references.

Table of changes (*concluded*)

Change No.	Date	Scope
Amdt 4	April 2005	Amended to update and add normative references, to change table 4.2 in respect of circuit-breakers, conduit, switch-disconnectors, transformers and watt-hour meters, to clarify requirements for disconnection, bonding, earthing, and underfloor heating, and to change the requirements for installations in agricultural locations and at swimming pools.
Amdt 5	May 2006	Amended to exclude caravans from the scope of the standard, and to delete annex A, to update referenced standards for socket-outlets and stove couplers, to clarify the accessibility of live parts and distribution boards, and the requirements for open wiring, busbars, prospective short-circuit current, and voltage drop calculations, to add information on the applicability of the values in the current rating and voltage drop tables for cables, and conditions for conductors under screed, buried cables, and inaccessible joints, and to amend the requirements for underfloor heating, telecommunication d.c. power systems, and marking and labelling.

Abstract

Applies to electrical installations of residential premises, commercial premises, public premises, industrial premises, prefabricated buildings, fixed surface installations on mining properties, construction and demolition site installations, agricultural and horticultural premises, caravan sites and similar sites, marinas, pleasure craft and house boats, medical locations, exhibitions, fairs and other temporary installations, extra low voltage lighting installations, electrical installations for street lighting and street furniture, and equipment enclosures (structures that

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provide physical and environmental protection for telecommunication equipment). Covers circuits supplied at nominal voltages up to and including 1 000 V a.c. or 1 500 V d.c.

Keywords

certificates of compliance, circuits, earthing, electrical installations, electrical insulation, electrical safety, electrical testing, electric wiring, inspection, installation, wiring code, wiring of premises.

Foreword

This South African standard was approved by National Committee StanSA SC 67F, *Electricity distribution systems and components – Installations*, in accordance with procedures of Standards South Africa, in compliance with annex 3 of the WTO/TBT agreement.

This edition is identified as edition 1.5 because it incorporates five amendments. The number 1.5 appears only on the pages affected by amendment 5.

A vertical line in the margin shows where the text has been modified by the most recent change.

With the first edition of this part of SANS 10142 (SABS 0142-1:2001), the standard was subdivided and now consists of the following parts, under the general title *The wiring of premises*:

Part 1: Low-voltage installations.

Part 2: Power installations above 1 kV not exceeding 33 kV a.c. (In course of preparation.)

Table 4.2 contains a list of the applicable standards for the components that may be installed in an electrical installation.

In the fourth edition of SANS 10142 (SANS 10142:1993), the design and installation requirements appeared in two separate clauses. However, because of the close link between these clauses, in edition 1 of SANS 10142-1 (SANS 10142-1:2001), the design and installation requirements were combined and are now given in clause 6 as installation requirements. The tables on cables and correction factors have been expanded extensively to align with the current cable specifications and relevant IEC standards. All the fundamental requirements have been grouped

together with the safety requirements and are given in clause 5 as fundamental requirements. Special installations or locations are given in clause 7.

The clause on medical locations (see 7.7) has been extended and replaces SABS 051-2.

Information on national legislation that applies only in South Africa is given in text boxes in the Introduction (see pages 3(a) and 3(b)), in 8.1, 8.2.4 and in the Certificate of Compliance (see page 281).

The updating of this part of SANS 10142 (SABS 0142) is the responsibility of a working group under the supervision of Committee StanSA SC 67F, *Electricity distribution systems and components – Installations*.

To ensure that this part of SANS 10142 (SABS 0142) is always up to date, amendments will be introduced regularly. Each change made to the text as a result of an amendment is/will be indicated in the margin by the number of the amendment.

Annexes B, C, D, E, F, G, J, K, L, M, N, O, P, Q and R are for information only.

Introduction

In this edition an attempt has been made to move towards the IEC codes: extra low voltage (below 50 V) and d.c. applications (up to 1,5 kV) have been introduced as new requirements owing to the extensive usage of, and increased fire risk that result from, high load currents. This part of SANS 0142 does not intend to cover the LV control circuits of machinery or system components that are external circuits between separately installed parts of the machinery or system components.

This part of SANS 10142 (SABS 0142) includes certain provisions which are for information and guidance only. These provisions do not use the word "shall" and they can be found in the text, in the notes and in the informative annexes. Except in tables, notes are always for information only.

The aim of this part of SANS 10142 (SABS 0142) is to ensure that people, animals and property are protected from hazards that can arise from the operation of an electrical installation under both normal and fault conditions. An electrical installation has to provide protection against

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- shock current,
- overcurrent,
- fault current,
- overvoltage,
- undervoltage,
- excessive temperatures, and
- electric arcs.

If any of the above arises, the protection should automatically disconnect the supply or limit currents and voltages to safe values. In the case of undervoltage, the protection should ensure that dangerous situations, due to the loss and restoration of supply (for example, to a motor), or due to a drop in voltage, cannot occur.

This part of SANS 10142 (SABS 0142) is concerned with ensuring the basic safety of electrical installations. To ensure the protection of people, animals and property and the proper functioning of an installation, the designer of an electrical installation should be aware of

- the characteristics of the power supply,
- the nature of the demand, and
- the operating environment of each part of the installation.

It is especially important to be aware of the activities of occupants of a building. For example, the occupants might be engaged in wet processes or in the handling of flammable or explosive materials. These activities will influence the design of the installation. If a client wants more safety features for the installation than those prescribed in this part of SANS 10142 (SABS 0142), such features have to be included in the contract documentation.

The provisions of this part of SANS 10142 (SABS 0142) apply only to the selection and application of electrical equipment, appliances and accessories, which are part of the fixed electrical installation. They do not apply to the construction and safety of the equipment, appliances and accessories; those aspects are dealt with in other standards.

The Mine Health and Safety Act, 1996 (Act No. 29 of 1996), which is administered by the Chief Inspector of Mines of the Department of Minerals and Energy, requires that certain prescribed electrical installations on mines comply with the requirements of SANS 10142-1. It also requires that a competent person, as defined, will be responsible to ensure that those prescribed electrical installations are in accordance with the standard.

The Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) (OHS Act), which is administered by the Chief Inspector of Occupational Health and Safety of the Department of Labour, requires that electrical installations comply with the requirements of SANS 10142-1. It also requires that an accredited person, as defined (master installation electrician, installation electrician or electrical tester for single phase), will issue a Certificate of Compliance for an electrical installation and that the certificate shall be in the form of the Certificate of Compliance published in this part of SANS 10142 (see 8.8).

In terms of the OHS Act, the provisions of this part of SANS 10142 (SABS 0142) apply only from the point of control to the point of consumption.

Because this part of SANS 10142 (SABS 0142) is continually updated, problems can arise on which version of the standard will be applicable when a contract is signed. The date of approval of the latest revision or amendment of this part of SANS 10142 (SABS 0142) will be the implementation date of the revision or the amendment. The applicable version of this part of SANS 10142 (SABS 0142) is the one with the latest implementation date before the contract date. So contracts signed before the approval of an amendment have to be carried out in accordance with the provisions of the unamended standard. If an existing installation is extended or altered, such extension or alteration has to comply with the provisions of this part of SANS 10142 (SABS 0142) that were applicable at the time of the erection of the extension or alteration.

The edition of the standard that was applicable at the date of erection of an electrical installation is to be considered the edition defining the requirements applicable to that particular electrical installation.

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The wiring of premises

Part 1: Low-voltage installations

1 Scope

1.1 Application of this part of SANS 10142 (SABS 0142)

This part of SANS 10142 (SABS 0142) applies to electrical installations of

- a) residential premises,
- b) commercial premises,
- c) public premises,
- d) industrial premises,
- e) prefabricated buildings,
- f) fixed surface installations on mining properties,
- g) construction and demolition site installations,
- h) agricultural and horticultural premises,
- i) caravan sites and similar sites, **Amdt 5**
- j) marinas, pleasure craft and house boats,
- k) medical locations,
- l) exhibitions, fairs and other temporary installations,
- m) extra low voltage lighting installations,
- n) electrical installations for street lighting and street furniture, and
- o) equipment enclosures (structures that provide physical and environmental protection for telecommunication equipment). **Amdt 1**

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1.2 Aspects covered by this part of SANS 10142 (SABS 0142)

This part of SANS 10142 (SABS 0142) covers

- a) circuits supplied at nominal voltages up to and including 1 000 V a.c. or 1 500 V d.c. The standard frequency for a.c. is 50 Hz. The use of other frequencies for special purposes is not excluded, **Amdt 3**
- b) circuits, other than the internal wiring of apparatus, that operate at voltages exceeding 1 000 V and are derived from an installation that has a voltage not exceeding 1 000 V a.c.,
- c) any wiring systems and cables not specifically covered by the standards for appliances,
- d) all consumer installations external to buildings,
- e) fixed wiring in the power supply circuits for telecommunication equipment, signalling equipment, control equipment and the like (excluding internal wiring of apparatus), **Amdt 3**
- f) the extension or alteration of the installation and also parts of the existing installation affected by the existing extension or alteration,
- g) fixed wiring needed to connect the various units of complex machinery that are installed in separate locations, and
- h) equipment for which no standard is referenced (for example, black boxes).

1.3 Where this part of SANS 10142 (SABS 0142) is not applicable

This part of SANS 10142 (SABS 0142) does not apply to

- a) electric traction equipment,
- b) automotive electrical equipment (excluding the caravan part of a roving vehicle),
- c) electrical installations on board ships,
- d) electrical installations in aircraft,

- e) electrical installations for underground and open cast mining operations,
- f) telecommunication, television and radio circuits (excluding the power supply to such equipment),
- g) lightning protection of buildings and structures, and

NOTE The installation of surge protection is not compulsory, but where it is installed, compliance with annex L is required. **Amdt 1; amdt 5**

- h) extra low voltage control circuits between different parts of machinery or system components, forming a unit, that are separately installed and derived from an independent source or an isolating transformer (excluding ELV lighting circuits). **Amdt 5**

1.4 Electrical equipment

Electrical equipment is dealt with only as far as its selection and application in the installation are concerned. This also applies to assemblies of electrical equipment that comply with the relevant standards.

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2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of SANS 10142 (SABS 0142) only for the compliance of the products. Parties to agreements based on this part of SANS 10142 (SABS 0142) are encouraged to take steps to ensure the use of the most recent editions of the standards. Information on currently valid national and international standards can be obtained from Standards South Africa. **Amdt 4; amdt 5**

2.1 Compulsory standards

Compulsory specification for circuit-breakers, as published by Government Notice No. 1090 (Government Gazette 20461) of 17 September 1999. (VC 8036)

Compulsory specification for earth leakage protection units, as published by Government Notice No. 2286 (Government Gazette 10987) of 16 October 1987. (VC 8035)

Compulsory specification for manually operated switches for fixed installations, as published by Government Notice No. R438 (Government Gazette 18779) of 3 April 1998. (VC 8003)

Compulsory specification for plugs, socket-outlets and socket-outlet adaptors, as published by Government Notice No. R442 (Government Gazette 18779) of 3 April 1998. (VC 8008)

Compulsory specification for the safety of electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V), as published by Government Notice No. R1169 (Government Gazette 21759) of 24 November 2000. (VC 8075)

Compulsory specification for the safety of flexible cords for electrical appliances, as published by Government Notice No. 1212 (Government Gazette 16598) of 11 August 1995. (VC 8006)

2.2 Standards

2.2.1 South African standards

SANS 152 (SABS 152), *Low-voltage air-break switches, air-break disconnectors, air-break switch-disconnectors, and fuse-combination units*. (Superseded by SANS 60947-3.) **Amdt 4**

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SANS 156 (SABS 156), *Moulded-case circuit-breakers.*

SANS 164-0, *Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 0: General and safety requirements.* **Amdt 5**

SANS 164-1, *Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 1: Conventional system, 16 A 250 V a.c.* **Amdt 5**

SANS 164-2, *Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 2: IEC system, 16 A 250 V a.c.* **Amdt 5**

SANS 164-3, *Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 3: Conventional system, 6 A 250 V a.c.* **Amdt 5**

SANS 164-4, *Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 4: Dedicated system, 16 A 250 V a.c.* **Amdt 5**

SANS 164-5, *Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 5: Flat non-rewirable two-pole plugs, 2,5 A 250 V a.c., with cord, for connection of class 2 equipment.* **Amdt 5**

SANS 337, *Stove couplers.* **Amdt 5**

SANS 529 (SABS 529), *Heat-resisting wiring cables.*

SANS 556-1, *Low-voltage switchgear – Part 1: Circuit-breakers.* **Amdt 4**

SANS 767-1 (SABS 767-1), *Earth leakage protection units – Part 1: Fixed earth leakage protection circuit-breakers.*

SANS 780 (SABS 780), *Distribution transformers.*

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SANS 950 (SABS 950), *Unplasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations.*

SANS 1012, *Electric light dimmers.*

SANS 1063 (SABS 1063), *Earth rods and couplers.*

SANS 1065-1 (SABS 1065-1), *Metal conduits and fittings (screwed-end and plain-end) for electrical wiring – Part 1: Metal conduits.* (Superseded by SANS 61386-1 and SANS 61386-21.) **Amdt 4**

SANS 1065-2 (SABS 1065-2), *Metal conduits and fittings (screwed-end and plain-end) for electrical wiring – Part 2: Metal fittings.* (Superseded by SANS 61386-1 and SANS 61386-21.) **Amdt 4**

SANS 1085, *Wall outlet boxes for the enclosure of electrical accessories.*

SANS 1195 (SABS 1195), *Busbars*

SANS 1213 (SABS 1213), *Mechanical cable glands.*

SANS 1239, *Plugs, socket-outlets and couplers for industrial purposes.*

SANS 1411-1, *Materials of insulated electric cables and flexible cords – Part 1: Conductors.*

SANS 1418-1 (SABS 1418-1), *Aerial bundled conductor systems – Part 1: Cores.*

SANS 1433-1 (SABS 1433-1), *Electrical terminals and connectors – Part 1: Terminal blocks having screw and screwless terminals.*

SANS 1433-2 (SABS 1433-2), *Electrical terminals and connectors – Part 2: Flat push-on connectors.*

SANS 1473-1, *Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested, partially type-tested and specially tested assemblies with a rated short-circuit withstand strength above 10 kA.* **Amdt 3**

SANS 1507-1 (SABS 1507-1), *Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 1: General.* **Amdt 1**

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SANS 1507-2 (SABS 1507-2), *Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 2: Wiring cables.* **Amdt 1**

SANS 1507-3 (SABS 1507-3), *Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 3: PVC distribution cables.* **Amdt 1**

SANS 1507-4 (SABS 1507-4), *Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 4: XLPE distribution cables.* **Amdt 1**

SANS 1507-5 (SABS 1507-5), *Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 5: Halogen-free distribution cables.* **Amdt 1**

SANS 1507-6 (SABS 1507-6), *Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) – Part 6: Service cables.* **Amdt 1**

SANS 1524-1, *Electricity payment systems – Part 1: Prepayment meters.*

SANS 1574, *Electric cables – Flexible cords and flexible cables.*

SANS 1607 (SABS 1607), *Electromechanical watt-hour meters.*
(Superseded by SANS 62053-11.) **Amdt 4**

SANS 1619, *Small power distribution units (ready boards) for single-phase 230 V service connections.*

SANS 1765, *Low-voltage switchgear and controlgear assemblies (distribution boards) with a rated short-circuit withstand strength up to and including 10 kA.* **Amdt 3**

SANS 1777, *Photoelectric control units for lighting (PECUs).*

SANS 1799, *Watt-hour meters – AC electronic meters for active energy.*

SANS 10086-1, *The installation, inspection and maintenance of equipment used in explosives atmospheres – Part 1: Installations including surface installations on mines.*

SANS 10089-2 (SABS 089-2), *The petroleum industry – Part 2: Electrical installations in the distribution and marketing sector.*

SANS 10108, *The classification of hazardous locations and the selection of apparatus for use in such locations.*

SANS 10198-4, *The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 4: Current ratings.*

SANS 10198-10 (SABS 0198-10), *The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 10: Jointing and termination of paper-insulated cables.*

SANS 10198-11 (SABS 0198-11), *The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 11: Jointing and termination of screened polymeric-insulated cables.*

SANS 10198-14 (SABS 0198-14), *The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 14: Installation of aerial bundled conductor (ABC) cables.*

SANS 10199, *The design and installation of earth electrodes.*

SANS 10222-3 (SABS 0222-3), *Electrical security installations – Part 3: Electric security fences (non-lethal).*

SANS 10292 (SABS 0292), *Earthing of low-voltage (LV) distribution systems.*

SANS 10313, *The protection of structures against lightning.*

SANS 60269-1/IEC 60269-1 (SABS IEC 60269-1), *Low-voltage fuses – Part 1: General requirements.*

SANS 60309-1/IEC 60309-1 (SABS IEC 60309-1), *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements.*

SANS 60309-2/IEC 60309-2 (SABS IEC 60309-2), *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories.*

SANS 60439-1/IEC 60439-1, *Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially type-tested assemblies.*

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SANS 60439-2/IEC 60439-2 (SABS IEC 60439-2), *Low-voltage switchgear and controlgear assemblies – Part 2: Particular requirements for busbar trunking systems (busways).*

SANS 60439-4/IEC 60439-4, *Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS).*

SANS 60439-5/IEC 60439-5 (SABS IEC 60439-5), *Low-voltage switchgear and controlgear assemblies – Part 5: Particular requirements for assemblies intended to be installed outdoors in public places – Cable distribution cabinets (CDCs) for power distribution in networks.*

SANS 60529/IEC 60529 (SABS IEC 60529), *Degrees of protection provided by enclosures (IP Code).*

SANS 60570/IEC 60570, *Electrical supply track systems for luminaires.*

SANS 60598-2-18/IEC 60598-2-18 (SABS IEC 60598-2-18), *Luminaires – Part 2: Particular requirements – Section 18: Luminaires for swimming pools and similar applications.*

SANS 60598-2-23/IEC 60598-2-23 (SABS IEC 60598-2-23), *Luminaires – Part 2-23: Particular requirements – Extra low voltage lighting systems for filament lamps.*

SANS 60601-1/IEC 60601-1 (SABS IEC 60601-1), *Medical electrical equipment – Part 1: General requirements for safety.*

SANS 60669-1/IEC 60669-1 (SABS IEC 60669-1), *Switches for household and similar fixed-electrical installations – Part 1: General requirements.*

SANS 60669-2-1/IEC 60669-2-1, *Switches for household and similar fixed electrical installations – Part 2-1: Particular requirements – Electronic switches.*

SANS 60906-3/IEC 60906-3 (SABS IEC 60906-3), *IEC systems of plugs and socket-outlets for household and similar purposes – Part 3: SELV plugs and socket-outlets, 16 A 6 V, 12 V, 24 V, 48 V, a.c. and d.c.*

SANS 60947-2/IEC 60947-2, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers.*

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SANS 60947-3/IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units.*

SANS 60947-4-1/IEC 60947-4-1, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

SANS 60947-4-2/IEC 60947-4-2, *Low-voltage switchgear and controlgear – Part 4-2: Contactors and motor-starters – AC semiconductor motor controllers and starters.* **Amdt 1**

SANS 60947-4-3/IEC 60947-4-3 (SABS IEC 60947-4-3), *Low-voltage switchgear and controlgear – Part 4-3: Contactors and motor-starters – AC semiconductor controllers and contactors for non-motor loads.* **Amdt 1**

SANS 60947-5-1/IEC 60947-5-1, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices.*

SANS 60947-5-2/IEC 60947-5-2, *Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches.*

SANS 60947-5-5/IEC 60947-5-5, *Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function.*

SANS 60947-6-1/IEC 60947-6-1 (SABS IEC 60947-6-1), *Low-voltage switchgear and controlgear – Part 6: Multiple function equipment – Section 1: Automatic transfer switching equipment.*

SANS 60950/IEC 60950 (SABS IEC 60950), *Safety of information technology equipment.* (Superseded by SANS 60950-1). **Amdt 4**

SANS 60950-1/IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements.* **Amdt 4**

SANS 61000-4-5/IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test.* **Amdt 1**

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SANS 61000-4-7/IEC 61000-4-7, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto.* **Amdt 1**

SANS 61008-1/IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules.*

SANS 61036/IEC 61036 (SABS IEC 61036), *Alternating current static watt-hour meters for active energy (classes 1 and 2).* (Superseded by SANS 62053-21.) **Amdt 4**

SANS 61084-1/IEC 61084-1 (SABS IEC 61084-1), *Cable trunking and ducting systems for electrical installations – Part 1: General requirements.*

SANS 61238-1/IEC 61238-1, *Compression and mechanical connectors for power cables for rated voltages up to 30 kV ($U_m = 36$ kV) – Part 1: Test methods and requirements.*

SANS 61312-1/IEC 61312-1 (SABS IEC 61312-1), *Protection against lightning electromagnetic impulse – Part 1: General principles.*

SANS 61312-2/IEC TS 61312-2 (SABS IEC TS 61312-2), *Protection against lightning electromagnetic impulse (LEMP) – Part 2: Shielding of structures, bonding inside structures and earthing.*

SANS 61312-4/IEC 61312-4 (SABS IEC 61312-4), *Protection against lightning electromagnetic impulse – Part 4: Protection of equipment in existing structures.*

SANS 61347-2-2/IEC 61347-2-2 (SABS IEC 61347-2-2), *Lamp controlgear – Part 2-2: Particular requirements for d.c. or a.c. supplied electronic step-down convertors for filament lamps.* **Amdt 1**

SANS 61386-1/IEC 61386-1 (SABS IEC 61386-1), *Conduit systems for electrical installations – Part 1: General requirements.* **Amdt 4**

SANS 61386-21/IEC 61386-21, *Conduit systems for cable management – Part 21: Particular requirements – Rigid conduit systems.* **Amdt 4**

SANS 61386-22/IEC 61386-22, *Conduit systems for cable management – Part 22: Particular requirements – Pliable conduit systems.* **Amdt 4**

SANS 61386-23/IEC 61386-23, *Conduit systems for cable management – Part 23: Particular requirements – Flexible conduit systems.* **Amdt 4**

SANS 61558-1/IEC 61558-1 (SABS IEC 61558-1), *Safety of power transformers, power supply units and similar – Part 1: General requirements and tests.*

SANS 61558-2-2/IEC 61558-2-2 (SABS IEC 61558-2-2), *Safety of power transformers, power supply units and similar – Part 2-2: Particular requirements for control transformers.* **Amdt 4**

SANS 61558-2-5/IEC 61558-2-5 (SABS IEC 61558-2-5), *Safety of power transformers, power supply units and similar – Part 2-5: Particular requirements for shaver transformers and shaver supply units.*

SANS 61558-2-6/IEC 61558-2-6 (SABS IEC 61558-2-6), *Safety of power transformers, power supply units and similar – Part 2: Particular requirements for safety isolating transformers for general use.*

SANS 61558-2-15/IEC 61558-2-15 (SABS IEC 61558-2-15), *Safety of power transformers, power supply units and similar – Part 2-15: Particular requirements for isolating transformers for the supply of medical locations.*

SANS 61643-1/IEC 61643-1, *Surge protective devices connected to low-voltage power distribution systems – Part 1: Performance requirements and testing methods.*

SANS 62053-11/IEC 62053-11, *Electricity metering equipment (a.c.) – Particular requirements – Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2).* **Amdt 4**

SANS 62053-21/IEC 62053-21, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2).* **Amdt 4**

2.2.2 International and foreign standards

BS 1363-2, *13 A plugs, socket-outlets and adaptors – Specification for 13 A switched and unswitched socket-outlets.* **Amdt 5**

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IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests.*

IEC 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure.*

IEC 60730-2-7, *Automatic electrical controls for household and similar use – Part 2-7: Particular requirements for timers and time switches.*

IEC 60998-2-1, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units.*

IEC 60998-2-2, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units.*

IEC/TS 61312-3, *Protection against lightning electromagnetic impulse – Part 3: Requirements of surge protective devices (SPDs).*

IEC 61557-8, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems.*

UL 508, *Industrial control equipment.*

NOTE Table 4.2 lists the standards applicable in this part of SANS 10142 (SABS 0142).

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3.68

sauna

enclosure in which heat is generated for therapeutic or recreational purposes and that is designed to accommodate one or more persons

3.69

series-connected system

cascaded system

protection system that allows for the installation of circuit-breakers that cannot necessarily be rated to handle the full prospective short-circuit current at their point of installation, provided that they are backed up by another fully rated circuit-breaker in a predetermined and tested coordination

3.70

shaver supply unit

accessory that embodies an isolating transformer with limited output and one or more socket-outlets that allow the use of only one plug at a time

3.71

short-circuit protective device

SCPD

device intended to protect a circuit or parts of a circuit against short-circuit currents by interrupting the current

3.72

socket-outlet

device that

- a) has two or more metallic spring contacts designed to accept the corresponding pins of a plug (see 3.54),
- b) is designed for fixing onto or into a building element (see 3.8) or other flat surface, and
- c) is arranged for connection to the wiring of an installation

NOTE Single-phase socket-outlets that are rated at 16 A, 15 A and 13 A and are used in residential and similar installations may be regarded as equivalent for the purposes of this part of SANS 10142 (SABS 0142) but, because it is intended that the standard rating will in due course be 16 A only, the use of socket-outlets rated at any value other than 16 A is not recommended, with the exception of two-contact socket-outlets. (See **point of outlet**, 3.57)

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3.73

spa

container

- a) in which water may be heated electrically or agitated electro-mechanically, or both,
- b) that is designed to accommodate at least one person, and
- c) the electrical equipment of which is permanently connected to the electricity supply

3.74

specialized electrical installation

electrical installation such as in

- a) a hazardous location, as described in SANS 10108 (SABS 0108),
- b) an explosive atmosphere, as described in SANS 10086-1 (SABS 086-1),
- c) the petroleum industry, as described in SANS 10089-2 (SABS 089-2), and
- d) a medical location, as described in 7.7 of this part of SANS 10142 (SABS 0142) (superseding SABS 051-2).

3.75

standard

applicable compulsory standard or an applicable standard published by Standards South Africa, or by another standards body whose standards have been referred to in this part of SANS 10142(SABS 0142)

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3.76

stove coupler

stove connection that complies with the requirements of SANS 60309-1/ IEC 60309-1 (SABS IEC 60309-1), and of the dimensions as given in SANS 337

Amdt 5

3.77

supplier

in relation to a particular installation, any local authority (see 3.47), statutory body or person who supplies, contracts or agrees to supply, electricity to that electrical installation

Table 4.2 (continued)

1	2	3	4
Commodity	Scope	Safety standard ^b	Recommended performance standard ^b
Conduit	<p>Conduit and fittings: rigid pliable flexible</p> <p>PVC rigid conduit and fittings: 20 mm to 63 mm dia.</p> <p>Metal conduit: 20 mm to 50 mm dia. Metal fittings</p>		<p>SANS 61386-1 SANS 61386-21 SANS 61386-22 SANS 61386-23</p> <p>SANS 950</p> <p>SANS 1065-1^d SANS 1065-2^d</p>
Connectors (terminals)	<p>Terminal blocks: – clamping: $\leq 300 \text{ mm}^2$ – screw type: $\leq 35 \text{ mm}^2$</p> <p>Flat push-on: – $0,75 \text{ mm}^2$ to 10 mm^2 – $\leq 300 \text{ }^\circ\text{C}$</p>		<p>SANS 1433-1 IEC 60998-2-1 IEC 60998-2-2</p> <p>SANS 1433-2</p>
Contactors, motor starters and overload relays	All	<p>SANS 60947-4-1 SANS 60947-4-2 SANS 60947-4-3 UL 508</p>	
Disconnectors (non-trip)	$\leq 1\ 000 \text{ V a.c.}$ or $1\ 500 \text{ V d.c.}$	SANS 60947-3	

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Table 4.2 (continued)

1	2	3	4
Commodity	Scope	Safety standard ^b	Recommended performance standard ^b
Distribution boards	<p>≤ 10 kA short-circuit current low-voltage switchgear and controlgear</p> <p>Assemblies > 10 kA</p> <p>For outdoor use and exposed to public</p> <p>Assemblies for construction sites</p>	<p>SANS 1765</p> <p>SANS 1473-1</p> <p>SANS 60439-5</p> <p>SANS 60439-4</p>	
Earth leakage circuit-breakers (ELCBs)	$I_{\Delta n} \leq 30 \text{ mA}$	VC 8035 ^a	
Earth leakage circuit-breakers (ELCBs)	$I_n \leq 125 \text{ A}; I_{\Delta n} > 30 \text{ mA}$	VC 8036 ^a	
Earth leakage circuit-breakers (ELCBs)	$I_n > 125 \text{ A}; I_{\Delta n} > 30 \text{ mA}$	SANS 60947-2	
Earth leakage switches (ELSWs)	$I_{\Delta n} \leq 30 \text{ mA}$	VC 8035 ^a	
Earth leakage switches (ELSWs)	$I_{\Delta n} > 30 \text{ mA}$	SANS 61008-1	
Earth rods	All		SANS 1063
Earth wire	Bare copper	SANS 1411-1	
Electricity dispensers (pre-payment meters)	All		SANS 1524-1
Emergency stop devices	With mechanical latching function	SANS 60947-5-5	
Enclosures	IP ratings		SANS 60529

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Table 4.2 (continued)

1	2	3	4
Commodity	Scope	Safety standard ^b	Recommended performance standard ^b
Ferrules and lugs	Ferrules and lugs for copper and aluminium conductors		SANS 61238-1
Fuses (low-voltage)	Rated voltage < 1 000 V a.c. Breaking capacity at least 6 kA Rated current < 1 250 A Rated voltage < 690 V a.c.	SANS 60269-1	
Light dimmers	For incandescent lamps – – electromechanical 250 V – electronic – maximum of 3 kW		SANS 1012 SANS 60669-2-1
Luminaires	ELV systems Pools and similar applications Supply track systems	SANS 60598-2-23 SANS 60598-2-18 SANS 60570	
Medical electrical equipment	General		SANS 60601-1
Medical monitoring devices	Medical IT systems	IEC 61557-8	
Meter cabinets	For outdoor use and exposed to public	SANS 60439-5	
Outlet boxes	All		SANS 1085
Proximity switches	Not with analogue outputs < 250 V		SANS 60947-5-2
Push buttons, indicator lights, etc.	Electromechanical control circuit devices – ≤ 1 000 V	SANS 60947-5-1	
Ready boards (SPDU)	Non-extendable and extendable – rated 230 V	SANS 1619	
Shaver supply transformers (isolating transformers)	Input: 250 V a.c. supply Output: 110/230 V a.c. Isolating; 20 VA to 50 VA	SANS 61558-2-5	

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Table 4.2 (continued)

1	2	3	4
Commodity	Scope	Safety standard ^b	Recommended performance standard ^b
Socket-outlets	6 A, 3-pin, 250 V 16 A, 3-pin, 250 V Dedicated 16 A, 3-pin, 250 V IEC systems for SELV plugs and socket-outlets 13 A fused flat pin	VC 8008 and SANS 164-3 VC 8008 and one of SANS 164-1 or SANS 164-2 VC 8008 and SANS 164-4 SANS 60906-3 BS 1363-2	
Socket-outlets (industrial type)	≤ 690 V; ≤ 250 A	SANS 1239 SANS 60309-1 and SANS 60309-2	
Stove coupler	All	SANS 60309-1 of dimensions as in SANS 337	
Surge arresters for low-voltage systems	≤ 1 000 V		SANS 61643-1
Switches (manually operated)	50 V – 440 V; 63 A	VC 8003 ^a	
Switches (photoelectric)	≤ 1 800 VA; 230 V		SANS 1777
Switches and switch-disconnectors (non-trip)	≤ 1 000 V a.c. or 1 500 V d.c.	SANS 60947-3	
Switch-disconnectors (trip)			See circuit-breakers used as switch-disconnectors
Timer switches	All		IEC 60730-2-7
Transfer switches	< 1 000 V	SANS 60947-6-1	
Transformers (distribution)	≤ 3 150 kVA Maximum 36 kV	SANS 780	

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Table 4.3 – Notices, labels and rating plates

1	2
Subclause	Topic
5.2.8(f)	Position of concealed distribution board
6.6.1.1	Switch-disconnectors for distribution boards and sub-distribution boards
6.6.1.13	Identification of ring circuits
6.6.1.20	Identification of incoming and outgoing circuits of distribution boards
6.6.1.21	Warning labels on distribution boards
6.7.4(d)	Series-connected (cascaded) systems
6.7.5.6	Standard socket-outlets not on 30 mA earth leakage or with a rated tripping current higher than 30 mA.
6.7.5.6	Socket-outlets powered from a safety supply or on dimmer control
6.8.2.3(b)	Load and line markings on circuit-breakers used as switches
6.9.1.1	Main switch-disconnectors in the case of multisupplies
6.9.3.2	Disconnecting devices with remote control
6.11.5	Earthing terminal for other services
6.14.1.7(a)	More than one phase or circuit in an enclosure
6.15.1.3(a)	Voltage rating on socket-outlets if not standard voltage
7.6.3.1	Caravan parks, mobile homes and marina sites
7.13.1	High-voltage equipment
7.13.3.2	High-voltage signs
7.13.10.5(g), (h)	Fireman's switch

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5 Fundamental requirements

NOTE This clause contains the general safety principles applicable to electrical installations. **Amdt 5**

5.1 Safety

5.1.1 Live parts

It shall not be possible to touch any live part within arm's reach with the standard test finger (see SANS 60529/IEC 60529 (SABS IEC 60529)) **Amdt 5**

- a) during normal operation, or
- b) when a cover is removed, unless the cover is removed with the use of a tool or a key.

5.1.2 Temperature

5.1.2.1 Unless otherwise permitted by an applicable standard (see 4.3 and table 4.2), electrical equipment shall be so designed, positioned and protected that accessible parts under normal operating conditions do not reach a temperature (safe touch temperature) that exceeds

- a) 70 °C in the case of metallic parts, and
- b) 90 °C in the case of non-metallic parts.

5.1.2.2 If electrical equipment has to be mounted in a fire risk area or adjacent to flammable material, the equipment shall be

- a) of, or enclosed by, thermally non-conductive non-flammable material, or
- b) so designed or positioned (or both) that the flammable material is not subjected to any hazardous heating, or
- c) so designed or positioned (or both) that any arc or sparks are contained within the enclosure.

5.1.3 Earth fault current protection


5.1.3.1 A new electrical installation shall not be connected to the supply unless the supply includes a protective conductor. (See also 6.11 and 8.7.3.)

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5.1.3.2 People, animals and property shall be protected against harmful earth fault currents by protective measures such as

- a) earthing and bonding,
- b) electrical separation of circuits,
- c) the use of an isolating transformer with an output of 50 V or less, or
- d) the use of electrical equipment that is double insulated.

NOTE 1 Electrical equipment that complies with an applicable standard (see 4.3 and table 4.2) and that bears the symbol  is deemed to be double insulated.

NOTE 2 The expression "electrical separation of a circuit" means that the circuit is electrically isolated from other circuits in an installation. If an electrically separate circuit is short and is well protected against damage (for example, as in a shaver unit), it is unlikely that there will be faults on the circuit. However, if the circuit is long, the risk of one conductor faulting to earth increases. One fault will reduce the effectiveness of "electrical separation of a circuit" as a protective measure; a second fault can be dangerous. To be able to rely on "electrical separation of a circuit" as a protective measure for a long circuit, a specially designed device should be used to monitor the circuit, and, if a fault occurs, the device should disconnect the circuit or give an audible or a visible warning of the fault.

5.1.3.3 Earth leakage protection shall not be used as an alternative protective measure to those given in 5.1.3.2(a) and 5.1.3.2(b). Earth leakage protection shall be considered an additional protective measure. (See also 6.7.5.)

5.1.3.4 The protective measures described in 5.1.3.2(a) to 5.1.3.2(d) may be applied to a

- a) complete installation,
- b) part of an installation,
- c) circuit, or
- d) locality.

No protective measure shall interfere with the operation of any other protective measure.

- a) overcurrent:
 - overload current; and
 - short-circuit current;
- b) single phasing;
- c) earth fault current;
- d) overvoltage;
- e) undervoltage;
- f) incorrect phase rotation; and
- g) fire risk.

5.2.6 Emergency control

If, in dangerous situations, it is necessary to immediately interrupt the power supply, the interrupting device shall be so installed that it

- a) is easily recognized, and
- b) can be effectively and quickly operated.

5.2.7 Disconnecting devices

An installation shall have disconnecting devices that allow the installation to be disconnected for maintenance, testing, fault detection or repair. In the case of circuits or items of equipment, additional disconnecting devices could be required to allow disconnection for maintenance, testing, fault detection or repair of such circuits or equipment.

5.2.8 Positioning and accessibility of electrical equipment

Electrical equipment shall be so positioned that

- a) it does not impair the functioning or safety of other equipment,
- b) it is readily accessible for installation, replacement, operation, testing, inspection, maintenance and repair (see 6.6.1.9 and 6.9.4 for the main switch). All parts of the installation shall be accessible without the need to enter any adjoining premises (for example, in an apartment building),

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NOTE Common areas (such as passages and entrance halls) are not regarded as adjoining areas.

- c) there is easy access to its location,
- d) it is not likely to be physically damaged, **Amdt 3**
- e) dust or moisture is not likely to accumulate on live or other parts and cause flashover, and **Amdt 3**
- f) where the distribution board is concealed by a cupboard or other covering, the notice for live electrical apparatus referred to in annex Q shall be in a conspicuous place indicating the position of the distribution board. **Amdt 3; amdt 5**

5.3 Characteristics

5.3.1 General

The characteristics of the selected equipment shall be appropriate to the conditions and parameters on which the design of an installation is based.

5.3.2 Voltage

The equipment shall be suitable for operation on the maximum steady (r.m.s.) voltage and overvoltage to which it is likely to be subjected. Equipment shall be rated in accordance with the intended application for use on one of the following voltages used in South Africa:

- a) A.C. circuits
 - 1) standard voltages:
 - 230 V single-phase,
 - 230/400 V three-phase four-wire, and
- the tolerance of $\pm 10\%$ on these voltages.

NOTE For certain equipment it may be necessary to consider the lowest voltage that is likely to occur.

- 2) declared voltages:
 - 525 V three-phase three-wire is a commonly used voltage and the tolerance is $\pm 5\%$.

**Table 6.2(b) — Single-core PVC insulated cables, unarmoured, with or without sheath
(SANS 1507 (SABS 1507))
Voltage drop (per ampere per metre) copper conductors**

Conductor operating temperature: 70 °C

1	2	3			4			5			6			7			8			9		
Conductor cross-sectional area mm ²	Two cables d.c. ‡ mV/A/m	Two cables – Single-phase a.c. †									Three or four cables – Three-phase a.c.											
		Installation methods 1 and 2 (enclosed in conduit, etc. in or on a wall)			Installation methods 3 and 4 (clipped direct or on trays, touching)			Installation method 5 (spaced) ^a			Installation methods 1 and 2 (enclosed in conduit, etc. in or on a wall)			Installation methods 3, 4 and 5 (in trefoil)			Installation methods 3 and 4 (flat and touching)			Installation method 5 (flat, spaced) ^a		
		mV/A/m			mV/A/m			mV/A/m			mV/A/m			mV/A/m			mV/A/m			mV/A/m		
1	44	44			44			44			38			38			38			38		
1,5	29	29			29			29			25			25			25			25		
2,5	18	18			18			18			15			15			15			15		
4	11	11			11			11			9,5			9,5			9,5			9,5		
6	7,3	7,3			7,3			7,3			6,4			6,4			6,4			6,4		
10	4,4	4,4			4,4			4,4			3,8			3,8			3,8			3,8		
16	2,8	2,8			2,8			2,8			2,4			2,4			2,4			2,4		
		r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z
25	1,75	1,80	0,33	1,80	1,75	0,20	1,75	1,75	0,29	1,80	1,50	0,29	1,55	1,50	0,175	1,50	1,50	0,25	1,55	1,50	0,32	1,55
35	1,25	1,30	0,31	1,30	1,25	0,195	1,25	1,25	0,28	1,30	1,10	0,27	1,10	1,10	0,170	1,10	1,10	0,24	1,10	1,10	0,32	1,15
50	0,93	0,95	0,30	1,00	0,93	0,190	0,95	0,93	0,28	0,97	0,81	0,26	0,85	0,80	0,165	0,82	0,80	0,24	0,84	0,80	0,32	0,86
70	0,63	0,65	0,29	0,72	0,63	0,185	0,66	0,63	0,27	0,69	0,56	0,25	0,61	0,55	0,160	0,57	0,55	0,24	0,60	0,55	0,31	0,63
95	0,46	0,49	0,28	0,56	0,47	0,180	0,50	0,47	0,27	0,54	0,42	0,24	0,48	0,41	0,155	0,43	0,41	0,23	0,47	0,40	0,31	0,51

^a Spacings larger than those specified in installation method 5 (see table 6.1) will result in larger voltage drop.

[†] In the case of single-phase circuits, the return path has been accounted for in the values given.

Table 6.2(b) (concluded)

1	2	3			4			5			6			7			8			9		
Conductor cross-sectional area mm ²	Two cables d.c. † mV/A/m	Two cables – Single-phase a.c. ‡									Three or four cables – Three-phase a.c. ^c											
		Installation methods 1 and 2 (enclosed in conduit, etc. in or on a wall)			Installation methods 3 and 4 (clipped direct or on trays, touching)			Installation method 5 (spaced) ^a			Installation methods 1 and 2 (enclosed in conduit, etc. in or on a wall)			Installation methods 3, 4 and 5 (in trefoil)			Installation methods 3 and 4 (flat and touching)			Installation method 5 (flat, spaced) ^a		
		r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z
120	0,36	0,39	0,27	0,47	0,37	0,175	0,41	0,37	0,26	0,45	0,33	0,23	0,41	0,32	0,150	0,36	0,32	0,23	0,40	0,32	0,30	0,44
150	0,29	0,31	0,27	0,41	0,30	0,175	0,34	0,29	0,26	0,39	0,27	0,23	0,36	0,26	0,150	0,30	0,26	0,23	0,34	0,26	0,30	0,40
185	0,23	0,25	0,27	0,37	0,24	0,170	0,29	0,24	0,26	0,35	0,22	0,23	0,32	0,21	0,145	0,26	0,21	0,22	0,31	0,21	0,30	0,36
240	0,180	0,195	0,26	0,33	0,185	0,165	0,25	0,185	0,25	0,31	0,17	0,23	0,29	0,160	0,145	0,22	0,160	0,22	0,27	0,160	0,29	0,34
300	0,145	0,160	0,26	0,31	0,150	0,165	0,22	0,150	0,25	0,29	0,14	0,23	0,27	0,130	0,140	0,190	0,130	0,22	0,25	0,130	0,29	0,32
400	0,105	0,130	0,26	0,29	0,120	0,160	0,20	0,115	0,25	0,27	0,12	0,22	0,25	0,105	0,140	0,175	0,105	0,21	0,24	0,100	0,29	0,31
500	0,086	0,110	0,26	0,28	0,098	0,155	0,185	0,093	0,24	0,26	0,10	0,22	0,25	0,086	0,135	0,160	0,086	0,21	0,23	0,081	0,29	0,30
630	0,068	0,094	0,25	0,27	0,081	0,155	0,175	0,076	0,24	0,25	0,08	0,22	0,24	0,072	0,135	0,150	0,072	0,21	0,22	0,066	0,28	0,29
800	0,053				0,068	0,150	0,165	0,061	0,24	0,25				0,060	0,130	0,145	0,060	0,21	0,22	0,053	0,28	0,29
1 000	0,042				0,059	0,150	0,160	0,050	0,24	0,24				0,052	0,130	0,140	0,052	0,20	0,21	0,044	0,28	0,28

^a Spacings larger than those specified in installation method 5 (see table 6.1) will result in larger voltage drop.

‡ In the case of single-phase circuits, the return path has been accounted for in the values given.

**Table 6.3(b) — Multicore PVC insulated cables, unarmoured, with or without protective conductor
(SANS 1507 (SABS 1507)) Voltage drop (per ampere per metre) copper conductors**

Conductor operating temperature: 70 °C

1	2	3			4		
Conductor cross-sectional area mm ²	Two-core cable d.c. † mV/A/m	Two-core cable, single-phase a.c. † mV/A/m			Three-core or four-core cable, three-phase a.c. mV/A/m		
		r	x	z	r	x	z
1	44						
1,5	29						
2,5	18						
4	11						
6	7,3						
10	4,4						
16	2,8						
25	1,75	1,75	0,170	1,75	1,50	0,145	1,50
35	1,25	1,25	0,165	1,25	1,10	0,145	1,10
50	0,93	0,93	0,165	0,94	0,80	0,140	0,81
70	0,63	0,63	0,160	0,65	0,55	0,140	0,57
95	0,46	0,47	0,155	0,50	0,41	0,135	0,43
120	0,36	0,38	0,155	0,41	0,33	0,135	0,35
150	0,29	0,30	0,155	0,34	0,26	0,130	0,29
185	0,23	0,25	0,150	0,29	0,21	0,130	0,25
240	0,180	0,190	0,150	0,24	0,165	0,130	0,21
300	0,145	0,155	0,145	0,21	0,135	0,130	0,185
400	0,105	0,155	0,145	0,185	0,100	0,125	0,160

† In the case of single-phase circuits, the return path has been accounted for in the values given.

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**Table 6.4(a) — Multicore PVC insulated armoured cables
(SANS 1507 (SABS 1507))
Current-carrying capacity copper conductors**

Ambient temperature: 30 °C

Conductor operating temperature: 70 °C

1	2	3	4	5
Conductor cross-sectional area mm ²	Installation method 3 (clipped direct)		Installation method 4 (on a perforated horizontal or vertical cable tray), or installation method 6 (in free air)	
	One two-core cable, single-phase a.c. or d.c.	One three-core or four-core cable, three-phase a.c.	One two-core cable, single-phase a.c. or d.c.	One three-core or four-core cable, three-phase a.c.
A	A	A	A	A
1,5	21	18	22	19
2,5	28	25	31	26
4	38	33	41	35
6	49	42	53	45
10	67	58	72	62
16	89	77	97	83
25	118	102	128	110
35	145	125	157	135
50	175	151	190	163
70	222	192	241	207
95	269	231	291	251
120	310	267	336	290
150	356	306	386	332
185	405	348	439	378
240	476	409	516	445
300	547	469	592	510
400	621	540	683	590

**Table 6.4(b) — Multicore PVC insulated armoured cables
(SANS 1507 (SABS 1507))
Voltage drop (per ampere per metre) copper conductors**

Amdt 1

Conductor operating temperature: 70 °C

1	2	3			4		
Conductor cross-sectional area mm ²	Two-core cable d.c. ‡	Two-core cable, single-phase a.c. ‡			Three-core or four-core cable, three-phase a.c.		
	mV/A/m	mV/A/m			mV/A/m		
1,5	29	29			25		
2,5	18	18			15		
4	11	11			9,5		
6	7,3	7,3			6,4		
10	4,4	4,4			3,8		
16	2,8	2,8			2,4		
		r	x	z	r	x	z
25	1,75	1,75	0,170	1,75	1,50	0,145	1,50
35	1,25	1,25	0,165	1,25	1,10	0,145	1,10
50	0,93	0,93	0,165	0,94	0,80	0,140	0,81
70	0,63	0,63	0,160	0,65	0,55	0,140	0,57
95	0,46	0,47	0,155	0,50	0,41	0,135	0,43
120	0,36	0,38	0,155	0,41	0,33	0,135	0,35
150	0,29	0,30	0,155	0,34	0,26	0,130	0,29
185	0,23	0,25	0,150	0,29	0,21	0,130	0,25
240	0,180	0,190	0,150	0,24	0,165	0,130	0,21
300	0,145	0,155	0,145	0,21	0,135	0,130	0,185
400	0,105	0,115	0,145	0,185	0,100	0,125	0,160

‡ In the case of single-phase circuits, the return path has been accounted for in the values given.

Amdt 5

**Table 6.5(a) — Single-core PVC insulated cables, unarmoured, with or without sheath
(SANS 1507 (SABS 1507)) Current-carrying capacity aluminium conductors**

Ambient temperature: 30 °C

Conductor operating temperature: 70 °C

1	2	3	4	5	6	7	8	9	10	11	12
Conductor cross-sectional area	Installation method 1 (enclosed in conduit in thermally insulating wall, etc.)		Installation method 2 (enclosed in conduit on a wall or in trunking, etc.)		Installation method 3 (clipped direct)		Installation method 4 (on a perforated cable tray, horizontal or vertical)		Installation method 5 (in free air)		
	Two cables, single-phase a.c. or d.c.	Three or four cables, three-phase a.c.	Two cables, single-phase a.c. or d.c.	Three or four cables, three-phase a.c.	Two cables, single-phase a.c. or d.c. (flat and touching)	Three or four cables, three-phase a.c. (flat and touching or trefoil)	Two cables, single-phase a.c. or d.c. (flat and touching)	Three or four cables, three-phase a.c. (flat and touching or trefoil)	Horizontal flat spaced	Vertical flat spaced	Trefoil
	A	A	A	A	A	A	A	A	A	A	A
mm ²											
50	93	84	118	104	134	123	144	132	163	148	128
70	118	107	150	133	172	159	185	169	210	191	165
95	142	120	181	161	210	194	225	206	256	234	203
120	164	140	210	186	245	226	261	240	298	273	237
150	189	170	234	204	283	261	301	277	344	317	274
185	215	194	266	230	324	299	344	317	394	364	316
240	252	227	312	269	384	354	407	375	466	432	375
300	289	261	358	306	444	410	469	433	538	501	435
380	–	–	413	352	511	472	543	502	625	584	507
480	–	–	477	405	591	546	629	582	726	680	590
600	–	–	545	462	679	626	722	669	837	787	680
740	–	–	–	–	771	709	820	761	956	902	776
960	–	–	–	–	900	823	953	886	1 125	1 066	907
1 200	–	–	–	–	1 022	926	1 073	999	1 293	1 229	1 026

Table 6.5(b) — Single-core PVC insulated cables, unarmoured, with or without sheath (SANS 1507 (SABS 1507)) Voltage drop (per ampere per metre) aluminium conductors

Conductor operating temperature: 70 °C

1	2	3			4			5			6			7			8			9			
Conductor cross-sectional area mm ²	Two cables d.c. [‡] mV/A/m	Two cables – Single-phase a.c. [‡]									Three or four cables – Three-phase a.c.												
		Installation methods 1 and 2 (enclosed in conduit, etc. in or on a wall)			Installation methods 3 and 4 (clipped direct or on trays, touching)			Installation method 5 (spaced) ^a			Installation methods 1 and 2 (enclosed in conduit, etc. in or on a wall)			Installation methods 3, 4 and 5 (in trefoil, touching)			Installation methods 3 and 4 (flat, touching)			Installation method 5 (flat, spaced) ^a			
		mV/A/m			mV/A/m			mV/A/m			mV/A/m			mV/A/m			mV/A/m			mV/A/m			
		r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	
50	1,55	1,60	0,30	1,60	1,55	0,190	1,55	1,55	0,28	1,55	1,35	0,26	1,40	1,35	0,165	1,35	1,35	0,24	1,35	1,35	0,32	1,40	
70	1,05	1,10	0,30	1,15	1,05	0,185	1,05	1,05	0,27	1,10	0,94	0,26	0,97	0,91	0,160	0,92	0,91	0,24	0,94	0,91	0,31	0,96	
95	0,77	0,81	0,29	0,86	0,77	0,185	0,79	0,77	0,27	0,82	0,70	0,25	0,74	0,67	0,160	0,69	0,67	0,23	0,71	0,67	0,31	0,74	
120	0,61	0,64	0,29	0,70	0,61	0,180	0,64	0,61	0,27	0,67	0,55	0,25	0,61	0,53	0,155	0,55	0,53	0,23	0,58	0,53	0,31	0,61	
150	0,49	0,51	0,28	0,59	0,49	0,175	0,52	0,49	0,26	0,55	0,45	0,24	0,51	0,42	0,155	0,45	0,42	0,23	0,48	0,42	0,30	0,52	
185	0,39	0,42	0,28	0,50	0,40	0,175	0,43	0,39	0,26	0,47	0,36	0,24	0,44	0,34	0,150	0,37	0,34	0,23	0,41	0,34	0,30	0,46	
240	0,30	0,32	0,27	0,42	0,30	0,170	0,35	0,30	0,26	0,40	0,28	0,24	0,37	0,26	0,150	0,30	0,26	0,22	0,35	0,26	0,30	0,40	
300	0,24	0,26	0,27	0,37	0,24	0,170	0,30	0,24	0,26	0,35	0,23	0,23	0,32	0,21	0,145	0,26	0,21	0,22	0,31	0,21	0,30	0,36	
380	0,190	0,22	0,27	0,35	0,195	0,165	0,26	0,195	0,25	0,32	0,190	0,23	0,30	0,170	0,145	0,22	0,170	0,22	0,28	0,170	0,29	0,34	
480	0,150	0,180	0,26	0,32	0,155	0,165	0,23	0,155	0,25	0,29	0,155	0,23	0,27	0,140	0,140	0,195	0,140	0,22	0,26	0,135	0,29	0,32	
600	0,120	0,150	0,27	0,31	0,130	0,160	0,21	0,125	0,25	0,28	0,125	0,22	0,26	0,110	0,140	0,180	0,110	0,22	0,24	0,110	0,29	0,31	
740	0,099	–	–	–	0,105	0,160	0,190	0,100	0,25	0,27	–	–	–	–	0,094	0,135	0,165	0,094	0,21	0,23	0,089	0,29	0,30
960	0,075	–	–	–	0,086	0,155	0,180	0,082	0,24	0,26	–	–	–	0,077	0,135	0,155	0,077	0,21	0,22	0,071	0,29	0,29	
1 200	0,060	–	–	–	0,074	0,155	0,170	0,068	0,24	0,25	–	–	–	0,066	0,135	0,150	0,066	0,21	0,22	0,059	0,28	0,29	

^a Spacings larger than those specified in installation method 5 (see table 6.1) will result in larger voltage drop.
[‡] In the case of single-phase circuits, the return path has been accounted for in the values given.

**Table 6.6(a) — Multicore PVC insulated cables, unarmoured
(SANS 1507 (SABS 1507))
Current-carrying capacity aluminium conductors**

Ambient temperature: 30 °C
Conductor operating temperature: 70 °C

1	2	3	4	5	6	7	8	9
Conductor cross-sectional area mm ²	Installation method 1 (enclosed in an insulating wall, etc.)		Installation method 2 (enclosed in conduit on a wall or ceiling, or in trunking)		Installation method 3 (clipped direct)		Installation method 4 (on a perforated cable tray), or installation method 6 (in free air)	
	One two-core cable, single-phase a.c. or d.c.	One three-core or four-core cable, three-phase a.c.	One two-core cable, single-phase a.c. or d.c.	One three-core or four-core cable, three-phase a.c.	One two-core cable, single-phase a.c. or d.c.	One three-core or four-core cable, three-phase a.c.	One two-core cable, single-phase a.c. or d.c.	One three-core or four-core cable, three-phase a.c.
	A	A	A	A	A	A	A	A
16	44	41	54	48	66	59	73	61
25	58	53	71	62	83	73	89	78
35	71	65	86	77	103	90	111	96
50	86	78	104	92	125	110	135	117
70	108	98	131	116	160	140	173	150
95	130	118	157	139	195	170	210	183
120	—	135	—	160	—	197	—	212
150	—	155	—	184	—	227	—	245
185	—	176	—	210	—	259	—	280
240	—	207	—	248	—	305	—	330
300	—	237	—	285	—	351	—	381

**Table 6.6(b) — Multicore PVC insulated cables, unarmoured
(SANS 1507 (SABS 1507))
Voltage drop (per ampere per metre) aluminium conductors**

Conductor operating temperature: 70 °C

1	2	3			4		
Conductor cross-sectional area mm ²	Two-core cable d.c. †	Two-core cable, single-phase a.c. †			Three-core or four-core cable, three-phase a.c.		
	mV/A/m	mV/A/m			mV/A/m		
		r	x	z	r	x	z
16	4,5	4,5			3,9		
25	2,9	2,9	0,175	2,9	2,5	0,150	2,5
35	2,1	2,1	0,170	2,1	1,80	0,150	1,80
50	1,55	1,55	0,170	1,55	1,35	0,145	1,35
70	1,05	1,05	0,165	1,05	0,90	0,140	0,92
95	0,77	0,77	0,160	0,79	0,67	0,140	0,68
120	—	—	—	—	0,53	0,135	0,55
150	—	—	—	—	0,42	0,135	0,44
185	—	—	—	—	0,34	0,135	0,37
240	—	—	—	—	0,26	0,130	0,30
300	—	—	—	—	0,21	0,130	0,25

† In the case of single-phase circuits, the return path has been accounted for in the values given.

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**Table 6.7(a) — Multicore PVC insulated armoured cables
(SANS 1507 (SABS 1507))
Current-carrying capacity aluminium conductors**

Ambient temperature: 30 °C

Conductor operating temperature: 70 °C

1	2	3	4	5
Conductor cross-sectional area mm ²	Installation method 3 (clipped direct)		Installation method 4 (on a perforated cable tray), or installation method 6 (in free air)	
	One two-core cable, single-phase a.c. or d.c.	One three-core or four-core cable, three-phase a.c.	One two-core cable, single-phase a.c. or d.c.	One three-core or four-core cable, three-phase a.c.
	A	A	A	A
16	68	58	71	61
25	89	76	94	80
35	109	94	115	99
50	131	113	139	119
70	165	143	175	151
95	199	174	211	186
120	—	202	—	216
150	—	232	—	250
185	—	265	—	287
240	—	312	—	342
300	—	360	—	399

**Table 6.7(b) — Multicore PVC insulated armoured cables
(SANS 1507 (SABS 1507))
Voltage drop (per ampere per metre) aluminium conductors**

Conductor operating temperature: 70 °C

1	2	3			4		
Conductor cross-sectional area	Two-core cable d.c. ‡	Two-core cable, single-phase a.c. ‡			Three-core or four-core cable, three-phase a.c.		
mm ²	mV/A/m	mV/A/m			mV/A/m		
16	4,5	4,5			3,9		
		r	x	z	r	x	z
25	2,9	2,9	0,175	2,9	2,5	0,150	2,5
35	2,1	2,1	0,170	2,1	1,80	0,150	1,80
50	1,55	1,55	0,170	1,55	1,35	0,145	1,35
70	1,05	1,05	0,165	1,05	0,90	0,140	0,92
95	0,77	0,77	0,160	0,79	0,67	0,140	0,68
120	—	—	—	—	0,53	0,135	0,55
150	—	—	—	—	0,42	0,135	0,44
185	—	—	—	—	0,34	0,135	0,37
240	—	—	—	—	0,26	0,130	0,30
300	—	—	—	—	0,21	0,130	0,25

‡ In the case of single-phase circuits, the return path has been accounted for in the values given.

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(As amended 2005)

**Table 6.8 — Multicore PVC insulated armoured cables buried directly in the ground (SANS 1507 (SABS 1507))
Current-carrying capacity**

Soil temperature: 25 °C

Maximum conductor temperature: 70 °C

1	2	3	4	5
Nominal conductor size mm ²	Standard rating ^a – Copper cables A			
	Cables buried in the ground		Cables in pipes or ducts buried in the ground	
	Two-core	Three-core or four-core	Two-core	Three-core or four-core
	Cu	Cu	Cu	Cu
1,5	29	24	23	20
2,5	37	32	31	26
4	50	42	41	34
6	62	53	51	43
10	83	70	68	58
16	107	91	88	75
25	142	119	116	96
35	171	143	139	116
50	203	169	165	138
70	249	210	203	171
95	299	251	244	205
120	339	285	278	234
150	380	320	311	263
185	430	361	354	298
240	496	416	410	344
300	554	465	459	385
400	624	522	517	441

NOTE See table 6.4(b) for voltage drop.

^a Standard conditions of installation:

Depth of burial: 0,5 m
Thermal resistivity of soil: 1,2 K·m/W
Each cable is thermally independent.

Amdt 4

Table 6.9(a) concluded

1	2	3	4
Conductor cross-sectional area mm ²	D.C. or single-phase a.c. (one two-core cable, with or without protective conductor) A	Three-phase a.c. (one three-core, four-core or five-core cable) A	Single-phase a.c. or d.c., two single-core cables, touching A
<p>NOTE 1 The current ratings tabulated are for cables in free air but may also be used for cables resting on a surface. If the cable is to be wound on a drum on load the ratings should be reduced in accordance with note 2 below and for cables that may be covered, in accordance with note 4 below.</p> <p>NOTE 2 The current ratings of flexible cables wound on reeling drums are to be reduced by the following correction factors:</p> <p>a) Radial type drum</p> <p style="padding-left: 40px;">Ventilated : 0,85</p> <p style="padding-left: 40px;">Non-ventilated : 0,75</p> <p>b) Ventilated cylindrical type drum</p> <p style="padding-left: 40px;">One layer of cable : 0,85</p> <p style="padding-left: 40px;">Two layers of cable : 0,65</p> <p style="padding-left: 40px;">Three layers of cable : 0,45</p> <p style="padding-left: 40px;">Four layers of cable : 0,35</p> <p>NOTE 3 A radial type drum is one where spiral layers of cable are accommodated between closely spaced flanges; if fitted with solid flanges the ratings given above should be reduced and the drum is described as non-ventilated. If the flanges have suitable apertures the drum is described as ventilated. A ventilated cylindrical type drum is one where layers of cable are accommodated between widely spaced flanges and the drum and end flanges have suitable ventilating apertures.</p> <p>NOTE 4 Where cable may be covered over or coiled up whilst on load, or where the air movement over the cable is restricted, the current rating should be reduced. It is not possible to specify the amount of reduction but the table of rating factors for cables wound on reeling drums can be used as a guide (see note 2).</p>			

Table 6.9(b) — 85 °C or 150 °C rubber-insulated and silicon-rubber-insulated flexible cables (SANS 1574 (SABS 1574))
Voltage drop (per ampere per metre) copper conductors

Conductor operating temperature: 85 °C or 150 °C

1	2	3			4			5		
Conductor cross-sectional area mm ²	One two-core or two single-core cables d.c. ‡	Two-core cable, single-phase a.c. ‡			Three-phase a.c. (one three-core, four-core or five-core cable)			Two single-core cables touching		
		mV/A/m			mV/A/m			Single-phase a.c. ^{a ‡} mV/A/m		
4	13	13			11			—		
6	8,4	8,4			7,3			—		
10	5,0	5,0			4,3			—		
16	3,1	3,1			2,7			—		
		r	x	z	r	x	z	r	x	z
25	2,0				1,70	0,150	1,70	—	—	—
35	1,42		0,175		1,20	0,150	1,20	1,42	0,21	1,43
50	0,99	2,0	—	2,0	0,90	0,145	0,91	0,99	0,21	1,01
70	0,70		—		0,61	0,140	0,63	0,70	0,20	0,72
95	0,53		—		0,46	0,135	0,48	0,53	0,195	0,56

NOTE The voltage drop figures given above are based on a conductor operating temperature of 85 °C and are therefore not accurate when the operating temperature exceeds 85 °C. In the case of the 150 °C cables with a conductor temperature of 150 °C, the above resistive values should be increased by a factor of 1,2.

^a Larger voltage drop will result if the cables are spaced.
[‡] In the case of single-phase circuits, the return path has been accounted for in the values given.

Amdt 5

Table 6.9(b) (concluded)

1	2	3			4			5		
Conductor cross-sectional area	One two-core or two single-core cables d.c. [‡]	Two-core cable, single-phase a.c. [‡]			Three-phase a.c. (one three-core, four-core or five-core cable)			Two single-core cables touching		
								Single-phase a.c. ^{a ‡}		
mm ²	mV/A/m	mV/A/m			mV/A/m			mV/A/m		
120	0,41		–		0,36	0,135	0,39	0,41	0,190	0,46
150	0,33		–		0,29	0,130	0,32	0,33	0,190	0,38
185	0,27		–		0,24	0,130	0,27	0,27	0,190	0,33
240	0,21		–		0,185	0,130	0,22	0,21	0,185	0,28
300	0,165		–		0,145	0,125	0,195	0,170	0,180	0,25
400	0,125		–		–	–	–	0,130	0,175	0,22
500	0,098		–		–	–	–	0,105	0,170	0,20
630	0,073		–		–	–	–	0,084	0,170	0,19

NOTE The voltage drop figures given above are based on a conductor operating temperature of 85 °C and are therefore not accurate when the operating temperature exceeds 85 °C. In the case of the 150 °C cables with a conductor temperature of 150 °C, the above resistive values should be increased by a factor of 1,2.

^a Larger voltage drop will result if the cables are spaced.
[‡] In the case of single-phase circuits, the return path has been accounted for in the values given.

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(As amended 2005)

6.2.7 Voltage drop

6.2.7.1 Difference in voltage (voltage drop)

6.2.7.1.1 When all conductors of an a.c. installation are carrying their design load, the difference in voltage (the voltage drop) between the point of supply and any point of outlet or terminals of fixed appliances shall not exceed 5 % of the standard or declared voltage. (See 5.2.2 and 5.3.2.)

In the case of a 230/400 V system, the voltage drop for single-phase circuits shall not exceed 11,5 V (5 % of 230 V) and the voltage drop for three-phase circuits shall not exceed 20 V (5 % of 400 V).

In the case of single-phase circuits derived from three-phase supplies with balanced loading, the phase-to-neutral voltage drop is calculated from three-phase values divided by $\sqrt{3}$.

NOTE 1 If the phase-to-neutral voltage is not declared, the value can be calculated by dividing the phase-to-phase voltage by 1,73.

NOTE 2 In the case where reticulation is part of the electrical installation after the point of supply, the 5 % voltage drop should be calculated to include the reticulation part of the installation (for example, in the case of a housing scheme where submetering with a further point of control is installed for individual consumers) (see 5.2.2.1).

6.2.7.1.2 When all conductors of a d.c. installation are carrying their maximum estimated load, the difference in voltage (the voltage drop) between any point of supply and any point of consumption shall not exceed 5 % of the circuit nominal voltage or shall comply with the requirements of the manufacturer of the equipment connected to the circuit.

Amdt 4

6.2.7.2 Tables of voltage drop

NOTE The values in the tables for a.c. operation apply only to frequencies in the range 49 Hz to 61 Hz. The values of voltage drop for cables that operate at higher frequencies may be substantially greater.

6.2.7.2.1 In tables 6.2(b) to 6.9(b), values of voltage drop are given for a current of one ampere for a distance of 1 m along the route taken by the cables and represent the result of voltage drop in all the circuit conductors. The values of the voltage drop assume that the conductors are at their maximum permitted normal operating temperatures.

- 3) the colours may be applied at the ends of a conductor by means of durable colour marking (e.g. insulating sleeves or by electrical insulating tape wound more than once around the conductor).

Amdt 1

- c) Where symbols are used
 - 1) the polarity of the positive conductor shall be identified by the + symbol,
 - 2) the polarity of the negative conductor shall be identified by the - symbol, and
 - 3) the symbols shall be applied at the ends of the conductor. The symbols may be applied by means of printed adhesive tape or cable markers.
- d) In an earthed d.c. installation, either the positive or the negative conductor may be earthed. The earthing system used in the installation shall be indicated by means of a notice placed at the d.c. supply.
- e) Where an installation contains both a.c. and d.c. circuits and colour is used to identify the polarity of the d.c. conductors, polarity symbols described in (c) above shall be added at both ends of the d.c. conductors to distinguish them from the a.c. conductors.

6.3.4 Aerial conductors

6.3.4.1 An aerial conductor shall be of

- a) hard-drawn copper,
- b) stranded aluminium, or
- c) composite construction, such as steel-cored aluminium.

6.3.4.2 A surge arrester should be installed at each end of each aerial conductor circuit in an installation (see 6.7.6).

Amdt 1

NOTE The arrangement, support and, where required, insulation of an aerial conductor has to comply with the relevant statutory requirements.

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6.3.5 Prefabricated wiring

6.3.5.1 A prefabricated wiring system that is not wired on site shall allow for variation in building dimensions in such a way that the system, including the cables, is not subjected to any strain.

6.3.5.2 A prefabricated wiring system, especially any exposed cable ends, shall be protected against damage both during and after installation.

6.3.6 PVC insulated multicore cables with a bare earthing conductor and round cable with metal stiffening

6.3.6.1 The cables may be installed

- a) on the surface,
- b) under plaster,
- c) under a raised floor,
- d) in hollows (such as in walls and partitions) (no additional protection being needed),
- e) in roof spaces,
- f) direct in the ground (see 6.4.4.2, unarmoured buried cables),
- g) outdoors or exposed to water (but unless the manufacturer proves that the cables can withstand ultraviolet radiation, the cable shall be out of sight of the sky), and
- h) under screed if protected by an earth leakage protection device with a rated earth leakage tripping current (rated residual current) $I_{\Delta n}$ not exceeding 30 mA. **Amdt 5**

6.3.6.2 These cables shall not be buried direct in concrete.

Amdt 3; amdt 5

6.3.7 Joints and terminations

6.3.7.1 Joints and terminations of cables, cores and conductors shall be made in accordance with manufacturers' instructions or the appropriate part of SANS 10198 (SABS 0198). Flexible cables shall only be joined using cable couplers or manufacturers' jointing kits. All joints

shall be accessible, protected against strain, and protected in accordance with 5.1.1, except for joints made and sealed permanently and intended to be maintenance free. **Amdt 1; amdt 3; amdt 4; amdt 5**

6.3.7.2 Joints and terminations shall not

- a) adversely affect the current-carrying capacity, the insulation resistance or the earth continuity of the cable, core or conductor in which they are made,
- b) be made in any connector, bend, elbow or tee-piece of a conduit,
- c) allow the strands of a stranded conductor to spread, or
- d) require strands of a stranded conductor to be cut away to allow connection of the conductors (for example, to terminals).

6.3.7.3 Any armouring or sheathing shall be terminated in or on equipment. Armour wires shall be terminated by a clamp or gland in such a way that

- a) pressure is not applied to insulating material, and
- b) there is an earth tag washer (or similar) for connecting to the earth continuity conductor.

6.4 Positioning and fixing of cables

6.4.1 Positioning

A cable shall not be run

- a) in the same trench or wireway as a supplier's cable, except with the supplier's permission,
- b) in the same wireway as the cables or wires of telecommunication, radio and signalling circuits that are not covered by this part of SANS 10142 (SABS 0142),
- c) where it is likely to be damaged by liquids such as oil, acid, acetone and alkali or by gases such as sulfur dioxide,
- d) within 150 mm of hot services such as hot pipes and flues if the heat is likely to damage the cable, unless the cable is cooled or shielded from heat, or

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- e) in a position where it is likely to be damaged, unless it is mechanically protected.

6.4.2 Separation

Where cables and wiring have to be kept separate, as in 6.4.1(b), barriers shall be used at cross-overs, junctions and terminations. In service tunnels and large wireways, barriers need not be used if the circuits can be kept separate, even when the wiring is being worked on.

6.4.3 Fixing

6.4.3.1 To avoid damage to the sheath of a cable, only appropriate cleats, saddles and clamps shall be used to fix a cable.

6.4.3.2 Cables shall be fixed in such a way as to prevent strain on terminals or connectors.

6.4.3.3 A cable shall not be bent more than is recommended by the cable manufacturer.

NOTE See annex F for information about bends in cables.

6.4.3.4 If a cable is not run on racks or in pipes or ducts, it shall be firmly fixed to prevent sagging or creeping.

NOTE 1 PVC insulated multicore cables with a bare earthing conductor may be fixed using adhesives recommended by the cable manufacturer.

NOTE 2 A cable installed in the space above a ceiling and that runs on the ceiling need not be fixed except at the ends to prevent strain on the conductors or terminations.

NOTE 3 A cable can be damaged if it sags under its own weight.

6.4.3.5 Each a.c. circuit shall be so arranged that

- a) all live cores are in the same wireway, and
- b) when live single-core conductors go through electrically conductive material, measures shall be taken to minimize eddy current heating. **Amdt 5**
- c) when live single-core conductors go through magnetic material, measures shall be taken to avoid hysteresis losses. **Amdt 5**

6.4.4 Buried cables

6.4.4.1 Unarmoured cables may be buried if they are insulated and sheathed. **Amdt 1**

6.4.4.2 If unarmoured insulated cables are buried at a depth of

- a) less than 0,5 m, they shall be enclosed in conduit or otherwise mechanically protected (for example, in the case of paving or concrete) (see also 6.5.), or protected by an earth leakage protection device with a rated earth leakage tripping current (rated residual current) $I_{\Delta n}$ not exceeding 30 mA, or **Amdt 5**
- b) at least 0,5 m, the backfill around them shall not contain sharp objects and there shall be a marker tape that runs above the route of the cable, at a depth of between 0,3 m and 0,4 m.

6.4.4.3 The armouring of armoured cables is considered to provide adequate mechanical protection in most circumstances except in the case of 6.4.1 (e).

6.4.5 Open wiring

NOTE Open wiring consists of single-core insulated conductors that operate at not more than 250 V to earth; however, this is not a recommended installation method for new installations. **Amdt 5**

6.4.5.1 Open wiring shall not be installed

- a) under thatched or wood-shingle roofs,
- b) in parts of a roof space where the working height is less than 750 mm,
- c) in roof spaces that are intended to be used (or are used) for storage, unless the wiring is suitably protected against mechanically damage, **Amdt 5**
- d) within 1 m of a trap door unless the wiring is suitably protected against mechanical damage, or **Amdt 5**
- e) where it will be in contact with flammable material.

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6.4.5.2 Each conductor of an open wiring system shall be visible where it is installed on, over, or next to beams that can be used for walking on, or it shall be suitably protected against mechanical damage. **Amdt 5**

6.4.5.3 Conductors shall

- a) be fixed at intervals not exceeding 1,5 m to building elements such as walls, rafters or purlins, **Amdt 5**
- b) if there is no ceiling, be at least 3 m above floor level,
- c) Deleted by amendment No. 5.
- d) Deleted by amendment No. 5.
- e) Deleted by amendment No. 5.
- f) be supported within 600 mm of the point where they enter conduit or other building elements, and **Amdt 5**
- g) be fixed in such a way that the fixing method does not impair the conductor insulation. **Amdt 5**

6.4.5.4 Where conductors enter a conduit, the conductors shall not be strained. Metal conduit shall project enough to allow a bush and an earth clip to be fitted. **Amdt 1; amdt 5**

6.4.5.5 Where the current-carrying capacity of conductors is impaired by thermal insulating material, the appropriate correction factors shall be applied. **Amdt 5**

6.4.6 Unarmoured cables

6.4.6.1 Unarmoured single-core cables without a metal sheath shall only be used

- a) in wireways (see 6.5),
- b) for open wiring (see 6.4.5), and
- c) for temporary wiring (see 7.8).

6.4.6.2 Unarmoured multicore cables do not require additional mechanical protection if they are installed

- a) under plaster in walls, or
- b) under raised floors, in spaces above ceilings, in partitions or in wall cavities,

but only if they will not be damaged during installation.

6.4.6.3 Unarmoured multicore cables shall, where they pass through metalwork, be suitably protected from damage.

6.4.6.4 Unarmoured multicore cables need not be fixed in position in places such as in roof spaces above ceilings and where the cables are unlikely to be disturbed.

6.4.7 Copper braided cables

6.4.7.1 The copper braiding of a cable shall be

- a) earthed,

NOTE The braiding may be used as the earth continuity conductor.

- b) bonded to any metal wireway in which it is run, and

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6.6 Distribution boards

NOTE This clause describes the minimum safety requirements for the construction and installation of distribution boards.

6.6.1 General

6.6.1.1 Each distribution board shall be controlled by a switch-disconnector. The switch-disconnector shall

- a) be mounted in or next to the distribution board,
- b) in the case of the main or first distribution board of an installation, be labelled as "main switch",
- c) in the case of a sub-distribution board, be labelled as "sub-main switch" or "main switch" if the board is labelled "sub-board ...",
- d) in the case where an alternative supply is installed (emergency supply, uninterruptible power systems (UPS), etc.), be labelled as required in 7.12.2.1, and
- e) have a danger notice on or near it. The danger notice shall give instructions that the switch-disconnector be switched off in the event of inadvertent contact or leakage.

6.6.1.2 A distribution board shall comply with the requirements of clause 5.

6.6.1.3 Each item of electrical equipment used in a distribution board shall comply with the requirements of clause 4.

6.6.1.4 The distribution board shall be suitable for the environmental conditions in which it operates.

6.6.1.5 Distribution boards shall be protected against corrosion.

6.6.1.6 Any point of a distribution board that has to be reached during normal operation shall not exceed a height of 2,2 m above floor (or walking) level. However, the board may be mounted higher if it can be disconnected from the supply by a switch-disconnector that is less than 2,2 m above floor level. (See also 5.2.8(b)). Unless a residential distribution board is housed in an enclosure and direct access cannot be obtained by an infant, no part of

Amdt 3

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an indoor distribution board shall be less than 1,2 m above the floor level and no part of an outdoor distribution board shall be less than 0,2 m above the ground level. **Amdt 3**

6.6.1.7 A distribution board shall not be mounted

- a) in a bathroom, except outside zone 3 and unless the enclosure provides an IP rating of IPX5 (see 7.1.4.3.6),
- b) above a fixed cooking appliance or in a position where a stationary cooking appliance could be put below it, unless the enclosure provides a degree of protection of at least IP44, or
- c) within a radius of 1 m from a water tap or valve (in the same room), unless the enclosure provides a degree of protection of at least IP44.

6.6.1.8 Wiring and feeder cables or tightening of connections shall not cause displacement of components.

6.6.1.9 Distribution boards shall be so positioned and arranged as to ensure safe operation and maintenance (see 5.2.8). **Amdt 3**

6.6.1.10 Text has been renumbered and moved to 6.6.2.6. **Amdt 3**

6.6.1.11 If a conductor of cross-sectional area exceeding 4 mm^2 is used, it shall be so installed to allow any one neutral conductor to be disconnected without disturbing the connection of any other neutral conductor.

6.6.1.12 A distribution board and the equipment mounted in or on it shall be so positioned and arranged that any conductor can easily be disconnected from the terminals.

6.6.1.13 Both ends of the live conductors and of the neutral conductors of a ring circuit shall be crimped together. Ring circuits shall clearly and permanently be identified by either a notice or a tag.

6.6.1.14 In a distribution board where the short-circuit rating exceeds 10 kA, the mechanical strength of the conductors installed between the busbars and the functional units shall be sufficient to withstand the short-circuit stresses which could occur. A conductor with a minimum cross-sectional area of 16 mm^2 shall be used if it cannot be shown by calculation or from the component manufacturer's information that a smaller conductor can be installed. **Amdt 3**

6.6.1.15 Switchgear shall be fully rated for withstanding the prospective short-circuit current that could occur at that point in the system, unless series-connected (cascaded) systems are applied in accordance with 6.7.4.

6.6.1.16 Where the prospective fault level of the supply cannot be determined, a fault current meter may be used (see 8.5.2).

6.6.1.17 All disconnecting devices in a distribution board

- a) shall be protected by a fully rated short-circuit protective device, and
- b) when used in combination with a short-circuit protective device (see 6.7.4), shall have a conditional short-circuit current rating (see 3.22.1) appropriate to its condition of installation, but of not less than 2,5 kA.

6.6.1.18 If an installation is likely to be extended, a distribution board with spare ways should be fitted.

6.6.1.19 Each unoccupied opening of a distribution board shall be fitted with a blanking plate.

6.6.1.20 Unless obvious, permanent labelling shall identify all incoming and outgoing circuits of the distribution board.

6.6.1.21 The following warning labels shall be fitted to all distribution boards:

- a) an indication of where the distribution board is fed from, except for single distribution board installations. (Where the supply is derived from sources other than the main supply, for example, generators or UPS, see 7.12.4.); **Amdt 1; tech. corr. 1**
- b) if the short-circuit rating exceeds 2,5 kA, the minimum fault current rating of switchgear that can be used;
- c) in the case of series-connected (cascaded) systems, the warning label required by 6.7.4(d); and
- d) the current rating of the busbars shall be indicated where it exceeds 100 A.

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6.6.1.22 The insulation-resistance test on wiring and components shall be performed in accordance with 8.7.8.

6.6.1.23 Deleted by amendment No. 3.

6.6.2 Busbars

6.6.2.1 Unless fully tested in accordance with SANS 60439-1/IEC 60439-1 (SABS IEC 60439-1), the current density of copper busbars shall not exceed 2 A/mm^2 for currents $\leq 1\ 600 \text{ A}$, or $1,6 \text{ A/mm}^2$ for currents $> 1\ 600 \text{ A}$. **Amdt 1**

6.6.2.2 The size and design of the busbar system shall be appropriate to the prospective short-circuit current that could occur at the supply terminals of the distribution board.

6.6.2.3 Where fishplates are used for busbar connections, the cross-sectional dimensions of the fishplates shall be similar to those of the busbar, and the overlap on each side shall be at least equal to the width of the busbar.

6.6.2.4 Standard colour coding, i.e. red, yellow, blue, or numbering L1, L2 and L3, shall be used to identify phase busbars. Green/yellow shall be used for the earthing busbar and black for the neutral busbar.

6.6.2.5 If colour is used for control wire coding, any colour may be used except green/yellow, green, or black.

6.6.2.6 In the case of a multiphase distribution board, the neutral busbar shall be at least 50 % of the cross-sectional area of the phase busbar provided that only particular application conditions permit such reduction. (For harmonics, see 6.2.11.) **Amdt 5**

6.6.2.7 The cross-sectional area of the earthing busbar (protective conductor) shall be not less than the appropriate value shown in table 6.24(a). **Amdt 5**

If the application of this table produces non-standard sizes, the nearest larger standard size shall be used. **Amdt 5**

Table 6.24(a) — Cross-sectional area of protective conductors

1	2
Cross-sectional area of phase conductors S mm ²	Minimum cross-sectional area of the corresponding protective conductor S_p mm ²
$S < 16$	S
$16 < S \leq 35$	16
$35 < S \leq 400$	$S/2$
$400 < S \leq 800$	200
$S > 800$	$S/4$

Amdt 5

6.6.3 Factory built distribution boards with a short-circuit rating up to and including 10 kA

6.6.3.1 Distribution boards shall comply with SANS 1765 (SABS 1765).

Amdt 1; amdt 3

6.6.3.2 Small power distribution units (SPDUs or ready boards) for single-phase 230 V service connections shall comply with SANS 1619 (SABS 1619).

Amdt 3

6.6.4 Distribution boards built or modified on site with a short-circuit rating up to and including 10 kA

Amdt 3

6.6.4.1 General

A distribution board shall comply with 6.6.1, 6.6.2, 6.6.4.2 and 6.6.4.3.

Amdt 1; amdt 3

6.6.4.2 Design

6.6.4.2.1 Deleted by amendment No. 3.

6.6.4.2.2 Deleted by amendment No. 3.

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(As amended Jan. 2003 and Dec. 2003)

6.6.4.2.3 Deleted by amendment No. 3.

6.6.4.2.4 Unless tested in accordance with SANS 60439-1, the minimum clearance between phases and between phase and earth shall be at least 8 mm. Equipment and components shall comply with the clearance distances given in the relevant product standards. **Amdt 3**

6.6.4.2.5 Deleted by amendment No. 3.

6.6.4.2.6 Deleted by amendment No. 3.

6.6.4.2.7 Deleted by amendment No. 3.

6.6.4.3 Electrical integrity

6.6.4.3.1 Deleted by amendment No. 3.

6.6.4.3.2 Unless tested in accordance with SANS 60439-1, the minimum creepage distance between phases and between phase and earth shall be at least 16 mm. Equipment and components shall comply with the creepage distances given in the relevant product standards. **Amdt 3**

6.6.4.3.3 Deleted by amendment No. 3.

6.6.5 Factory built distribution boards with a short-circuit rating above 10 kA **Amdt 3**

Distribution boards that form part of a fixed electrical installation shall comply with SANS 1473-1. **Amdt 1; amdt 3**

6.6.6 Alterations/extensions to distribution boards with a short-circuit rating above 10 kA **Amdt 3**

6.6.6.1 Alterations or extensions on site to distribution boards with a short-circuit withstand current above 10 kA shall comply with the requirements of 6.6.6.2, and where reports and similar documents are available, apply

Amdt 1; amdt 3; amdt 5

- a) the rules given in SANS 1473-1 for the maximum permissible deviations allowed for a PTTA, or **Amdt 5**
- b) the rules for deviations from an STA. **Amdt 5**

6.6.6.2 When a distribution board is modified or extended, the following requirements shall apply: **Amdt 3**

- a) the mechanical and electrical integrity of the distribution board shall not be infringed;
- b) the integrity of the area in a distribution board or a section of a distribution board that comprises the conductors (including distribution busbars) between the main busbars and the supply side of functional units and the components included in these units, which is regarded as fault free on the basis of the reduced short-circuit stresses that occur on the load side of the prospective short-circuit protective device in each unit, is still applicable; **Amdt 3**
- c) extensions to the busbar systems shall not adversely affect the electrical and mechanical performance of the complete busbar system;
- d) components shall be selected for their suitability for application taking into account information available from the component manufacturers. It might be necessary to derate the components depending upon environment and application conditions; **Amdt 3**
- e) any changed properties due to alteration or extension of the distribution board shall be marked indelibly on a supplementary nameplate; and **Amdt 3**
- f) the required IP rating shall not be reduced. **Amdt 3**

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(As amended Jan. 2003 and Dec. 2003)

6.7.4 Series-connected (cascaded) systems

NOTE A series-connected (cascaded) system is a protection system that allows for the installation of circuit-breakers which cannot necessarily be rated to handle the full prospective short-circuit current at their points of installation, provided that they are backed up by another fully rated circuit-breaker in a predetermined and tested coordination.

In a series-connected (cascaded) system, the following rules shall apply:

- a) the combinations of circuit-breakers used shall comply with the requirements of A.6.2(a) and A.6.4 of SANS 60947-2:2003 (Ed. 3) or equivalent standard for coordinated back-up protection; **Amdt 3**
- b) Deleted by amendment No. 3. **Amdt 1**
- c) back-up circuit-breakers shall be fully rated to handle the maximum prospective short-circuit current at the point of installation; and
- d) a warning label shall be fitted to every distribution board, switchboard, panelboard and the like where series-connected (cascaded) systems are used. The label shall include the following wording:

WARNING

This is a series-connected (cascaded) system. Except when recommended by the circuit-breaker manufacturer, do not replace any circuit-breaker in the system with a circuit-breaker that is not of identical type and rating.

6.7.5 Earth leakage protection

6.7.5.1 Except as allowed in 6.7.5.5 and 7.10.1.6, non-auto-reclosing earth leakage protection shall be provided **Amdt 1**

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- a) in a new installation for circuits that supply SANS 164-1 (SABS 164-1) or SANS 164-2 (SABS 164-2) type socket-outlets,
- b) in an existing installation for all the circuits that supply socket-outlets when any such circuit or circuits are rewired or extended. **Amdt 3**

NOTE It is recommended that earth leakage protection be installed in all circuits that supply socket-outlets in an existing installation. **Amdt 3**

6.7.5.2 Industrial type single-phase and three-phase socket-outlets (including "welding" socket-outlets) shall comply with the requirements of SANS 1239 (SABS 1239), and, except as allowed in 6.7.5.5 and 7.10.1.6, shall have earth leakage protection if the circuit is intended to supply portable or stationary class I appliances.

6.7.5.3 Earth leakage protection shall disconnect

- a) both phase and neutral in a single-phase system, and
- b) all three phases in a three-phase system.

When a single-phase socket-outlet is supplied from a three-phase earth leakage circuit-breaker, the earth leakage protection shall break both phase and neutral.

An earth leakage protection device that is used as a switch-disconnector (see 6.9.4) shall comply with the relevant requirements of a standard for disconnectors as given in clause 4.

6.7.5.4 Unless allowed elsewhere in this part of SANS 10142 (SABS 0142) or for a special application, the rated earth leakage tripping current (rated residual current) $I_{\Delta n}$ required to activate an earth leakage protection device shall not exceed 30 mA. It shall not be possible to desensitize an earth leakage protection device while the circuit in which it is installed is in service. However, this does not prevent the use of non-integral earth leakage protection devices when the rupturing capacity exceeds 2,5 kA.

Amdt 3

6.7.5.5 The following do not need earth leakage protection:

- a) socket-outlets connected to a safety supply, but see 7.8.3.3 and 7.12; **Amdt 5**
- b) a socket-outlet that complies with SANS 164-4 and that is intended only for the connection of an appliance for critical application (such as

emergency lighting, a deep-freeze, a burglar alarm or data processing equipment); **Amdt 5**

- c) circuits that supply fixed socket-outlets positioned out of normal reach, rated at less than 16 A and intended for the connection of luminaires (see 6.14.1.4); and
- d) a stove coupler that complies with SANS 60309-1/IEC 60309-1 (SABS IEC 60309-1) and of dimensions as given in SANS 337 (see 6.15.1.2.5). **Amdt 5**

6.7.5.6 A warning label shall be fitted to every socket-outlet circuit where **Amdt 5**

- a) the rated earth leakage tripping current (rated residual current) $I_{\Delta n}$ is higher than 30 mA, or **Amdt 3; amdt 5**
 - b) the socket-outlet circuit is powered from a safety supply, or **Amdt 5**
 - c) the socket-outlet circuit is on dimmer control, **Amdt 5**
- indicating such tripping current, safety supply or dimmer control. **Amdt 5**

6.7.5.7 An earth leakage protection device that is not provided with integral overcurrent protection

- a) shall be protected by a fully rated short-circuit protective device, or
- b) when used in combination with a short-circuit protective device, shall have a conditional short-circuit current rating (see 3.22.1) appropriate to its condition of installation, but of not less than 2,5 kA.

6.7.6 Surge protection

Surge protection devices (SPDs) may be installed to protect an installation against overvoltage surges such as those due to switching operations or those induced by atmospheric discharges (lightning). **Amdt 1**

See annex L for the installation of SPDs. **Amdt 1**

Pages 170 to 173 have been deleted by amendment No. 1.

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6.8 Circuit-breakers

6.8.1 Circuit-breakers used as main or local switch-disconnectors

A circuit-breaker that is used as a main or local switch-disconnector (see 6.9.4) shall comply with the relevant requirements of a standard given in clause 4 for switch-disconnectors, or, alternatively, a switch-disconnector shall be positioned on the supply side of the circuit-breaker.

6.8.2 Circuit-breakers used as switches

6.8.2.1 A circuit-breaker that is used as a switch (for example, as a protective device for a socket-outlet) shall comply with the requirements of standards for both circuit-breakers and switches.

6.8.2.2 Except for a circuit-breaker that is mounted next to the appliance or socket-outlet that it controls, each circuit-breaker shall be labelled to show which circuit or appliance it controls.

6.8.2.3 Circuit-breakers, disconnectors and switch-disconnectors shall not be mounted upside down. Horizontal mounting is allowed unless specifically prohibited by the manufacturer.

Any deviation from the convention of connecting line to the top and load to the bottom of switchgear is not recommended. Reverse connection is allowed only if

- a) it is specifically allowed by the manufacturer,
- b) "load" and "line" are so marked that they are clearly visible during maintenance, and
- c) any contradictory marking is not visible after installation.

6.9 Disconnecting devices

6.9.1 General

6.9.1.1 Each installation shall have one disconnecting device to disconnect the entire installation, except in the case of multisupplies or more than one transformer supplying the installation where each supply shall have its own disconnecting device. There shall be a notice fixed next to each such disconnecting device indicating that the installation has more than one main switch-disconnector.

6.9.1.2 If an installation consist of separate parts, each part shall be controlled by a sub-main switch-disconnector to disconnect

- a) that part of the installation, or
- b) individual circuits and appliances.

6.9.1.3 A disconnecting device that is intended to disconnect equipment for repair, maintenance, or inspection shall have at least the safety isolating requirements of a switch-disconnector.

6.9.2 Disconnecting devices for neutral conductors

6.9.2.1 A neutral conductor shall not have a single-pole disconnecting device.

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6.9.2.2 In the case of a single-phase circuit, the disconnecting device shall disconnect live and neutral. In the case of a multiphase circuit, the disconnecting device shall disconnect all the phase conductors but need not disconnect the neutral conductor in an installation connected to a supply system in which the neutral conductor is earthed direct (see the TN system in annex M). **Amdt 4**

6.9.2.3 A disconnecting device used in a supply system in which there is no direct connection between earth and any live conductor shall disconnect all the live conductors (see the TT and IT systems in annex M).

NOTE In a safety supply, none of the conductors are connected to earth, so any disconnecting device in such a circuit has to disconnect all the conductors.

6.9.3 Disconnecting devices for equipment

Amdt 3

6.9.3.1 An appliance or equipment that is not supplied from a socket-outlet, including equipment automatically or remote controlled, shall be capable of being disconnected from the supply by an easily accessible switch-disconnector. The disconnector shall be mounted (if not specified elsewhere in this part of SANS 10142 (SABS 0142), but excluding luminaire circuits) (see also 6.16.1.4) **Amdt 1**

- a) within arm's reach from the terminals of the appliance, or
- b) in a distribution board, if the device is capable of being locked in the open position.

The disconnector can control more than one appliance if the functions of the appliances are related. Where equipment which belongs to the supplier of electricity (such as meters or remote controlled load switching) is installed, the main switch may be regarded as the disconnecting device.

6.9.3.2 All supply circuits to equipment and interconnected devices (such as appliances with remote control or alarm) shall be capable of being disconnected. Where more than one disconnecting device is used, each device shall have a notice fixed next to it, giving the location and function of the other disconnecting device.

6.9.3.3 The disconnecting device shall be a switch-disconnector that disconnects all the phase conductors, however

- a) a circuit-breaker may be used instead of a switch-disconnector if overcurrent protection is also required (see also 6.8.1.), or

6.14 Lighting

NOTE For extra low voltage lighting installations, see 7.9.

6.14.1 Lighting circuits

6.14.1.1 A single-phase circuit that supplies luminaires only can supply any number of luminaires.

6.14.1.2 Each identified group of single-phase luminaires supplied from a multiphase supply that also feeds other luminaires, shall be controlled by a local multiphase disconnecting device.

NOTE The disconnecting device should disconnect all live conductors that feed the group of luminaires, including the neutral, in order that maintenance work can be carried out without switching off all the lights.

6.14.1.3 A circuit that has two phase conductors and that supplies only luminaires that are connected between the phase conductors, may supply any number of points if

- a) the circuit is controlled by a multipole switch-disconnector, and
- b) any additional switches in the circuit are multipole switches.

6.14.1.4 In a lighting circuit, a luminaire that is in a false ceiling or in a roof space 4 m above the floor where there is no ceiling, or in a floor cavity, or in a wall cavity, or in a similar position, may be fed from a socket-outlet which may be unswitched and not protected by earth leakage protection, provided that the socket-outlet

- a) complies with SANS 164-3 or, except in the case of residential installations, with BS 1363-2 (for 13 A fused plugs), **Amdt 5**
- b) supplies one luminaire only, not exceeding the rating of the socket-outlet,
- c) is accessible for maintenance purposes, and
- d) is within 3 m of the luminaire that it supplies.

6.14.1.5 A lighting circuit that incorporates 6 A socket-outlets or 13 A socket-outlets in accordance with 6.14.1.4 shall be protected by a circuit-breaker of not exceeding 20 A. Lighting circuits that incorporate 13 A (fused plug top) socket-outlets shall not be installed in a residential installation. **Amdt 5**

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6.14.1.6 In a lighting circuit, a luminaire may be fed from a socket-outlet on a wall (that may be unswitched), provided that the socket-outlet

- a) complies with SANS 164-3, **Amdt 5**
- b) is protected by earth leakage protection,
- c) supplies one luminaire only, not exceeding the rating of the socket-outlet, and
- d) is within 3 m of the luminaire that it supplies.

At least one 16 A socket-outlet that complies with SANS 164-1 or SANS 164-2 (see 6.15.2.1) shall be installed in the same room. **Amdt 5**

6.14.1.7 If more than one phase in a lighting circuit is brought into one enclosure for switching purposes,

- a) labels (see 4.5) stating that the voltage between phase conductors could exceed 250 V shall be fixed in a visible position inside the enclosure (not on the cover plate); or **Amdt 1**
- b) the phase terminals in the enclosure shall be separated by suitable barriers.

NOTE To avoid nuisance tripping where earth leakage protection is used, it is advisable to restrict the number of discharge luminaires on a circuit.

6.14.1.8 If more than one circuit is brought into an enclosure, a warning label shall be fixed inside the enclosure.

6.14.2 Luminaires

6.14.2.1 Surface-mounted luminaires shall be selected and installed such that thermal damage to the mounting surface is avoided.

6.14.2.2 Ancillary equipment for luminaires (such as capacitors, chokes, resistors and transformers) shall be enclosed in

- a) a luminaire, or
- b) an enclosure that
 - 1) is non-flammable,

6.14.4.2 The outer contact of an Edison-screw type lamp holder shall be connected to the neutral conductor.

6.15 Socket-outlets

NOTE Earth leakage protection on socket-outlets is compulsory except where specified otherwise (see 6.7.5).

6.15.1 Construction

6.15.1.1 Deleted by amendment No. 3.

6.15.1.2 Dimensions

6.15.1.2.1 The dimensions of single-phase socket-outlets intended for general use shall comply with the requirements of SANS 164-1 (SABS 164-1) or SANS 164-2 (SABS 164-2).

6.15.1.2.2 Socket-outlets intended for the connection of industrial type equipment such as welding machines, shall conform to the dimensions given in SANS 1239 (SABS 1239). NOVA and DIN socket-outlets may only be fitted as replacement of, and in extension to, an installation where such socket-outlets exist.

6.15.1.2.3 Socket-outlets that supply caravans or boats shall conform to the dimensions given in SANS 1239 (SABS 1239) and shall have a six o'clock earthing position (see 7.6).

6.15.1.2.4 A socket-outlet that complies with SANS 164-4 may be used for the connection of appliances for critical application (such as a deepfreeze, a burglar alarm or data-processing equipment). **Amdt 5**

NOTE 1 Dedicated socket-outlets need not be protected by earth leakage.

Amdt 5

NOTE 2 Prevention of theft is not considered a critical application.

6.15.1.2.5 A stove coupler shall comply with the requirements of SANS 60309-1/IEC 60309-1 (SABS IEC 60309-1) and shall be of dimensions as given in SANS 337. **Amdt 5**

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NOTE 1 Earth leakage protection is not required for the stove circuit when a stove coupler is used.

NOTE 2 For a three-phase coupler, the earth connection needs special consideration.

6.15.1.3 Voltage

Socket-outlets that supply voltages other than the standard voltage shall

- a) have the voltage marked on them in a position that is visible after installation,
- b) be of a plug and socket system such that the socket-outlet cannot accept a plug in accordance with any part of SANS 164, and the plug cannot be plugged into a socket-outlet in accordance with any part of SANS 164; and **Amdt 5**
- c) in the case of SELV (below 50 V), comply with SANS 60906-3/IEC 60906-3 (SABS IEC 60906-3).

6.15.2 Rating

6.15.2.1 Socket-outlets shall be rated in accordance with the intended load. Unless otherwise allowed in this part of SANS 10142 (SABS 0142), socket-outlets rated at less than 16 A shall not be used in an electrical installation.

6.15.2.2 The anticipated load of a circuit that feeds socket-outlets shall not exceed 5 kW.

6.15.3 Single-phase circuits that only supply socket-outlets rated at 16 A

Single-phase circuits that only supply socket-outlets rated at not more than 16 A,

- a) shall have overcurrent protection;
- b) shall use conductors that are rated at not less than 16 A;
- c) shall, if the circuit protection is rated at more than 20 A, use only protected socket-outlets, with, as far as is practicable, discrimination between the protective devices for the circuit and the protective

devices associated with the socket-outlets. The protective device of a protected socket-outlet shall

- 1) have a fixed rated current that does not exceed the rating of the socket-outlet,
- 2) be mounted next to the socket-outlet that it protects,
- 3) provide protection against overload currents,
- 4) provide protection against short-circuit currents, unless short-circuit protection is provided by a separate device, for example on the distribution board,
- 5) if it needs the protection of a back-up short-circuit device, be marked with the required or maximum rating of the back-up device,
- 6) if it protects more than one socket-outlet, be so installed that all the socket-outlets are connected in parallel, have the same rated current, and are mounted next to the device, and
- 7) if it is a circuit-breaker, comply with the requirements of 6.8.2.

NOTE In the interests of safety, the use of the building, the convenience of the occupants and the possibility of heating and cooling equipment being connected to socket-outlets, should be considered when the number and position of points of consumption are being determined.

6.15.4 Mixed loading of circuits

6.15.4.1 Except as allowed in 6.15.4.2 and 6.15.4.3, there shall be no mixed loading of circuits. (See also 6.16.3.2.3.) **Amdt 5**

6.15.4.2 A single-phase circuit that has overcurrent protection rated at not more than 20 A may supply a mixed load of

- a) socket-outlets rated at not more than 16 A and fixed luminaires,
- b) socket-outlets and fixed appliances, or
- c) socket-outlets, luminaires and fixed appliances.

NOTE The number of points need not be limited.

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6.15.4.3 Socket-outlets rated at 16 A or more that are connected to circuits with mixed loading shall comply with the earth leakage requirements of 6.7.5.

NOTE 1 See 7.1 for the conditions under which a socket-outlet may be installed in a bathroom.

NOTE 2 See 6.16.1.6 for the conditions under which a socket-outlet may be used for the connection of fixed appliances.

6.15.5 Circuits that supply single-phase socket-outlets rated at more than 16 A, or that supply three-phase socket-outlets, or both

In a circuit that supplies single-phase socket-outlets rated at more than 16 A, or that supplies three-phase socket-outlets, or both, and that supplies more than one socket-outlet,

- a) single-phase and three-phase socket-outlets may be supplied from the same circuit; and
- b) the rating of the circuit protection shall not exceed 125 % of the rating of the lowest rated socket-outlet, or each socket-outlet that has a rating of less than that of the circuit protection shall be individually protected against overcurrent.

6.15.6 Positioning of socket-outlets

6.15.6.1 A socket-outlet that is exposed to the weather (or to the condensation, dripping, splashing or accumulation of water) shall have a rating of at least IP44 in accordance with SANS 60529/IEC 60529 (SABS IEC 60529). The rating applies whether a plug is in or out.

NOTE The IP ratings are explained in annex J.

6.15.6.2 A floor-mounted socket-outlet (recessed or not) shall be so mounted that

- a) the floor can be cleaned or washed without the insulation resistance of the installation being affected, and
- b) there is no risk of live parts touching any floor covering used.

6.15.6.3 A socket-outlet shall not be installed within a radius of 2 m of a water tap (in the same room) unless the socket-outlet

- a) has earth leakage protection, or
- b) is connected to a safety supply.

6.15.7 General

6.15.7.1 A socket-outlet in a d.c. circuit shall be controlled by a switch that is fixed next to it. **Amdt 5**

6.15.7.2 Each socket-outlet connected in a ring circuit shall be marked as such.

6.16 Fixed appliances

6.16.1 General

NOTE The general requirements in 6.16.1.1 to 6.16.1.13 apply, except where otherwise required for specific cases. **Amdt 4**

6.16.1.1 Fixed appliances do not form part of the electrical installation other than their positioning in relation to the supply and the wiring carried out between different parts of the appliances. **Amdt 1**

6.16.1.2 Deleted by amendment No. 4.

6.16.1.3 The power supply to every fixed appliance, except luminaires, shall be supplied through

- a) a disconnecting device that disconnects both live conductors in a single-phase supply and all phase conductors in a multiphase supply, or **Amdt 3**
- b) a socket-outlet **Amdt 3**

that is directly accessible at all times that any person is exposed to such appliance while the supply is on. In the case of a remotely installed appliance, the position of the disconnecting device shall be indicated by means of a notice in close proximity to or on the appliance. **Amdt 3**

6.16.1.4 Where a fan or heater is included in a luminaire, the luminaire is regarded as a fixed appliance. If the luminaire circuit is protected by earth leakage, a disconnector is not required (see 6.9.3.1). **Amdt 1**

6.16.1.5 The disconnecting device shall be positioned **Amdt 3**

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(As amended 2003)

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(As amended Jan. 2003 and Dec. 2003)

- a) within 1,5 m from the appliance, or
- b) in a distribution board (if the switch-disconnector is capable of being locked in the open position). **Amdt 3**

Even where a disconnecting device is on the appliance, a separate disconnecting device shall be provided in the fixed installation to allow for the total removal of the appliance. **Amdt 3**

NOTE A standard switch is not a switch-disconnector.

6.16.1.6 A socket-outlet shall supply only one fixed appliance. The use of flexible cords of length exceeding 3 m is not recommended. The reason for this recommendation is an endeavour to ensure operation of the overcurrent protective device. (But see also 6.14.1.4 for luminaires.)

Amdt 1

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NOTE 1 Subclause 6.7.5 requires a socket-outlet to be protected by earth leakage protection.

NOTE 2 If an appliance is installed in a bathroom, see table 7.1 regarding earth leakage protection.

6.16.1.7 Where a socket-outlet in accordance with SANS 164-1, SANS 164-2, SANS 164-3, or SANS 1239 (SABS 1239) is part of the appliance (built-in), the circuit shall be protected by overcurrent and earth leakage protection (see 6.15.) Socket-outlets in accordance with SANS 164-4 shall have overcurrent protection. **Amdt 5**

6.16.1.8 Surface-mounted appliances shall be selected and installed in such a way that thermal damage to the mounting surface is avoided.

6.16.1.9 Unless part of the appliance or self contained in their own enclosure, control components of fixed appliances that form part of the fixed installation, including their input terminations and associated protective switchgear that are not mounted in the distribution board, shall be incorporated in a suitable enclosure(s) that comply with the requirements of 6.6.1 and 6.6.4. Enclosure(s) shall be

- a) non-flammable,
- b) located as near to the appliance(s) as is practicable,
- c) permanently installed,
- d) such that they cannot be opened without the use of a tool, and
- e) readily accessible.

6.16.1.10 The connections between circuit conductors and appliance conductors shall

- a) allow enough slack immediately behind the base of the appliance for easy handling, and
- b) in the case of a pre-wired appliance, be made using a connector.

NOTE PVC insulated conductors should not be used where the temperature of the conductor could exceed 70 °C, unless the conductors are shielded from heat sources.

6.16.1.11 The wiring between different parts of a fixed appliance that are installed separately is part of the fixed installation, even where it is supplied from a socket-outlet, unless such wiring is less than 1,5 m in length.

Such wiring shall be protected by separate overload protection unless its current-carrying capacity is such that the circuit protection of the socket-outlet circuit will provide protection or that part of the appliance has built-in thermal overload protection.

6.16.1.12 Flexible conduit may be used for the final connection to a fixed or stationary appliance but may not be used as the final connection to a portable appliance, unless it has been authorized for this use.

6.16.1.13 The earth continuity conductor shall be connected to the earthing terminal of fixed electrical appliances that

- a) are exposed to the weather or to the condensation, dripping, splashing or accumulation of water, or
- b) use water, such as cooking appliances, laundering and dishwashing machines, water heaters, garbage disposal units and air-conditioning equipment.

6.16.2 Water heaters

NOTE Water heaters include geysers, instantaneous water heaters including units for boiling water, and the like (see also 6.16.1). **Amdt 4**

6.16.2.1 All water heaters shall be bonded in accordance with 6.13.

6.16.2.2 Dedicated circuits shall be provided for water heaters and there may be more than one water heater on each circuit.

NOTE If a water heater is installed in a bathroom, see table 7.1 regarding earth leakage protection.

6.16.3 Cooking appliances

NOTE Cooking appliances include built-in stoves, oven hobs, and the like (see also 6.16.1). **Amdt 4**

6.16.3.1 Switch-disconnector

6.16.3.1.1 The circuit that supplies a cooking appliance through fixed wiring, a stove coupler (see 6.16.3.3), or an industrial type socket-outlet (see SANS 60309-1), shall have a readily accessible switch-disconnector. The switch-disconnector may supply more than one appliance. **Amdt 4**

6.16.3.1.2 A switch-disconnector for a cooking appliance(s) shall

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- a) be in the same room as the appliance(s),
- b) be at a height above floor level of not less than 0,5 m and not more than 2,2 m,
- c) preferably not be above the cooking appliance(s),
- d) be within 3 m of the appliance(s), but within 0,5 m of the appliance(s) if the switch-disconnector's purpose is not clearly indicated, and
- e) not be fixed to the appliance.

6.16.3.2 Cooking appliance circuits

6.16.3.2.1 A dedicated circuit(s) shall be provided for cooking appliance(s) that are rated at more than 16 A.

6.16.3.2.2 One circuit shall not supply more than one permanently connected cooking appliance, unless the appliances are in the same room.

6.16.3.2.3 A cooking appliance circuit may also supply one socket-outlet if the rating of the socket-outlet does not exceed 16 A and if the following are all contained in one control unit (see also 6.15.4.1): **Amdt 5**

- a) the socket-outlet;
- b) an earth leakage protection device including overcurrent protection for protecting the socket-outlet; and
- c) the switch-disconnector required for the cooking appliance (see 6.16.1).

NOTE The socket-outlet has to be protected against earth leakage so, unless the protection device (see (b) above) is in the control unit, the entire cooking appliance circuit has to be protected against earth leakage.

6.16.3.2.4 If a cooking appliance is connected by means of a stove coupler (6.16.3.3.1 (a)) or an industrial type socket-outlet (6.16.3.3.1(c)), the open end of the connector tube or socket-outlet shall point downwards. **Amdt 4**

6.16.3.3 Stove connection

6.16.3.3.1 A stove designed to be a free-standing appliance rated above 16 A shall be connected through **Amdt 4**

- a) a stove coupler which shall comply with SANS 60309-1/IEC 60309-1 (SABS IEC 60309-1) and of dimensions as given in SANS 337 (a maximum of 45 A single-phase and 16 A per phase for three phase), or

Amdt 5

NOTE 1 Earth leakage protection is not required for the stove circuit when a stove coupler is used.

NOTE 2 For a three-phase coupler, the earth connection needs special consideration.

- b) Deleted by amendment No. 1.

- c) a socket-outlet that complies with SANS 60309-1/IEC 60309-1 (SABS IEC 60309-1) (industrial type) with 30 mA earth leakage protection, however, the use of industrial type socket-outlets is not recommended for stove connections.

6.16.3.3.2 Text has been renumbered and moved to 6.16.3.2.4.

Amdt 4

6.16.4 Heaters, appliances for space heating and for cooling

NOTE 1 Heaters include towel rail and mirror heaters, hair and hand dryers, and the like (see also 6.16.1).

Amdt 4

NOTE 2 Appliances for space heating include fixed heaters (including air conditioners), underfloor, undertile, undercarpet, underplaster heating, and the like (see also 6.16.1).

Amdt 4

NOTE 3 Appliances for cooling include extraction and ventilation fans, fans combined with luminaires, air conditioning, refrigeration and freezer units, and the like (see also 6.16.1).

Amdt 4

6.16.4.1 Heating and cooling

6.16.4.1.1 Dedicated circuits shall be provided for fixed space heating and cooling (air-conditioning units) that are rated at more than 16 A. There may be more than one unit on each circuit and the power supply to each unit shall be controlled by a switch-disconnector.

6.16.4.1.2 In the case of a space heater, the switch-disconnector shall be fitted either on the space heater or in the same room. A heater with exposed live parts shall be mounted out of arm's reach from the floor.

6.16.4.2 Underfloor heating

Amdt 4

6.16.4.2.1 The circuit that supplies underfloor heating shall be protected by an earth leakage protection device that has a rated earth leakage tripping current (rated residual current) $I_{\Delta n}$ not exceeding 30 mA.

Amdt 5

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6.16.4.2.2 The cables used to terminate underfloor heating shall be

Amdt 4; amdt 5

- a) metal sheathed, or
- b) double insulated, or
- c) cables with reinforced insulation.

Amdt 5

6.16.4.2.3 Heating elements installed under a wooden floor or under a carpet shall be covered by a metallic sheath (screened), which shall be connected to earth.

Amdt 5

6.16.5 Motors

NOTE Motors include the motors in automatic doors and gates, garbage disposal units, pumps (pool, fountain, spa, etc.), and the like (see also 6.16.1).

Amdt 4

6.16.5.1 Motor protection and control

Amdt 1

6.16.5.1.1 Deleted by amendment No. 1.

6.16.5.1.2 In addition to the requirements of 6.7, the circuit that supplies a motor shall have overcurrent protection unless the motor

- a) forms part of equipment that has built-in overcurrent protection, or
- b) has an integral thermal protector with an accessible reset button, or
- c) has an automatic resetting thermal protector and there is no likelihood of mechanical damage or of injury to persons when the motor restarts, or
- d) is of a high impedance type that can stall without overheating (such as the motor of an electric clock).

6.16.5.1.3 The overcurrent protective device shall

- a) have a tripping value that is as near to the full load rated current of the motor as is practicable,
- b) have sufficient time delay to allow the motor to start and accelerate under normal conditions,
- c) prevent a multiphase motor from continuing to operate under load if single phasing occurs, and
- d) in the case of an automatically controlled motor, have to be manually reset after operation before allowing automatic restarting of the motor.

6.16.5.1.4 Any manually operated device used to control a motor shall be readily accessible to the person who operates it.

7.1.3.2 Protection against electric shock

7.1.3.2.1 In zone 0, only protection by safety extra low voltage at nominal voltage not exceeding 12 V is permitted, the safety source being installed outside zone 0.

7.1.3.2.2 The measures of protection by means of obstacles and by placing equipment out of arm's reach are not permitted.

7.1.3.2.3 The measures of protection by non-conducting location and earth-free equipotential bonding are not permitted.

7.1.3.3 Supplementary equipotential bonding

A local supplementary equipotential bonding conductor shall connect all extraneous conductive parts in zones 1, 2 and 3 with the protective conductors of all exposed conductive parts in these zones.

7.1.4 Selection and erection of electrical equipment**7.1.4.1 Degrees of protection**

Electrical equipment shall have at least the following degrees of protection against ingress of water:

in zone 0 : IPX7;

in zone 1 : IPX5;

in zone 2 : IPX4;

in zone 3 : IP21; and

outside zone 3 in the same room : IP21, except for a distribution board : IPX5 (see 7.1.4.3.6).

7.1.4.2 Wiring systems

7.1.4.2.1 In zones 0, 1 and 2, wiring systems shall be limited to those necessary for the supply of appliances situated in these zones.

7.1.4.2.2 Junction boxes are not permitted in zones 0, 1 and 2.

7.1.4.3 Switchgear and controlgear

7.1.4.3.1 In zones 0, 1 and 2, no switchgear and accessories shall be installed except that emergency push buttons, which operate at a safety

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extra low voltage at nominal voltage not exceeding 12 V, are permitted in zones 1 and 2.

7.1.4.3.2 Insulating cords of cord-operated switches are permitted in zones 1 and 2, provided that the cord-operated switch complies with the requirements for switches (see table 4.2).

7.1.4.3.3 In zone 3, socket-outlets are permitted only if they are

- a) supplied individually by an isolating transformer that complies with SANS 61558-2-6/IEC 61558-2-6 (SABS IEC 61558-2-6), or
- b) supplied by safety extra low voltage (SELV) (see 5.7), or
- c) protected by an earth leakage protection device with a rated earth leakage tripping current (rated residual current) $I_{\Delta n}$ not exceeding 30 mA.

Amdt 3

7.1.4.3.4 Any switches and socket-outlets shall be at a distance of at least 0,60 m from the door opening of the prefabricated shower cabinet (see figures 7.1.4 and 7.1.5).

7.1.4.3.5 Where heating elements are installed in the water circulating system of a bath or a spa, the supply to the elements shall be interlocked with the circulating pump.

7.1.4.3.6 If a distribution board is installed in a room that contains a fixed bath or a shower, it shall be outside zone 3 and the enclosure shall have a degree of protection of IPX5 (see 6.6.1.7(a)).

7.1.4.4 Other fixed equipment

7.1.4.4.1 The following requirements do not apply to appliances at safety extra low voltage in accordance with the conditions of 5.7, 7.1.3.2 and 7.9:

- a) in zone 0, no fixed electrical equipment shall be installed;
- b) in zone 1, only water heaters may be installed; and
- c) in zone 2, only water heaters and class II luminaires may be installed.

7.1.4.4.2 Heating units embedded in the floor and intended for heating the location may be installed in zones 1, 2 or 3 provided **Amdt 5**

- a) the heating elements are covered by a metallic sheath (screened), or **Amdt 5**
- b) a metallic grid is installed above the heating elements, and **Amdt 5**

the sheath or grid is connected to the equipotential bonding specified in 7.1.3.3. Terminations shall comply with 6.16.4.2.2. **Amdt 4; amdt 5**

7.4.6.4 A circuit-breaker rated in accordance with the anticipated diverse load, and with a symmetrical short-circuit breaking capacity commensurate with the prospective symmetrical fault current shall be installed at the source end. Rating and timing shall be set to provide protection but avoiding spurious trips caused, for example, by sub-transient inrush currents on motor starting.

7.4.6.5 The metalwork shall be protected against corrosion and the damage expected under site conditions. The final finish shall be orange.

7.4.6.6 Isolating devices shall be suitable for securing in the off position (for example, a padlock or location inside a lockable enclosure).

7.4.6.7 The distribution board shall contain

- a) one or more multi-element robust LED indicator lamps per phase to show that the board is alive. HRC fuses or correctly rated circuit-breakers within the board shall protect these lamps,
- b) where required, four-pin (three-phase and earth) welding socket-outlets, typically 63 A rating, each of which shall be protected by a circuit-breaker and 30 mA earth leakage protection,
- c) where required, three-pin (phase neutral and earth) welding socket-outlets rated at 32 A with associated circuit-breakers and 30 mA earth leakage protection. This shall particularly be provided for portable single-phase welding sets, and
- d) switched socket-outlets (16 A), connected in pairs to individual single-pole 20 A combined circuit-breakers and 30 mA earth leakage protection of sufficient number.

7.4.6.8 The circuit-breakers and associated earth leakage relays referred to in 7.4.6.7(b), (c) and (d) shall be provided as combined units to reduce the possibility of the sensors being bypassed.

7.4.6.9 A sufficient number of the different types of socket-outlets to suit the circumstances shall be installed.

7.4.6.10 When live single-core conductors go through **Amdt 5**

- a) electrically conductive material, measures shall be taken to minimize eddy current heating, or **Amdt 5**
- b) magnetic material, measures shall be taken to avoid hysteresis losses. **Amdt 5**

7.4.6.11 The cabinet size shall allow the door to be comfortably closed with the largest plugs inserted in the socket-outlets. The bending radius of the trailing cable shall be safe and grommetted slots shall be provided on the return lip of the door.

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(As amended 2005)

7.5 Agricultural and horticultural locations

NOTE 1 Agricultural locations are rooms or areas where livestock are kept and include kennels, SPCA premises, stables for cattle, pigs, horses, sheep, game and goats, and chicken-houses and the like including adjacent rooms (e.g. feed-processing locations, milking machine locations, milk-storage rooms).

Amdt 4

NOTE 2 Horticultural locations are greenhouses, nurseries and the like.

Amdt 4

7.5.1 General

7.5.1.1 The design of an installation for agricultural and horticultural locations should make particular allowances for the environmental conditions and the need for earthing and bonding.

7.5.1.2 In agricultural and horticultural locations, socket-outlets shall be mounted at least 1 m above floor level.

7.5.1.3 Except for wireways, all electrical equipment shall be inaccessible to, or protected from, livestock. Cables shall be mechanically protected (kick pipes) for at least 1,5 m above the floor level.

7.5.1.4 Where animals are fed and where vermin is likely to be, wireways shall be vermin-proof and barriers shall be installed to prevent vermin passage should they enter the wireway. PVC wireways and PVC insulated conductors shall not be accessible.

7.5.1.5 Suspended electrical equipment (for example, luminaires, heaters, etc.), including the cables themselves, shall be so supported that conductors or cables are not strained. In the case where such suspended equipment is less than 1,5 m above the floor, it shall have a rating of IP35.

7.5.1.6 Cattle feed dust is explosive and areas where such dust is generated are classified as hazardous areas. The electrical installation in these areas shall comply with 7.14.

7.5.2 Supplementary equipotential bonding

In locations used for animals, supplementary equipotential bonding shall connect all exposed conductive parts and extraneous conductive parts, which can be touched simultaneously, to the protective conductor of the installation. If a metallic grid is laid in the floor, it shall be connected to the local supplementary bonding.

7.9.3.2.2 Each secondary circuit of a safety extra low voltage (SELV) supply source (transformer or convertor) shall have overcurrent protection (see 6.7.1 and 6.7.2). The overcurrent protection may be either by a common protective device, or a protective device for each SELV circuit.

NOTE A circuit-breaker installed in the secondary circuit is not regarded as a distribution board and may be installed in an accessible position in the roof space.

Amdt 5

7.9.3.2.3 A protective device shall be readily accessible unless it is built into the supply source and is of the automatic resetting type.

7.9.3.2.4 Secondary overcurrent protection is not required where the maximum output of the SELV transformer is 50 VA, the secondary circuit conductor is at least 1,5 mm², not exceeding a length of 2,5 m, and at least one conductor and its terminals are insulated to prevent a short circuit.

Amdt 1

7.9.3.3 Protection against fire risk

7.9.3.3.1 Mounting of luminaires

7.9.3.3.1.1 For the selection of luminaires with regard to their thermal effect on the surroundings, the following features shall be taken into account:

- a) the maximum permissible power dissipated by the lamps;
- b) fire resistance of adjacent material
 - at the point of installation; and
 - in the thermally affected areas; and
- c) minimum distance to combustible materials, including materials in the path of a spotlight beam.

7.9.3.3.1.2 Depending on the fire resistance of the material at the point of installation and in thermally affected areas, the manufacturer's installation instructions shall be followed. Marked luminaires shall be selected and installed according to the marking instructions.

7.9.3.3.1.3 At least 200 mm of the conductors leading from an ELV lamp holder shall be 180 °C (class H) flexible conductors such as silicon-rubber-insulated conductors. The lamp holder shall also be suitable for an operating temperature of at least 180 °C.

Amdt 3

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7.9.3.3.1.4 The ELV power source shall not be installed above the lamp or within 200 mm from the lamp to any side unless a heat barrier is installed between the lamp and the power source.

7.9.3.3.2 Fire risk by short circuit

At least one conductor and its terminals, for the part of the circuit between the transformer and the protective device, shall be insulated to prevent a short circuit.

7.9.4 Position of components

7.9.4.1 Primary terminals of the supply source shall be in an enclosure.

7.9.4.2 Cables shall be fixed in such a way as to prevent strain on the terminals or connectors.

7.9.4.3 Any SELV sources with a mass of more than 1 kg shall be fixed.

7.9.4.4 Transformers, protective devices or similar equipment mounted above false ceilings that are moveable, or easily accessible, or in a similar place, shall be mounted on a fixed part of the building such as a beam, and information shall be given about its presence and location.

7.9.4.5 If the identification of a protective device for a circuit is not immediately evident, a sign or diagram (label) close to the protective device shall identify the circuit and its purpose.

7.10 Stage and theatre equipment

7.10.1 General equipment and wiring

7.10.1.1 Resistors and dimmers that generate heat shall be supported on, and, where necessary, enclosed in, non-flammable material. Ventilation shall be used to prevent them from overheating.

7.10.1.2 Equipment that generates heat in excess of the safe touch temperature (see 5.1.2) shall be inaccessible to the public.

7.10.1.3 See 7.13.7.2 concerning autotransformers.

7.10.1.4 Arc lamps, other than those in projectors, shall be controlled by a multipole switch mounted on the frame that supports them.

- f) wine cellars,
- g) areas for the storage and filling of LPG cylinders,
- h) battery charging locations, and
- l) sewage plant.

7.15 Telecommunication d.c. power systems **Amdt 5****7.15.1 Selection of equipment and circuits** **Amdt 5**

7.15.1.1 All equipment and protection devices in d.c. installations shall be specified to operate on the specific d.c. voltages and shall be suitably rated. **Amdt 5**

7.15.1.2 Where batteries are used, protection devices and conductors suitable for the short-circuit current rating of the batteries shall be selected. **Amdt 5**

7.15.1.3 The live polarity is the polarity that is not connected to earth (positive on a negative-earth system, or negative on a positive-earth system); the earth or "O V" polarity is the polarity that is connected to earth. **Amdt 5**

7.15.1.4 The polarities shall be clearly marked with $\frac{\perp}{\equiv}$ and + or -. **Amdt 5**

7.15.2 Earthing **Amdt 5**

Earthing and bonding of power supply circuits for telecommunication systems shall comply with the following requirements: **Amdt 5**

- a) the "O V" (earth) polarity of each d.c. power system of a telecommunication system shall be bonded with a solid connection to an earthing terminal at the point of supply of the d.c. power plant, which shall be the main earthing terminal; **Amdt 5**
- b) if an earth electrode is required, it shall comply with the requirements of SANS 1063, be installed in accordance with SANS 10199 and be bonded to the main earthing terminal of the electrical installation; **Amdt 5**
- c) the main earthing terminal shall be bonded to the consumer's earth terminal (see also 6.11); **Amdt 5**
- d) the common bonding network shall be bonded to the main earthing terminal at least at one point; **Amdt 5**

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- e) all accessible conductive parts of the installation (rectifier cabinets, equipment racks and cabinets, enclosures, grids, wire-ways, etc.) shall be bonded to the common bonding network; and **Amdt 5**
- f) the d.c. return path in its entire length shall be capable of carrying overcurrents in the case of a fault between a live power conductor of the secondary supply and the common bonding network; **Amdt 5**

NOTE 1 Earthing of telecommunication installations is multifunctional and used for the following purposes: **Amdt 5**

- a) electrical protection; **Amdt 5**
- b) protection against lightning and surges; **Amdt 5**
- c) to provide a reference plane for signalling; and **Amdt 5**
- d) to comply with EMC requirements. **Amdt 5**

NOTE 2 The earthing practices in telecommunication d.c. power systems deviate significantly from the earthing standards given in this part of SANS 10142. Main points of deviation are **Amdt 5**

- a) the multiple earthing or bonding connections to current-carrying conductors at points beyond the point of control, and **Amdt 5**
- b) the current that flows in the protective earth bonding conductors, and in all metallic parts bonded to the system. Correct sizing of power conductors generally minimizes this. **Amdt 5**

7.15.3 Overcurrent protection **Amdt 5**

An overcurrent protective device shall be installed at both ends of the conductor between the live terminals of the battery and the battery charger and as close as practically possible to the terminals. For overcurrent protection of other circuits, see 6.7.1. **Amdt 5**

7.15.4 Disconnection (See also 6.9) **Amdt 5**

7.15.4.1 In an earthed d.c. installation where one of the polarities is connected to earth, all switch-disconnectors and protective devices shall break the live polarity only. The return circuit shall not be disconnected or broken. **Amdt 5**

7.15.4.2 Each group of telecommunication equipment, racks or cabinets shall have a disconnecting device to disconnect the d.c. power supply to the entire group. The disconnecting device shall be mounted **Amdt 5**

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- a) within arm's reach from the terminals of the racks or cabinets, or **Amdt 5**
- b) in a distribution board, if the devices are capable of being locked in the open position. **Amdt 5**

7.15.4.3 The d.c. power supply to every telecommunication equipment rack or cabinet shall be controlled by its own switch-disconnector. Where the disconnecting device is on the rack or cabinet, a separate disconnecting device shall be mounted in the fixed installation to allow for the total removal of the rack or cabinet. **Amdt 5**

7.15.5 Distribution boards (See also 6.6) **Amdt 5**

The provisions of 6.6 shall apply. **Amdt 5**

7.16 Earthing of d.c. circuits

Deleted by amendment No. 5.

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8.5.1 Obtain the estimated prospective short-circuit current (PSCC) at the point of supply or control from the supplier of electricity. **Amdt 5**

NOTE In the case of existing installations, determine whether the transformer capacity has been changed, since such change can affect the kA rating of the switchgear. **Amdt 1**

8.5.2 Alternatively, for supply systems rated at not more than 250 V to earth, measure the PSCC at the point of supply or control with a commercially available instrument (fault current meter), but do not use such an instrument where the current rating at the main switch disconnector is more than 100 A. **Amdt 5**

NOTE Do not measure three-phase PSCC if the meter is not specifically designed for that purpose.

CAUTION Verify the accuracy of the PSCC instrument with the manufacturer. **Amdt 5**

8.5.3 Information on three-phase PSCC can also be obtained from graphs, tables and computer programs, suppliers of equipment, or can be calculated using the following formula:

$$\text{PSCC} = \frac{V}{\sqrt{3} \times Z_{\text{total}}}$$

where

V is the phase-to-phase voltage, in volts;

Z_{total} is the total impedance of the upstream network, in ohms (including, for example, the source transformer impedance and the impedance of a phase conductor).

8.5.4 The source transformer impedance can be calculated using the following formula:

$$Z_{\text{transformer}} = \frac{V^2}{P \times 10^3} \times \frac{Z_{\%}}{100}$$

where

$Z_{\text{transformer}}$ is the source transformer impedance, in ohms;

P is the power of the transformer, in kilovolt amperes;

$Z_{\%}$ is the rated short-circuit impedance voltage of the transformer, expressed as a percentage.

8.5.5 A.C. circuits

In a.c. circuits the impedance of a phase conductor can be calculated using the following formula:

$$Z_{\text{conductor}} = \frac{L \sqrt{R^2 + X^2}}{1\,000}$$

where

$Z_{\text{conductor}}$ is the impedance of the phase conductor, in ohms;

L is the length of the cable, in metres;

R is the conductor resistance, in ohms per kilometre (see table E.1);

X is the conductor reactance, in ohms per kilometre (see table E.1).

NOTE This calculation gives practical and conservative results.

8.5.6 D.C. circuits

8.5.6.1 In d.c. installations where a back-up source of power is provided (such as a battery), all sources shall be taken into account when calculating the prospective short-circuit current (PSCC).

8.5.6.2 Obtain the estimated prospective short-circuit current of the rectifiers and d.c. generators from the suppliers of the equipment.

8.5.6.3 The prospective short-circuit current of batteries can be calculated using the following formula:

$$\text{PSCC} = \frac{E_B}{R_{\text{BBR}}} \text{ A}$$

where

E_B is the open-circuit voltage of the batteries; if this information is not known, then use

$$E_B = 1,05 \times U_{\text{NB}} \text{ V (where } U_{\text{NB}} = 2,0 \text{ V/cell);}$$

R_{BBR} is the total resistance of the upstream network, in ohms, including the internal resistance of the battery and the resistance of the conductors;

$$R_{BBR} = 0,9 \times R_B + R_{BL} + R_Y \ \Omega \text{ (see figure 8.1);}$$

R_B is the internal resistance of the battery;

R_{BL} is the resistance of the battery connections;

R_Y is the resistance of the conductors.

NOTE The internal resistance of the battery can be obtained from the manufacturer's data.

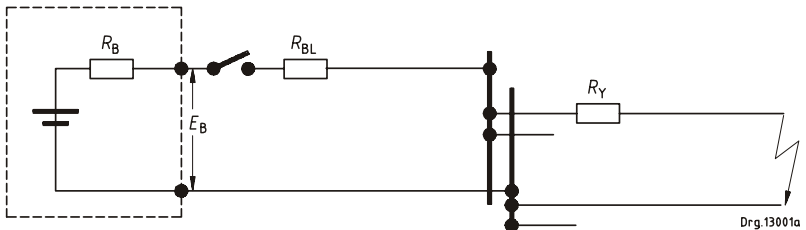


Figure 8.1 — Resistance components in a battery power source circuit

8.5.6.4 Alternatively the estimated PSCC at the battery terminals, as supplied by the manufacturer of the battery, may be used.

8.6 Inspection

8.6.1 Normally, inspection precedes testing and should be done with the installation isolated. Inspect the installation to confirm that equipment has been selected and installed in accordance with this part of SANS 10142 (SABS 0142) and that equipment it is not so damaged as to impair safety.

8.6.2 Complete the inspection table in the CoC by confirming the statements with "Yes" in the appropriate block. "No" answers to any of the statements will prevent the issuing of the Certificate.

8.6.3 During the inspection, ensure that

- a) accessible components are correctly selected,

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- b) all protective devices are of the correct rating and capable of withstanding the prospective short-circuit current,
- c) conductors are of the correct rating and current-carrying capacity for the protective devices and connected load,

Pay attention to voltage rating, voltage drop, current-carrying capacity and short-circuit capacity.

- d) components have been correctly installed, and are accessible where necessary,
- e) disconnecting devices (isolators) are correctly located and that all switchgear switches the phase conductors,
- f) different circuits are separated electrically. Circuits for control communication, security, detection, safety and the like should be electrically separated and, where specified, physically separated,
- g) connections of conductors and earthing and bonding are mechanically sound and electrically continuous,
- h) circuits, fuses, switching devices, terminals, earth leakage units, circuit-breakers and distribution boards are correctly and permanently identified, marked or labelled,

Pay attention to installations where circuit-breakers are used in series-connected (cascaded) systems.

- i) fire barriers have been erected and other precautions have been taken against the spread of fire or the effects of heat. Where an electrical system passes through a fire barrier, the integrity of the fire barrier has to be maintained,
- j) safety lighting, emergency lighting and safety signs function correctly,
- k) except for installations that existed before October 1992, the installation, including all accessible components, complies with this part of SANS 10142 (SABS 0142), and
- l) in the case of installations that existed before October 1992, the installation complies with the fundamental requirements of this part of SANS 10142 (SABS 0142) and is reasonably safe. **Amdt 5**

8.7 Testing

Certain tests shall not be carried out in hazardous locations. Due to the characteristics of the intrinsic safety features of equipment, such equipment can be damaged by certain tests. Certain tests might be impractical in existing installations already under power.

Amdt 5

8.7.1 General

For the testing of installations that are fully or partially in hazardous or specialized locations, see the relevant standards, and complete the supplementary form (see 8.8.2 for medical locations and 8.8.3 for hazardous locations).

For cases where multiple tests are required, record the worst-case measurement on the CoC.

In the case of failure in any test, the test shall be repeated after the fault has been rectified. Other tests that might have been influenced by the fault shall also be repeated.

Measuring instruments shall be accurate to within 5 % or better.

8.7.2 Continuity of bonding

Amdt 4

Test the continuity of the bonding between the consumer's earth terminal and all exposed conductive parts using a supply that has a no-load d.c. or a.c. voltage of 4 V to 24 V, and a current of at least 0,2 A. In each case, the resistance shall not exceed 0,2 Ω .

Amdt 4

8.7.3 Resistance of earth continuity conductor

Use a resistance meter to measure the resistance of the earth continuity conductors between the consumer's earth terminal and the earthing terminals of all points of consumption and switches. The values shall not exceed those given in table 8.1.

Table 8.1 — Maximum resistance of earth continuity conductor

1	2
Rated current of protective device	Maximum resistance of earth continuity path
A	Ω
6,3	1,7
10	1,1
16	0,70
20	0,55
25	0,53
32	0,41
40	0,33
50	0,26
63	0,24
80	0,19
100	0,14
125	0,12
160	0,096
200	0,077
250	0,062
315	0,049
NOTE	In the case of metallic roofs, gutters, down pipes and waste pipes (see 6.13.2.4), the resistance of the earth continuity path shall not exceed 0,2 Ω .

All socket-outlets shall be tested by inserting a plug and including the resistance of the earth pin in the measurements.

8.7.4 Continuity of ring circuits

Remove both ends of each live conductor, separate them and test the circuit for continuity. Ensure that the two ends of the live conductor are connected to the same terminal after the test (see 6.6.1.13).

8.7.5 Earth fault loop impedance at the main switch

8.7.5.1 At the main switch, the impedance shall be such that an earth fault current double the rated current (or higher) of the main protective device automatically disconnects the supply to the installation. Table 8.2 indicates the earth fault loop circuits for different distribution systems.

Certificate of Compliance for all electrical installations

CERTIFICATE NO.	Date of issue:
CERTIFICATE OF COMPLIANCE for ELECTRICAL INSTALLATIONS to SANS 10142-1 (SABS 0142-1)	
<div style="border: 3px double black; padding: 5px; margin-bottom: 10px;">NOTE 1 In terms of South African legislation, the user or lessor is responsible for the safety of the electrical installation</div> <p>NOTE 2 This certificate covers only the part of the installation described in section 3. NOTE 3 This certificate covers the circuits for fixed appliances, but does not cover the actual appliances, for example stoves, geysers, air conditioning and refrigeration plant and lights. NOTE 4 Medical and hazardous locations require additional Certificates (see 8.8.2 and 8.8.3). NOTE 5 Enter the required information or tick the appropriate block.</p>	
SECTION 1 – LOCATION	
Physical address:	
Name of building:	
Pole number (if applicable):	Other names or numbers:
Erf/Lot No. :	Suburb/Township:
District/Town/City:	Province:

Amdt 3

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Certificate of Compliance *(continued)***SECTION 2 – INSTALLATION**

Existing certificate: No. Yes Date issued: Number:

Existing installation Alteration/extension New installation Temporary installation

Type of installation: Domestic Commercial Industrial Sectional title

Other

Estimated year of original installation:.....

Type of electricity supply system:

Supply earth terminal provided: TN-S TN-C-S TN-C TT IT

Yes No

Characteristics of supply:

Voltage: 230 V 400 V 525 V Other:

Number of phases: One Two Three

Phase rotation: Clockwise Anticlockwise

Frequency: 50 Hz Other:.....

Prospective short-circuit current at point of control: kA d.c.

How determined? Calculated Measured From supplier

Main switch type:

Switch disconnector (on-load isolator) Fuse switch Circuit-breaker

Earth leakage circuit-breaker Earth leakage switch disconnector

Number of poles: Current rating: Short-circuit/withstand rating:

Rated earth leakage tripping current $I_{\Delta n}$: 30 mA Other:

Surge protection : Yes No

Is any part of the installation a specialized electrical installation? No Yes

If yes, complete additional Certificate (see 8.8.2 or 8.8.3).

Amdt 1; amdt 3; amdt 5

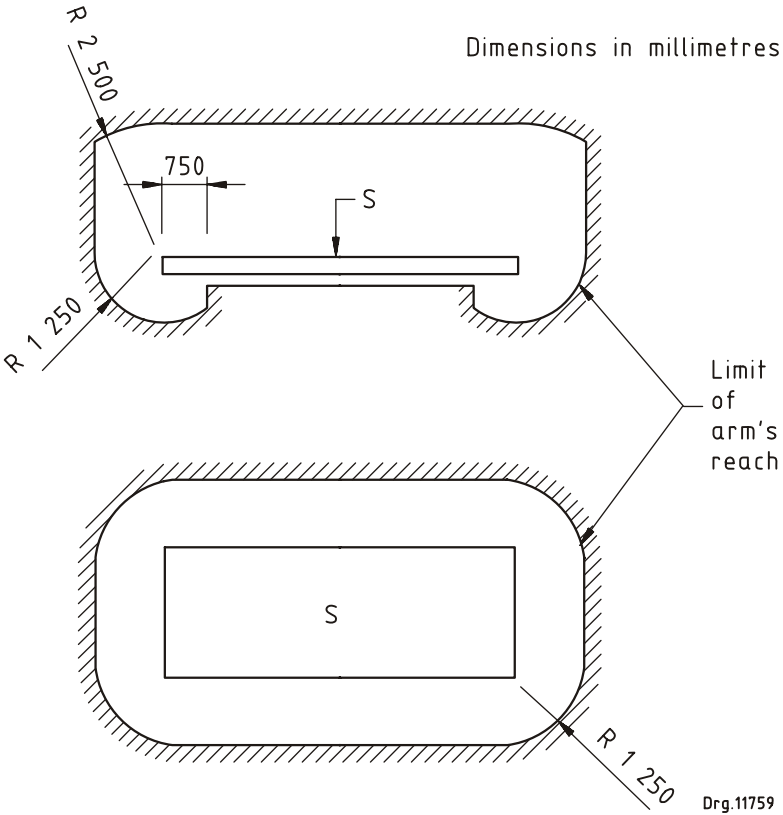
Annex A
(normative)

Deleted by amendment No. 5.

Pages 294 to 297 have been deleted by amendment No. 5.

Annex B
(informative)

Limits of "arm's reach"

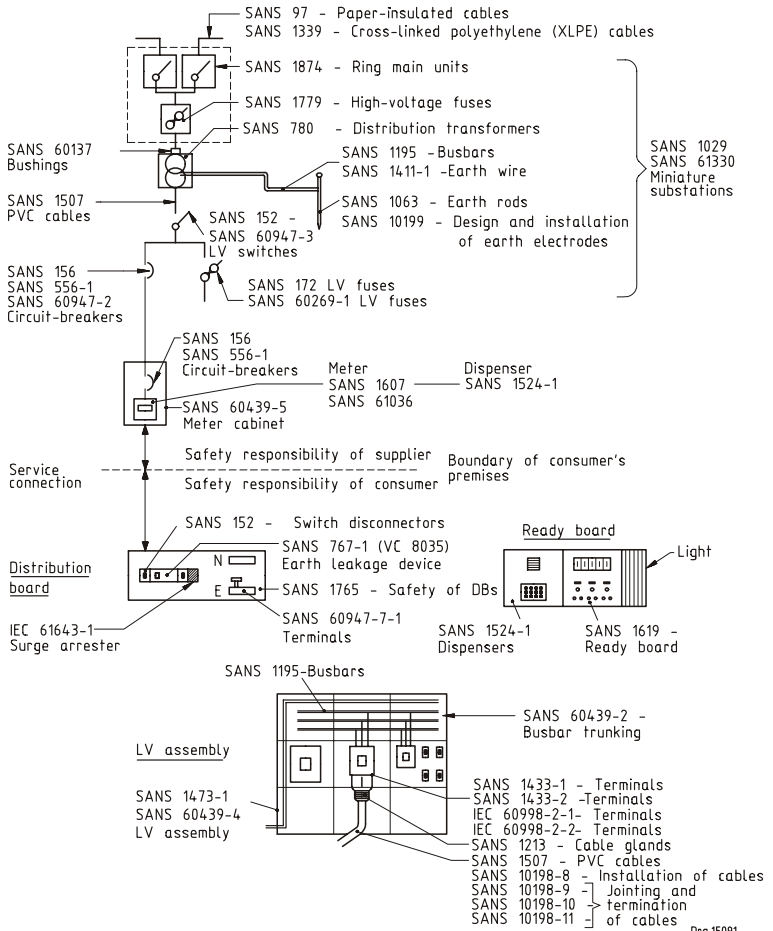


S is the surface expected to be occupied by persons.

Figure B.1 — Limits of arm's reach

Annex C
(informative)
Installation components

C.1 Installation components — Standards for service connections



NOTE For equivalent SABS numbers of SANS standards, see clause 2.

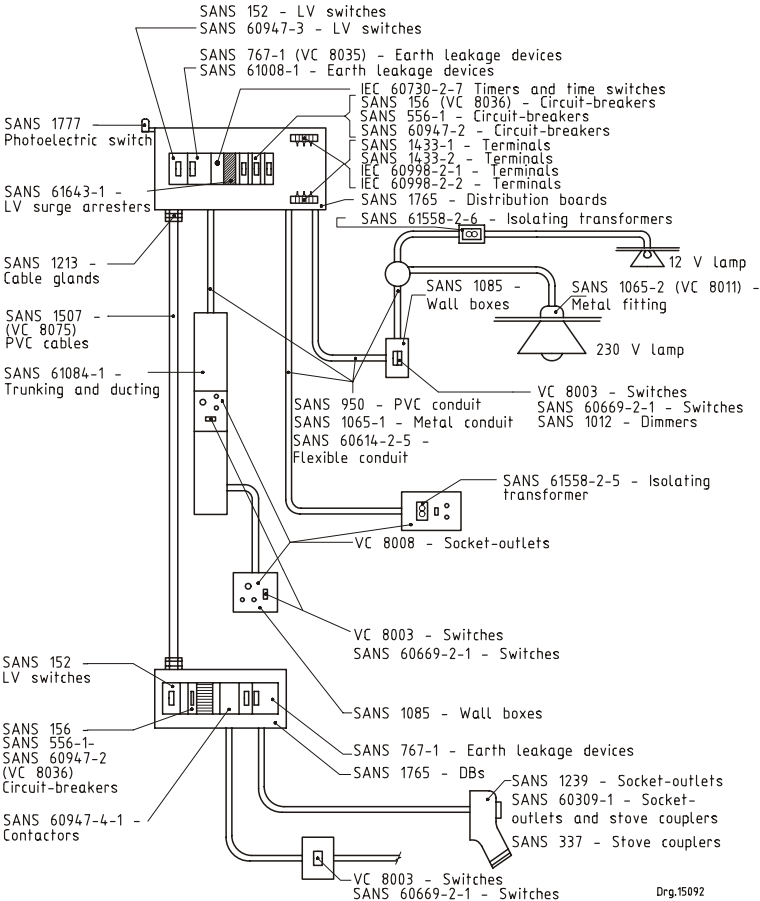
Amdt 1; amdt 4; amdt 5

Figure C.1 — Installation components up to the main distribution board
(See table 4.2 – High-voltage equipment not included)

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C.2 Installation components — Standards for fixed electrical installations



NOTE For equivalent SABS numbers to SANS standards, see clause 2.

Amdt 4; amdt 5

Figure C.2 — Installation components from the point of control to the point of consumption
 (See table 4.2)

Annex E
(informative)

Calculation of voltage drop

E.1 The calculation of voltage drop

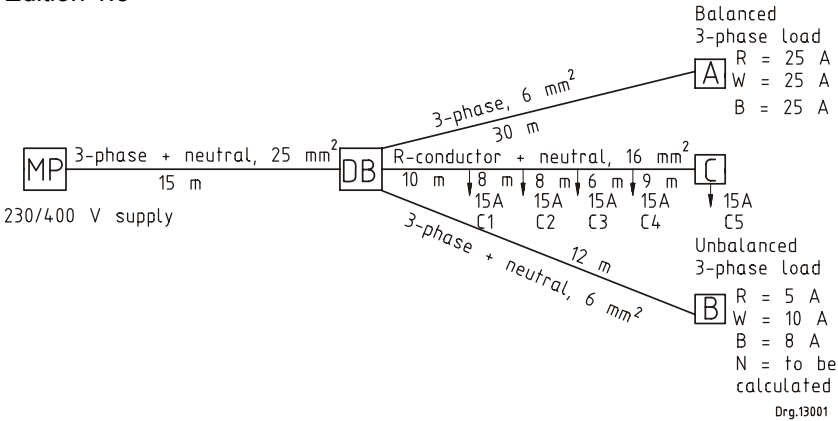
E.1.1 Example of determining the voltage drop due to specific loads by using the tables 6.2 to 6.9

Calculate the voltage drop at each point of consumption indicated in figure E.1 and determine if the cable selection is correct.

Assume the following case:

Multicore armoured PVC insulated cables are installed and buried directly in the ground. The following example assumes that the cables stated will result in a total voltage drop of less than 5 %.

Amdt 5



MP is the meter point

DB is the distribution board

A is a balanced three-phase load (point of consumption) **Amdt 5**

B is an unbalanced three-phase load (point of consumption) **Amdt 5**

C is a single-phase circuit feeding different loads at different points **Amdt 5**

(Maximum loads are indicated at each point of consumption – C1 to C5) **Amdt 5**

NOTE 1 All conductors are copper.

NOTE 2 Phase and neutral conductors have the same nominal cross-sectional area.

NOTE 3 All circuits are fully loaded and at unity power factor to represent the worst-case voltage drop. **Amdt 5**

NOTE 4 In the case of single-phase circuits, the return path has been accounted for in the values given in tables 6.2(b), 6.3(b), 6.4(b), 6.5(b), 6.6(b), 6.7(b) and 6.9(b). **Amdt 5**

NOTE 5 The effect of voltage drop due to harmonic current has not been considered. **Amdt 5**

Figure E.1 — Example of voltage drop calculation for a cable installation with specific loads

E.1.2 Circuit DB/A

Consider the 25 A balanced load: **Amdt 5**

From table 6.8 (current-carrying capacity for PVC insulated armoured copper cables buried in the ground), the 6 mm² cable selection is in order. **Amdt 5**

From table 6.4(b) (voltage drop), for a 6 mm² three-core cable, the voltage drop is 6,4 mV/A/m.

Calculate the cable voltage drop per phase :

Amdt 5

Voltage drop = $mV/A/m \times A \times m$

$$= (6,4 \times 10^{-3}) \times 25 \times 30$$

$$= 4,8 \text{ V}$$

Amdt 5**Amdt 5****E.1.3 Circuit DB/B**

E.1.3.1 Calculate the voltage drop for each current-carrying conductor.

E.1.3.2 Calculate voltage drop per phase.

Amdt 5

From table 6.4(b) (voltage drop), for a 6 mm² four-core cable, the voltage drop is 6,4 mV/A/m. Due to the unbalanced load, treat each phase as a single-phase circuit.

Amdt 5

$$\begin{aligned} \text{Red phase} &= (6,4 \times 10^{-3}) \times 5 \times 12 = 0,384 \text{ V} \\ \text{White phase} &= (6,4 \times 10^{-3}) \times 10 \times 12 = 0,768 \text{ V} \\ \text{Blue phase} &= (6,4 \times 10^{-3}) \times 8 \times 12 = 0,614 \text{ V} \end{aligned}$$

The voltage drop DB to B (worst case in the white phase) = 0,768 V **Amdt 5**

The voltage drop DB to B in the red phase = 0,384 V

Amdt 5

E.1.3.3 Calculate the neutral current:

Amdt 5

$$\begin{aligned} I_n &= \sqrt{[R^2 + W^2 + B^2] - [(RW) + (RB) + (BW)]} \\ &= \sqrt{[5^2 + 10^2 + 8^2] - [(5 \times 10) + (5 \times 8) + (10 \times 8)]} \\ &= \sqrt{[25 + 100 + 64] - [50 + 40 + 80]} \\ &= \sqrt{189 - 170} \\ &= \sqrt{19} \\ &= 4,4 \text{ A} \end{aligned}$$

Amdt 5**E.1.4 Circuit DB/C**

Selected cable voltage drop to be repeated for each load point from the previous load point. **Amdt 5**

From table 6.4(b) (voltage drop), for a 16 mm² two-core cable single-phase a.c., the voltage drop is 2,8 mV/A/m

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DB to C1 voltage drop	$= (2,8 \times 10^{-3}) \times (5 \times 15) \times 10$	$= 2,10 \text{ V}$	Amdt 5
C1 to C2 voltage drop	$= (2,8 \times 10^{-3}) \times (4 \times 15) \times 8$	$= 1,34 \text{ V}$	Amdt 5
C2 to C3 voltage drop	$= (2,8 \times 10^{-3}) \times (3 \times 15) \times 8$	$= 1,01 \text{ V}$	Amdt 5
C3 to C4 voltage drop	$= (2,8 \times 10^{-3}) \times (2 \times 15) \times 6$	$= 0,50 \text{ V}$	Amdt 5
C4 to C5 voltage drop	$= (2,8 \times 10^{-3}) \times (1 \times 15) \times 9$	$= 0,38 \text{ V}$	Amdt 5
Total voltage drop DB to C5 (red phase)		$= 5,33 \text{ V}$	Amdt 5

[1]

Consider the total load at DB of the three loads (A + B + C)

Red phase	$= 25 + 5 + (5 \times 15)$	$= 105 \text{ A}$	Amdt 5
White phase	$= 25 + 10 + 0$	$= 35 \text{ A}$	Amdt 5
Blue phase	$= 25 + 8 + 0$	$= 33 \text{ A}$	
Neutral	$= 0 + 4,4 + (5 \times 15)$	$= 79,4 \text{ A}$	

E.1.5 Circuit MP/DB

Assume that it is a balanced three-phase load and the current in all phases is equal to the highest of the three unbalanced phases. Consider the worst case, which is the red phase for the circuit MP/DB. **Amdt 5**

From table 6.4(b) (voltage drop), for a 25 mm² four-core cable the voltage drop is 1,5 mV/A/m

$$\begin{aligned} \text{Voltage drop} &= \text{mV} \times \text{A} \times \text{m} \\ &= (1,5 \times 10^{-3}) \times 105 \times 15 = 2,363 \text{ V} \end{aligned} \quad \text{Amdt 5}$$

$$\begin{aligned} \text{Voltage drop for red phase} &= \frac{2,363}{\sqrt{3}} \\ &= 1,364 \text{ V} \end{aligned} \quad \begin{array}{l} \text{Amdt 5} \\ \text{Amdt 5} \end{array}$$

[2]

NOTE For phase-to-neutral voltage drop, see 6.2.7.1.1. **Amdt 5**

Because the voltage drop will be across both the phase and neutral in the single-phase circuit, both these shall be considered.

The maximum voltage drop (worst case) for the red circuit	$[(1)] + [(2)]$	Amdt 5
	$= 5,33 + 1,364$	Amdt 5
	$= 6,694 \text{ V}$	Amdt 5

E.1.6 Total circuit **Amdt 5**

A maximum of 5 % of 230 V or 11,5 V is allowed in the single-phase circuit. The cable selection was correct.

NOTE The 25 mm² cable size cannot be reduced as the maximum rating of a 16 mm² cable is 91 A and the load in the red phase is 105 A. **Amdt 5**

Table E.1 – Impedance of 600/1 000 V conductors that comply with SANS 1507 (SABS 1507)

Ambient temperature: 30 °C

Conductor operating temperature: 70 °C

1	2	3	4	5	6	7
Nominal cross-sectional area of conductor mm ²	Conductor resistance <i>R</i> for a.c. circuits Ω/km		Conductor reactance <i>X</i> for a.c. circuits Ω/km		Conductor resistance <i>R</i> for d.c. circuits Ω/km	
	Material of conductor					
	Copper Cu	Aluminium Al	Copper Cu	Aluminium Al	Copper Cu	Aluminium Al
1	21,9	36,0	0,107	0,107	21,9	36,0
1,5	14,6	24,0	0,100	0,100	14,6	24,0
2,5	8,7	14,4	0,095	0,095	8,7	14,4
4	5,5	9,0	0,093	0,093	5,5	9,0
6	3,6	6,0	0,090	0,090	3,6	6,0
10	2,2	3,6	0,084	0,084	2,2	3,6
16	1,4	2,3	0,080	0,080	1,4	2,2
25	0,88	1,44	0,079	0,079	0,87	1,44
35	0,63	1,03	0,076	0,076	0,62	1,03
50	0,44	0,72	0,076	0,076	0,44	0,72
70	0,31	0,52	0,074	0,074	0,31	0,51
95	0,23	0,38	0,073	0,073	0,23	0,38
120	0,18	0,30	0,072	0,072	0,18	0,30
150	0,15	0,24	0,072	0,072	0,15	0,24
185	0,12	0,20	0,072	0,072	0,12	0,19
240	0,095	0,156	0,072	0,072	0,091	0,150
300	0,077	0,127	0,071	0,071	0,073	0,120
400	0,060	0,099	0,071	0,071	0,055	0,090
500	0,050	0,083	0,070	0,070	0,044	0,072
630	0,043	0,071	0,069	0,069	0,035	0,057
800	0,037	0,061	0,058	0,058	0,027	0,045
1 000	0,033	0,054	0,049	0,049	0,022	0,036

E.2 Alternative calculation of voltage drop

E.2.1 The resistance and reactance values for copper and aluminium conductors of various cross-sectional areas listed in table E.1 can be used in the following formulae to calculate the voltage drop. Alternatively, the maximum length of a circuit before the permissible voltage drop would be reached can be calculated. Examples of calculated maximum current lengths are given in table E.2. The values in tables E.1, E.2 and E.3 are average values for the purpose of easy calculations and can differ from the values determined by using the tables in clause 6 or from cable manufacturers' data.

E.2.2 In the case of the pure resistive load, the circuit voltage drop can be calculated from the following formula:

$$V_d = \frac{F_v \times I \times R \times L}{1\,000}$$

where

V_d is the voltage drop, in volts;

F_v is the multiplication factor determined from table E.3;

I is the current, in amperes;

R is the resistance, in ohms per kilometre;

L is the length, in metres.

E.2.3 In the case of a load with impedance, the circuit voltage drop can be calculated from the following formula:

$$V_d = \frac{F_v \times I \times (R \cos \varnothing + X \sin \varnothing) \times L}{1\,000}$$

The phase angle \varnothing of the load is determined by power factor = $\cos \varnothing$.

E.2.4 The voltage drop for a given current at unity power factor will in most cases represent the worst-case voltage drop.

E.2.5 The voltage drop of single-core cables can be improved by using a trefoil configuration.

E.2.6 The reactance (X) values for trefoil cables can be obtained from cable manufacturers.

WARNING: Use only for maximum lengths. For current-carrying capacity of cables and conductors, see 6.2

Table E.2(a) — Maximum lengths, in metres, of copper cables/circuits at a given circuit-breaker current rating for single phase ($F_V = 2$)

1	2	3	4	5	6	7	8	9	10
Nominal cross-sectional area mm ²	Circuit-breaker current rating A								
	10	15	20	25	30	40	50	60	80
1	26	–	–	–	–	–	–	–	–
1,5	39	26	–	–	–	–	–	–	–
2,5	66	44	33	26	–	–	–	–	–
4	104	69	52	41	34	–	–	–	–
6	159	106	79	63	53	39	–	–	–
10	261	174	130	104	87	65	52	43	–
16	410	273	205	164	136	102	82	68	51

NOTE 1 Power factor is unity.
 NOTE 2 Maximum permissible voltage drop between phases and neutral if full circuit-breaker loading is 5 % of 230 V, i.e. 11,5 V.
 NOTE 3 Only popular circuit-breaker ratings have been selected.

Table E.2(b) — Maximum lengths, in metres, of copper cables/circuits at a given circuit-breaker current rating for three-phase ($F_V = 1$ balanced)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Nominal cross-sectional area mm ²	Circuit-breaker current rating A																
	10	15	20	25	30	40	50	60	80	100	125	150	200	225	250	300	350
1	52	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1,5	78	52	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2,5	132	88	66	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4	209	139	104	83	69	–	–	–	–	–	–	–	–	–	–	–	–
6	319	212	159	127	106	79	–	–	–	–	–	–	–	–	–	–	–
10	522	348	261	209	174	130	104	–	–	–	–	–	–	–	–	–	–
16	–	547	410	328	273	205	164	136	–	–	–	–	–	–	–	–	–
25	–	–	660	528	440	330	264	220	165	–	–	–	–	–	–	–	–
35	–	–	–	741	618	463	370	309	231	185	–	–	–	–	–	–	–
50	–	–	–	–	–	653	522	435	326	261	209	174	–	–	–	–	–
70	–	–	–	–	–	–	741	618	463	370	296	247	–	–	–	–	–
95	–	–	–	–	–	–	–	–	625	500	400	333	250	222	–	–	–
120	–	–	–	–	–	–	–	–	798	638	511	425	319	283	255	–	–
150	–	–	–	–	–	–	–	–	–	766	613	511	383	340	306	255	–
185	–	–	–	–	–	–	–	–	–	–	766	638	479	425	383	319	273

Table E.3 – Multiplication factor F_V for the relevant circuit conditions

1	2
Type of supply and mode connection of load	Multiplication factor F_V
Direct current load across two conductors	2
Single-phase load between phase and neutral	2
Single-phase load between two phases only	2
Balanced three-phase load on all three phases, neutral unconnected	1
Three identical single-phase loads, one between each phase and connected neutral	1
Unbalanced loads between all three phases and connected neutral:	
a) unbalanced < 75 %	1
b) unbalanced > 75 %	2
Unbalanced loads between all three phases, neutral unconnected:	
a) unbalanced < 75 %	1
b) unbalanced > 75 %	1,2
NOTE If the voltage drop values are calculated using tables 6.2(b), 6.3(b), 6.4(b), 6.5(b), 6.6(b), 6.7(b) and 6.9(b), the multiplication factor F_V is not applicable.	

Amdt 5

Annex F (informative)

Recommended bending of cables

The values of radius of curvature given in table F.1 should be exceeded wherever possible.

Table F.1 — Minimum radius of curvature of cables








1	2	3	4
Type of cable	Type of sheathing	Diameter of cable mm	Minimum radius of curvature
PVC insulated, that complies with relevant requirements of SANS 1507 (SABS 1507)	Unsheathed	$d \leq 10$ $10 < d \leq 25$ $25 < d \leq 40$ $40 < d$	$3d$ $4d$ $6d$ $8d$
	Sheathed but unarmoured	–	$8d$
	Armoured	–	$10d$
Paper-insulated	Lead sheathed	–	$15d$
NOTE d is the overall diameter of the cable.			

Annex Q
(informative)

IEC symbols associated with switchgear

The following symbols are associated with switchgear. The marking of switchgear with these symbols is voluntary, except if prescribed in the product or in any mandatory specification.

Table Q.1 — IEC symbols for switchgear

1	2
Symbol	Description
	General symbol for switch
	Disconnecter (off-load isolator) provisionally used for other switchgear which has isolation properties
	Switch-disconnector (on-load isolator)
	Circuit-breaker
	Circuit-breaker, suitable for isolation
<div style="border: 1px solid black; padding: 2px; display: inline-block;">2,5 kA</div> or <div style="border: 1px solid black; padding: 2px; display: inline-block;">2 500</div>	Short-circuit rating (kA or A respectively)
	Live electrical apparatus
	Transformers

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Amdt 5

Annex R
(informative)

Example of the application of correction factors for harmonic currents

Consider a three-phase circuit with a design load of 39 A to be installed using a four-core PVC insulated cable clipped to a wall, installation method 1 (see table 6.1).

In table 6.3(a), a 6 mm² cable with copper conductors has a current-carrying capacity of 41 A and hence is suitable if harmonics are not present in the circuit.

If 20 % third harmonic is present, a correction factor of 0,86 (see table 6.18) is applied and the design load becomes

$$\frac{39}{0,86} = 45 \text{ A}$$

For this load a 10 mm² cable is suitable.

If 40 % third harmonic is present, the cable selection is based on the neutral current, which is

$$39 \times 0,4 \times 3 = 46,8 \text{ A}$$

and the correction factor of 0,86 (see table 6.18) is applied, leading to a design load of

$$\frac{46,8}{0,86} = 54,4 \text{ A}$$

For this load a 10 mm² cable is suitable.

If 50 % third harmonic is present, the cable size is again selected on the basis of the neutral current, which is

$$39 \times 0,5 \times 3 = 58,5 \text{ A}$$

In this case the rating factor is 1 and a 16 mm² cable is suitable.

All the cable selections in this annex are based on the current-carrying capacity of the cable only. Voltage drop and other aspects of design (such as other correction factors) have not been considered.