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TECHNICAL REPORT

RAPPORT TECHNIQUE

Electrical installation guide –
Part 52: Selection and erection of electrical equipment – Wiring systems

Guide pour les installations électriques –
Partie 52: Choix et mise en œuvre des matériels électriques – Canalisations

IEC/TR 61200-52:2013

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ELECTRICAL INSTALLATION GUIDE –

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FOREWORD

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IEC 61200-52, which is a technical report, has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock.

This second edition cancels and replaces the first edition, published in 1993, and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the scope has been modified; whilst the Guide does not form part of the IEC 60364 series, it serves as a supplement to IEC 60364-5-52:2009 and explains the rules so as to facilitate the design, selection, erection and maintenance of wiring systems;

b) guidance associated with conduit systems, cable ducting systems, cable trunking systems, cable tray systems and cable ladder systems has been added giving, for example, recommended maximum straight lengths of conduit to ease the installation circuit wiring;

c) guidance associated with selection and erection of wiring systems in relation to external influences has been extended to cover impact, and other mechanical stresses.

d) guidance for grouping of cables has been added.

e) guidance on maximum temperatures of terminals in normal service conditions has been extended;

f) guidance on the connection of multi wire, fine wire and very fine wire conductors has been added;

g) guidance on proximity of communication cables has been added;

h) guidance on cables in contact with thermal insulation has been added.

This technical report serves as a supplement to IEC 60364-5-52:2009 and follows the numbering of that standard.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
64/1875/DTR	64/1887/RVC

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

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

ELECTRICAL INSTALLATION GUIDE –

Part 52: Selection and erection of electrical equipment – Wiring systems

520 Introduction

520.1 Scope

This Technical Report serves as a supplement to IEC 60364-5-52:2009 and explains the rules so as to facilitate the design, selection, erection and maintenance of wiring systems.

It is written for everyone concerned with the design, the selection and supply of equipment, as well as the persons who install, maintain and use electrical installations.

520.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60227-4, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 4: Sheathed cables for fixed wiring*

IEC 60245-4, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 60364-4-43:2008, *Low-voltage electrical installations – Part 4-43 Protection for safety – Protection against overcurrent*

IEC 60364-5-51:2005, *Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules*

IEC 60364-5-52:2009, *Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

IEC 60502-1, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV (U_m = 1,2 kV) up to 30 kV (U_m = 36 kV) – Part 1: Cables for rated voltages of 1 kV (U_m = 1,2 kV) and 3 kV (U_m = 3,6 kV)*

IEC/TR 60890, *A method of temperature-rise assessment by extrapolation for partially type-tested assemblies (PTTA) of low-voltage switchgear and controlgear*

IEC/TR 60943, *Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals*

IEC 61084 (all parts), *Cable trunking and ducting systems for electrical installations*

IEC 61084-2-2, *Cable trunking and ducting systems for electrical installations – Part 2-2: Particular requirements – Cable trunking systems and cable ducting systems intended for underfloor and flushfloor installations*

IEC 61386 (all parts), *Conduit systems for cable management*

IEC 61386-21, *Conduit systems for cable management – Part 21: Particular requirements – Rigid conduit systems*

IEC 61386-22, *Conduit systems for cable management – Part 22: Particular requirements – Pliable conduit systems*

IEC 61386-23, *Conduit systems for cable management – Part 23: Particular requirements – Flexible conduit systems*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

521 Types of wiring system

521.6 Conduit systems, cable ducting systems, cable trunking systems, cable tray systems and cable ladder systems

The following includes recommendations to ease the installation, or replacement, of circuits installed in conduit.

a) Straight conduit lengths between access points should not exceed 25 m. Conduit lengths which include changes in direction should not exceed 15 m between access points. There should be no more than three changes in direction between access points.

b) The number of bends in any run should be minimized.

c) Any bending radius should be as large as possible and in accordance with the manufacturer's instructions.

d) The cables or insulated conductors should not occupy more than one-third of the total internal cross-sectional area of the conduit.

e) Conduit systems should be installed so as to minimize the mechanical stress on the conduit.

f) If conduit systems are to be installed outdoors, consideration should be given to the ambient temperature and effects of solar radiation as indicated in 522.1 and 522.11.

g) Where self-recovering conduit has to be embedded in concrete, consideration should be given to the possibility of permanent deformation of the cross-section of the conduit that might result in damage to the enclosed cables or insulated conductors. Where necessary, measures should be taken such as additional mechanical protection or the use of conduit having suitably increased diameter or resistance to compression.

When electrical accessories are mounted in trunking or ducting systems that are installed in or under a floor, the type of floor treatment likely to be used (wet or dry) should be taken into consideration.

Where cable trunking systems are installed in a skirting position (e.g. Item 6 of Table A52.3 of IEC 60364-5-52:2009), damage caused by the ingress of water can be avoided by placing the insulated conductors laid within at least 10 mm above the floor level.

Cable trunking systems and cable ducting systems intended for underfloor and flushfloor installations are covered by IEC 61084-2-2.

Where cable tray systems are used, the use of a cover can also be necessary, for example for mechanical protection or design reasons or preventing access (e.g. in the basin of public fountains).

522 Selection and erection of wiring systems in relation to external influences

522.4 Presence of solid foreign bodies (AE)

Cable management systems will not protect against ingress of solid foreign bodies unless they comply with a protection degree at least IP2X.

522.6 Impact

Trunking, ducting and conduit systems provide mechanical protection to the cable, but cable tray and cable tray with cover might not provide such mechanical protection, as, according to the product standard, they are not tested for this purpose.

522.8 Other mechanical stresses (AJ)

522.8.101 Reduction of the risk of short-circuit or earth fault

Where devices for short-circuit protection are placed in accordance with 434.2.1 of IEC 60364-4-43:2008, it is required that the conductors shall be installed so as to reduce the risk of a short-circuit to a minimum.

This implies that conductor arrangements should be made so as to minimize the risk of contact between the conductors and contact of live conductors with earthed parts and to provide protection against damage due to external influences (e.g. mechanical damage).

Examples of such arrangements are as follows:

a) Arrangement consisting of single-core cables in accordance with IEC 60502-1, single-core non-metallic sheathed cables in accordance with IEC 60227-4 or single-core rubber insulated and sheathed flexible cables in accordance with IEC 60245-4 and where the risk of mechanical damage is prevented.

b) Cables and rubber-insulated and sheathed flexible cables laid so that they are accessible but not in the vicinity of combustible materials and where the risk of mechanical damage is prevented.

c) Cables with non-metallic sheath installed in rigid, flexible or pliable conduits in accordance with IEC 61386-21, IEC 61386-22 or IEC 61386-23.

d) Cables with non-metallic sheath installed in trunking or ducting systems in accordance with the IEC 61084 series.

With regard to safety, an arrangement of cables or insulated conductors which could burn out without endangering their environment (e.g. buried cables) is considered to be equivalent to a circuit installed so as to reduce the risk of a short-circuit to a minimum.

522.11 Solar radiation (AN) and ultraviolet radiation

Where wiring systems are installed outdoors, particular attention should be given to the effects of solar radiation. The two main effects to be considered are the heating effects and the UV stability. As indicated in 512.2.2 of IEC 60364-5-51:2005 and Table 51A of that standard, if the product does not, by its construction, have the characteristics relevant to the external influences of its location, it may nevertheless be used on condition that it is provided with appropriate additional protection in the erection of the installation, such as interposition of screens.

NOTE The IEC 60287 [1][1] series gives a method for determining the current-carrying capacity in case of solar radiation.

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1 Figures in square brackets refer to the Bibliography.

523 Current-carrying capacities

The current-carrying capacity of a cable is affected by the type of insulation material of the cable, ambient temperature, installation method, grouping and presence of thermal insulation. See the NOTE in 522.11.

Annex B of IEC 60364-52:2009 includes tabulated reduction factors for a limited number of circuits. Increasing the number of circuits in a group (conductors within a single installation method) will require further reduction in the current-carrying capacity of those conductors (smaller reduction factors than specified for the maximum number of circuits or conductors), due to increased heating effects. Because of this, it is recommended that such groups, with more circuits or conductors than the maximum indicated in the tables, be divided into smaller groups of circuits or conductors with spacing provided between the groups.

526 Electrical connections

526.4 Maximum temperatures of terminals in normal service conditions

526.4.101 General

The temperature of a terminal is the sum of the ambient temperature and its temperature rise in normal service.

Product standards give conventional limit values for temperature rise under defined test conditions. For installation conditions that differ from the defined test conditions, rating factors may need to be applied and guidance should be obtained from the manufacturer. Relevant standards in this respect are the IEC 61439 series and IEC 60890.

The temperature at a terminal is affected by the heat dissipated in normal service by the equipment. This heat may be caused by internal losses dissipated in the equipment and by neighbouring internal and external heat sources, if any. A possible external heat source is the cable of the wiring system connected to the terminal equipment.

Compatibility between the temperature achieved at the terminals of equipment and the temperature permitted for the insulation of the conductors and cables should be obtained by appropriate arrangement during design/installation.

Current-carrying capacities of conductors, the values of which are tabulated in IEC 60364-5-52, are calculated so that the temperature on the cores does not exceed the permissible temperature determined by the selection of the insulation. These current-carrying capacities do not take account of any temperature rise at a termination.

526.4.201 Limitation of temperature at a terminal

It is necessary to limit the temperature at a terminal so that the maximum steady-state or peak temperature limits of the insulation of the conductors connected to the terminal and of any insulating material used to support the connection are not exceeded. The temperature at a terminal can be limited by one or more of the following measures:

a) Limitation of contents of enclosures (cubicles, cabinets, trunkings, conduits). The limitation of contents of trunkings and conduits is recommended when a large number of circuits issue from the same panel; in this case it is preferable to divide the circuits between several runs of trunking or conduit.

b) Spacing between equipment in order to improve natural ventilation. Spacing between adjacent equipment permits better dissipation of heat. It is necessary to refer to the manufacturer's instructions. This solution is especially recommended when a great number of items of equipment are installed in the same enclosure (cubicle or cabinet).

c) Appropriate arrangement of equipment dissipating heat inside enclosures. It is recommended that equipment dissipating heat is installed in an appropriate way so that the correct operation of other equipment will not be impaired. Other means, such as the interposition of screens or deflectors, may be used for this purpose.

d) Natural or forced ventilation or air-conditioning of cubicles, cabinets or locations. Forced ventilation of the equipment may be necessary, for reasons other than cooling, in specific applications, for example to protect against ingress of dust.

e) Derating of equipment by use of equipment having higher rated current, consequently dissipating less heat. Derating of equipment can be used to reduce the temperature of terminals, provided that such derating is permitted for the equipment.

f) Selection of material for enclosures of cubicles or cabinets in which terminals are installed in order to improve the thermal dissipation. Thin metallic enclosures will dissipate heat more readily than thick walled enclosures manufactured from insulation materials.

g) Maintenance of correct clamping of conductors in the terminals. Arrangements should be made to ensure the maintenance of clamping pressure of conductors in their terminals. Such arrangements may be built in (for example, use of resilient connections) or result from instructions for the inspection of the installation.

h) Introduction of an intermediate terminal (of the appropriate rated operating temperature) outside the current-using equipment enables a conductor of larger cross-sectional area or a higher temperature type of cable to be connected.

i) Where cables that are permitted to run at a temperature exceeding 70 °C (such as cross-linked insulated cables) are connected to equipment or accessories designed to operate at a temperature not exceeding 70 °C, the conductor size should be chosen based on the current ratings for 70 °C cables of a similar construction.

j) Separation of conductors of multicore cables between the end of the sheath and the terminal will lead to a decrease in the terminal temperature. Choice of a sufficient length for the separation may be based on experiment or on a calculation according to IEC/TR 60943.

k) Connection of a short length of conductor, at the termination, whose cross-sectional area is larger than that required by the current, will reduce the temperature at the termination. Increasing the cross-sectional area of conductors for other reasons (voltage drop, withstand of short-circuit currents, reduction of the fault loop impedance) improves the thermal withstand of the conductors and hence reduces the possibility of excessive temperatures at terminations.

526.4.301 Limitation of the effects of temperature at a terminal in normal service

The effect of temperature rise of terminals can be limited by one or more of the following:

a) Selection of the insulation of the conductors having due regard to the temperature of the terminals. Permissible temperatures in steady-state service for some types of insulation of conductors are determined by TC 20: Electric cables. If cables with elastomeric insulation rather than thermoplastic are used, in order to utilize their higher operating temperature, it may be necessary to derate the equipment to which they are connected. Seek advice from the equipment manufacturer in this case. Temperatures for commonly used insulation materials are given below:

   – thermoplastic (PVC): 70 °C;
   – cross-linked (XLPE, EPR): 90 °C;
   – cross-linked (silicone): 120 °C.

b) Reinforcement or substitution of the insulation of the conductors close to a termination by a sleeve that permits a higher temperature reduces the risk of thermal degradation of the insulation at a termination. Insulated conductors which permit temperatures at least equal to 110 °C are recommended for the supply to equipment operating at a high temperature, such as heating appliances.

c) Selection of the means of connection to the terminals having due regard to their temperature.

526.8 Connection of multiwire, fine wire and very fine wire conductors

Subclause 526.8 of IEC 60364-5-52:2009 concerns the suitable selection of the means of connection. Where multi-stranded, fine wire conductors are to be terminated, measures should be taken to prevent the individual conductor strands spreading. The manufacturer's instructions for termination of conductors should be followed.

Crimped ferrules fitted to the conductors are a suitable means of terminating multi-stranded fine wire conductors, provided that care is taken to ensure that all strands are inserted into the ferrule. Crimped ferrules shall not be used with screwless terminals.

528 Proximity of wiring systems to other services

528.2 Proximity of communication cables

Refer to 528.2 for requirements.

When power cables buried in the ground approach underground components of overhead telecommunication lines including their anchorage, stays and earth connections, a minimum clearance of 800 mm is recommended. This clearance may be reduced if the power cables have additional protection against mechanical damage. The protection should extend at least 500 mm on either side beyond the point of proximity.