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MS 1979 (2007) (English): ELECTRICAL INSTALLATIONS OF BUILDINGS - CODE OF PRACTICE

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MALAYSIAN STANDARD

MS 1979:2007

ELECTRICAL INSTALLATIONS OF BUILDINGS - CODE OF PRACTICE

ICS: 91.140.50, 29.020

Descriptors: practices, electrical installations, buildings, residential houses, dwellings

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For further information on Malaysian Standards, please contact:

Department of Standards Malaysia OR
Ministry of Science, Technology and Innovation
Level 1 & 2, Block 2300, Century Square
Jalan Usahawan
63000 Cyberjaya
Selangor Darul Ehsan
MALAYSIA

Tel: 60 3 8318 0002
Fax: 60 3 8319 3131
http://www.standardsmalaysia.gov.my

E-mail: central@standardsmalaysia.gov.my

SIRIM Berhad
(Company No. 367474 - V)
1, Persiaran Dato' Menteri
Section 2
40700 Shah Alam
Selangor Darul Ehsan
MALAYSIA

Tel: 60 3 5544 6000
Fax: 60 3 5510 8095
http://www.sirim.my

E-mail: msonline@sirim.my

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Committee representation

The Electrotechnical-1 Industry Standards Committee (ISC E-1) under whose authority this Malaysian Standard was developed, comprises representatives from the following organisations:

Association of Consulting Engineers Malaysia
Department of Standards Malaysia
Federation of Malaysian Manufacturers
Independent Power Producer
Jabatan Kerja Raya Malaysia
Kementerian Perdagangan Dalam Negeri dan Hal Ehwal Pengguna
Malaysian Cable Manufacturers Association
Malaysian Electrical Appliances and Distributors Association
Ministry of International Trade and Industry
Persatuan Pengguna-Pengguna Standard Malaysia
Pusat Tenaga Malaysia
SIRIM QAS International Sdn Bhd (Electrotechnical Testing Section)
SIRIM QAS International Sdn Bhd (Product Certification Section)
Suruhanjaya Komunikasi dan Multimedia Malaysia
Suruhanjaya Tenaga
Tenaga Nasional Berhad
The Electrical and Electronics Association of Malaysia
The Institution of Engineers, Malaysia
Universiti Teknologi Malaysia

The Technical Committee on Electrical Installation, Protection and Insulation Practice which developed this Malaysian Standard was managed by The Electrical and Electronics Association of Malaysia (TEEAM) in its capacity as an authorised Standards-Writing Organisation and consists of representatives from the following organisations:

Association of Consulting Engineers Malaysia

EITA Holdings Sdn Bhd

G.H. Liew Engineering (1990) Sdn Bhd

Jabatan Bomba dan Penyelamat Malaysia

Jabatan Kerja Raya Malaysia

Sabah Electricity Sdn Bhd

Sarawak Electricity Supply Corporation

SIRIM QAS International Sdn Bhd (Electrotechnical Testing Section)

Suruhanjaya Tenaga

The Electrical and Electronics Association of Malaysia (Secretariat)

The Institution of Engineers, Malaysia

Time Era Sdn Bhd

TNB Distribution Division

Universiti Malaya

Universiti Teknologi Malaysia

FOREWORD

This Malaysian Standard was developed by the Technical Committee on Electrical Installation, Protection and Insulation Practice under the authority of the Electrotechnical Industry Standards Committee. Development of this standard was carried out by The Electrical and Electronics Association of Malaysia which is the Standards-Writing Organisation (SWO) appointed by SIRIM Berhad to develop standards for electrical installation, protection and insulation practice.

This Standard is the result of the combined effort of TEEAM SWO operating as the Working Group and as the Chair of SIRIM's Technical Committee No. 10 (TC 10): Electrical Installation, Protection and Insulation, overseeing the various stages of development of the COP.

More than 80 % of Malaysian electricity customers are domestic and residential installations catering to uninformed consumers. On the other hand, less than 20 % of Malaysian electricity customers are either commercial or industrial consumers. Therefore, whilst MS IEC 60364 as a set of standards provides guidelines for the broad spectrum of LV installations, for both the informed as well as the uninformed consumers, this standard developed under the direction of the regulatory body, however, deals with the safety of (uninformed) consumers.

This standard provides for the relevant requirement as prescribed by electrical safety consideration for consumers' protection of relevant technical considerations of the practices.

ELECTRICAL INSTALLATIONS OF BUILDINGS – CODE OF PRACTICE

0. Introduction

This Malaysian Standard has been developed based on the source material as contained *in the guide to MS IEC 60364 on electrical installations of buildings.*

In stating the safety requirements for (uninformed) consumers, this standard articulates the practices relating to electrical installations of buildings for residential houses and dwellings. Furthermore, this standard also addresses certain instances where and when other forms of low voltage (LV) electrical installations have impact upon the safety requirements for uninformed persons; as long as the LV public electricity supply is of the TT system and the installation is not in contradiction to the dictates of the professional design electrical engineer.

Ninety one numbers of code of practices constitute this standard with each practice having its own discreet reference number. The chronological appearance of the listing of practices generally follows the flow of the fourteen issues as addressed in the guide of MS IEC 60364 on electrical installations of buildings.

Each code of practice is a concise statement of the relevant requirement as prescribed by electrical safety consideration for consumers' protection; as is the Malaysian industrial norm and per the law.

1. Scope

This Malaysian Standard has been developed based on the source material as contained *in the guide to MS IEC 60364 on electrical installations of buildings.*

This Malaysian Standard provides the requirement for LV electrical installations of buildings such as residential houses and dwellings, and in certain circumstances, where and when similarities exist, to those in commercial and industrial installations.

For electrical installations, other than those for residential houses and dwellings where the design of the electrical installations will be carried out by professional design electrical engineers for informed consumers, the relevant and applicable sections in MS IEC 60364 will prevail in accordance to professional judgment.

2. Normative references

The following normative references are indispensable for the application of this standard. For dated references, only the edition cited applied. For undated references, the latest edition of the normative reference (including any amendments) applies.

Guide to MS IEC 60364 on Electrical Installations of Buildings

Electricity Supply Act 1990 - Act 447

Electricity Regulations 1994

3. Requirements

The requirements as developed in this standard conform to those as prescribed in the Electricity Supply Act 1990 - Act 447 and the Electricity Regulations 1994, and those sections and parts suitable for Malaysian practices as specified in MS IEC 60364.

4. Issues addressed

4.1 General characteristics of electricity supply

Almost all Malaysian electrical installations for residential buildings and dwellings receive the LV supply from the electricity supply body.

4.1.1 COP 01, Characteristics of public electricity supply

The public electricity supply has the following characteristics:

Voltage: 240 V a.c. for single phase system
415 V a.c. for three phase 4-wire system
Variation is + 5 % and – 10 %

Frequency: 50 Hz ± 1 %

Wiring system: TT-system (the user has to establish his own earth)

4.1.2 COP 02, Suitability for use

All electrical equipment selected shall be suitable for use under the conditions as stated in COP 01 (see 4.1.1).

4.1.3 COP 03, Application for supply of electricity

Pursuant to the requirement under Section 24 of the Electricity Supply Act 1990 as well as any other guidelines of the licensee, a person requiring a supply of electricity shall make an application to the respective licensee, stating the location of the premises where electricity supply is required, the minimum period for which the supply is required to be given, the maximum demand required and the date of commencement of supply. The licensee shall confirm in writing that the application is acceptable, the applicable tariff, payment for expenses incurred under section 27 (1) of the ESA 1990, if any, and amount of security required and any documentation required by the licensee and approved by the regulatory body before work commences.

4.2 Protection against electric shock

Electric shock can arise from direct contact or indirect contact. In practice direct contact usually occurs when a person touches a bare live conductor.

4.2.1 COP 04, Protection against direct contact

To protect against direct contact, all live conductors in the wiring system shall be insulated with a dielectric medium such as poly vinyl chloride (PVC) or cross linked poly ethylene (XLPE). Supplementary measures to protect against direct contact by the use of barriers or enclosures and placing live conductors out of reach are encouraged.

4.2.2 COP 05, Earthing of equipment

All metal enclosures of electrical equipment shall be earthed (connected to a protective conductor). In addition, water and gas pipes, structural metal parts of the building and the ducting of the air conditioning system shall also be connected to the main equipotential bonding.

Take note of COP 71 on equipotential bonding.

4.2.3 COP 06, Isolation on fault

In case of a fault between a live conductor and the metal enclosure of electrical equipment, the fault shall be isolated by a circuit breaker, fuse or residual current device (RCD). Protection against electric shock requires the fulfillment of the condition

$$R_A \times Ia \leq 50\text{ V}$$

where,

Ia is the operating current of the protective device ($I\Delta n$ in the case of RCD) and the 5 s operating current for overcurrent devices having an inverse time characteristic; and

R_A is the resistance of the earth electrode and protective conductor.

4.2.4 COP 07, Requirement of earthing system

The primary requirement of the earthing system is to ensure effective operation of the circuit protective device. For effective operation of the circuit protective device, the resistance of the earthing system shall be as low as possible. In installations where RCDs are used as the circuit protective device, earthing resistance of less than 10 Ω will generally ensure effective operation of the RCDs. However earthing resistance of less than 1 Ω is the target.

4.3 Protection against thermal effects

There are three factors to be considered when applied to protection against thermal effects:

a) protection against fire;

b) protection against burns; and

c) protection against overheating.

4.3.1 COP 08, Protection against fire

To protect against fires, as a minimum, electrical equipment that produces heat shall be mounted within materials that can withstand the temperatures produced. In operation, the temperature attained by the material shall be less than 55 °C (if the material is metallic) or 65 °C (if the material is non-metallic).

4.3.2 COP 09, Protection by placing out of reach

Electrical equipment intended to be operated in such a way that they are within arm's reach shall not attain temperatures likely to cause burns to persons. If this condition is not assured, the electrical equipment shall be put behind a guard.

4.3.3 COP 10, Protection against overheating

Forced air heating system and appliances producing hot water or steam shall be equipped with devices to protect against overheating.

4.4 Overcurrent protection

Overcurrent in a conductor causes a temperature rise which may result in a fire.

4.4.1 COP 11, Overcurrent protection of phase conductors

Overcurrent protection shall be provided for all phase conductors.

4.4.2 COP 12, Cross section area of neutral conductor

The neutral conductor shall have the same cross-sectional area as the phase conductor also refer to COP 35 (see 4.6.16).

4.4.3 COP 13, Nominal current of protection device

The nominal current of the protective device (I_n) shall be greater than the design current (I_B).

$$I_n > I_B$$

4.4.4 COP 14, Current carrying capacity of cable

The continuous current carrying capacity of the cable (I_z) shall be greater than the nominal current of the protective device (I_n).

$$I_z > I_n$$

4.4.5 COP 15, Current to ensure effective operation of protective device

In addition to COP 14, the current to ensure effective operation of the protective device (I_2) must be less than 145 % of the current carrying capacity of the cable. In other words, the protective device must operate before the conductor is overloaded by 45 %.

$$I_2 < 1.45\, I_z$$

EXAMPLE

I_B = 13.1 A

Choose I_n = 30 A

Try a solution using 10 mm^2 PVC cable. Assuming no derating effects,

I_z = 52 A

1.45 I_z = 75.4 A

The 30 A MCB must operate before the current reaches 75.4 A.

4.4.6 COP 16, Determination of short circuit current

In order to design short circuit protection properly, the short circuit current at every relevant part of the installation shall be determined. The short circuit current can be obtained by calculation or by measurement of the impedances at the relevant points. Upon request the electricity supply body shall provide the short circuit current at the point of common coupling with the utility's installation.

4.4.7 COP 17, Rating of short circuit protective device

The short circuit protective device shall have a short circuit breaking capacity not less than the prospective short circuit current at the place of installation.

4.5 Protection against voltage disturbance

Voltage disturbance in the LV system can be caused by many factors such as the following:

a) earth fault in the LV system;

b) loss of neutral in TT system;

c) short circuit in the LV system;

d) lightning; and

e) switching.

4.5.1 COP 18, Common earthing system

There shall be one earthing system for the installation to which shall be connected the following:

a) earth electrodes;

b) transformer tanks;

c) armouring of cables;

d) earth wires of the high voltage (HV) system;

e) neutral of the LV system;

f) HV and LV switchboard panels;

g) other metal parts e.g. equipment control panels, structural steel works; and

h) steel bars in reinforced concrete foundations.

Take note of COP 70 (see 4.11.2).

4.5.2 COP 19, Installation of SPD

Where an installation is supplied from overhead lines, it is recommended to install surge protective device (SPD).

Take note of COP 59 (see 4.9.1).

4.6 Wiring Systems

4.6.1 COP 20, Prevention of eddy current

When single core power cables are to be terminated in metal switchboards, ensure that all the phase and neutral conductors are within the switchboard so as to prevent eddy current heating. If this cannot be achieved, the part of the switchboard where the single core cables are terminated shall be made of non-ferrous materials e.g. hard fibre board, aluminium, brass, etc.

4.6.2 COP 21, Separation of HV and LV cables

HV and LV cables shall not be installed within the same trunking nor run on the same cable tray.

4.6.3 COP 22, Installation of three phase and single phase circuits

Three phase and single phase circuits LV power cables may be installed within the same conduit or trunking.

4.6.4 COP 23, Connection of dissimilar metals

When a connection is made between dissimilar metals e.g. copper to aluminium, precautions shall be taken to avoid electrolytic effect. In an environment where there is water, the more noble metal (in this case copper) shall be installed in such a way that it is below the less noble metal (aluminium in this case) when considered in the direction of the flow of water. Specially made bimetallic connectors shall be used to connect dissimilar conductors e.g. copper and aluminium.

4.6.5 COP 24, Installation of conductors in buried cable ducts

Conduits or cable duct systems intended to be buried in structures shall be completely erected for each circuit before any insulated conductor is drawn in.

4.6.6 COP 25, Bending radius of cables

The radius of every bend in the wiring system shall be sufficiently large to prevent damage to the cables. For common wiring installations, a bending radius of 12 times the diameter of the cable would normally be adequate. In order to satisfy this criterion, elbows and junction boxes shall be included at places where the cable run changes direction.

4.6.7 COP 26, Support for vertical cables

When cables of large cross-section areas are installed vertically, they may be damaged by their own weight. Hence they shall be adequately supported at regular intervals of 1 m by cable clamps or cable ties.

4.6.8 COP 27, Space factor

When cables are installed within conduits, a space factor of 40 % shall be maintained. When a cable trunking is used, the space factor shall be 45 %.

$$\text{Space factor} = \frac{\text{Sum of cross section areas of cables (including insulation)}}{\text{Internal cross section area of conduit/trunking}}$$

4.6.9 COP 28, Cables installed behind walls

Where cables are installed buried behind walls, they shall be installed horizontally or vertically i.e. parallel to the edges of the room. Subject to the dimensions of the columns and beams, they shall be within 150 mm from the top of the walls and 150 mm from the edge of the wall.

4.6.10 COP 29, Mechanical protection for cables within walls

Cables installed within walls shall be provided with mechanical protection such as a conduit. Direct installation of cables within walls is not allowed.

4.6.11 COP 30, Cables installed within ceiling space

Where cables are installed behind suspended ceilings or the ceiling space under the roof, they shall be provided with mechanical protection such as being installed within approved conduits. In addition they shall be installed either parallel or perpendicular to the edges of the walls.

4.6.12 COP 31, Water heater circuits

A circuit intended to supply a water heater shall have a double pole switch installed at a suitable location. In the vicinity of the water heater, there shall be a socket outlet (an unswitched type is acceptable) to facilitate the connection of the circuit to the apparatus and to facilitate disconnection during maintenance.

4.6.13 COP 32, Air conditioner circuits

A circuit intended to supply an air conditioner shall have a socket outlet (an unswitched type is acceptable) in the vicinity of the air conditioner to facilitate the connection of the circuit to the apparatus and to facilitate disconnection during maintenance.

4.6.14 COP 33, Group reduction factors

When groups of cables are run together, a group reduction factor shall be applied to take into account the heat generated by the loaded cables.

Take note of COP 08 for protection against fire.

Take note of COP 21 for separation of HV and LV cables.

4.6.15 COP 34, Consideration for loaded conductors

When considering the number of loaded conductors, only the conductors in a circuit that carry load shall be considered. Hence the neutral conductor of a balanced three phase circuit need not be considered.

4.6.16 COP 35, Size of neutral conductor

With the increasing use of electronic equipment that have their own power supplies, harmonic currents in three phase systems will cause the neutral conductor to carry current. To cater for this neutral current, as a minimum, the size of the neutral conductor in wiring system shall be the same as the phase conductors. Also refer to COP 12 (see 4.4.2).

4.6.17 COP 36, Neutral conductor reduction at the discretion of Professional Design Electrical Engineer

Notwithstanding COP 35, the professional design electrical engineer may reduce the size of the neutral conductors between the transformer and the main switchboard after taking into account the requirements of the particular electrical installation.

4.6.18 COP 37, Phase conductors connected in parallel

Two or more conductors may be connected in parallel in the same phase. (This is especially so in situations when the load current is high and the use of a single large conductor may present difficulties during installation. Further, this type of installation improves the electromagnetic compatibility (EMC) of the circuit).

4.6.19 COP 38, Cable suitable for the most onerous condition

A cable route may consist of different installation conditions that have different heat dissipation properties. The current carrying capacity of the cable shall be selected based on the most onerous condition encountered along the cable route.

4.6.20 COP 39, Minimum size of wiring conductors

The minimum cross sectional areas of live conductors used for wiring purposes shall be 1.5 mm^2 copper or 2.5 mm^2 aluminium.

4.6.21 COP 40, Neutral conductor for every circuit

For every circuit there shall be a separate neutral conductor which shall be clearly identifiable at the distribution board or consumer unit and arranged in the same order as the circuits.

4.6.22 COP 41, Allowable voltage drop

The voltage drop between the origin of the consumer's installation and the equipment shall not exceed 4 % of the nominal voltage of the installation. Voltage drops during temporary conditions such as motor starting may be exempted from this requirement. For most installations, a voltage drop of 10 % during motor starting may be acceptable.

4.7 Electrical connections

4.7.1 COP 42, Soldered connections

Soldered connections shall not be used to connect conductors or to terminate conductors.

4.7.2 COP 43, Use of sockets and crimps for connections

Connections between two lengths of conductors shall be made by sockets and crimping.

4.7.3 COP 44, Cables for final sub-circuits

Cables used in final sub-circuits in LV installations shall not be joined.

4.7.4 COP 45, Sealing of partitions

Where a wiring system passes through walls, floors, partitions etc in a building, the openings shall be sealed with fire retardant compounds. If the wiring system includes conduits or cable trunking, then in addition to the above, the internal of the conduit or cable trunking shall also be sealed with fire retardant compounds.

4.8 Switching and Control

4.8.1 COP 46, Multi-pole switching devices

All poles of a multi-pole circuit breaker or disconnector shall operate together. The contact for the neutral may close before and open after the phase contacts.

4.8.2 COP 47, No MCB or fuse in a neutral conductor

A miniature circuit breaker (MCB) or fuse shall not be inserted in the neutral conductor of a three phase or a single phase circuit.

4.8.3 COP 48, Operation of RCD

In operation, a RCD shall ensure the disconnection of all live conductors in the circuit protected.

4.8.4 COP 49, Protective conductor of a circuit

The protective conductor (or earth wire) of a circuit shall not pass through the magnetic circuit of an RCD.

4.8.5 COP 50, Current operated RCD

RCD shall be of the current operated type; earth leakage circuit breaker (ELCB) of the voltage operated type shall not be used.

4.8.6 COP 51, RCD for single phase circuit

RCDs for single phase installations shall have rated residual operating current not exceeding 100 mA.

4.8.7 COP 52, RCD for three phase circuit

RCDs for three phase systems shall have rated residual operating current not exceeding 100 mA. Provided there are no three phase loads in the installation, it is recommended to install three single phase RCD instead of a three phase RCD in a three phase installation. This practice will reduce the extent of power disruption in the installation in case there is a fault in one phase.

4.8.8 COP 53, RCD for hand held equipment

RCDs with rated residual operating current not exceeding 30 mA shall be installed in installations where hand held equipment (generally power tools) is used.

4.8.9 COP 54, RCD for special places

RCDs with rated residual operating current not exceeding 10 mA shall be installed in the following instances:

a) in places of public entertainment;

b) where the floor is likely to be wet; and

c) for the protection of electric water heaters.

4.8.10 COP 55, Location of RCD

If an installation is protected by a single RCD, it shall be located at the origin of the installation.

4.8.11 COP 56, Regular testing of RCD

An installation protected by an RCD shall be tested at least two times a year to ensure its proper operation. The test shall be carried out in accordance to the manufacturers' recommendations or by the use of RCD testing equipment approved for this purpose.

4.8.12 COP 57, Selection of short circuit protective device

Selection of a short circuit protective device shall be based on its rated service short circuit breaking capacity instead of its ultimate short circuit breaking capacity.

4.8.13 COP 58, Requirement for devices for emergency switching

Devices for emergency switching shall be red in colour and clearly identified. They shall be of the latching type or restrained in the "STOP" position. When released, the emergency switching device shall not re-energise the installation.

4.9 Surge Protective Devices

4.9.1 COP 59, Installation of SPD

To protect against lightning surges or overvoltage surges, it is recommended to install a surge protective device (SPD) near the origin of the installation. The SPD is recommended to be installed before the RCD (on the supply side).

Take note of COP 19 (see 4.5.2) on installing SPD for electricity supply fed from overhead lines.

4.9.2 COP 60, Use of SPD

The maximum continuous operating voltage U_c of the SPD shall be at least 1.1 U_o where U_o is the line to neutral voltage of the LV installation which is commonly 240 V a.c.

4.9.3 COP 61, Rating of SPD

The nominal discharge current I_n of the SPD shall not be less than 5 kA.

4.9.4 COP 62, Protection of electronic devices by SPD

Additional SPD is recommended to be installed near sensitive electronic equipment.

4.9.5 COP 63, Installation of SPD in special environments

SPD installed in environments where there is a risk of fire (category BE2) or risk of explosion (category BE3) shall be appropriately protected to prevent this risk.

4.9.6 COP 64, Earth connection of SPD

For SPDs to function properly an effective connection to earth is essential. The minimum cross section area of the conductor connecting the SPD to the main earthing terminal shall be 10 mm^2 copper. The connection shall be as short as possible (not more than 0.5 m).

4.10 Isolation

4.10.1 COP 65, Requirement for circuit isolation

Every circuit shall be provided with a means of isolation from each of the live supply conductors of the source of supply.

4.10.2 COP 66, Marking of isolation devices

The isolation devices e.g. MCB shall have markings to indicate that the contacts are open (OFF or 'O').

4.10.3 COP 67, Prohibition on the use of semiconductor devices for isolation

Semiconductor devices shall not be used for isolation.

4.10.4 COP 68, Prevention of unintentional re-energising

Means shall be provided to prevent electrically operated equipment from being unintentionally re-energised during maintenance by padlocking, warning notices or installation within lockable enclosures.

4.11 Earthing

4.11.1 COP 69, Uses of earthing system

The earthing system may be used solely for protective purpose or it may also serve other functional purposes e.g. as the reference earth for electronic systems, including ICT purposes.

4.11.2 COP 70, Earth electrodes

Earth electrodes may be established using round copper sheathed steel rods, copper tapes or conductors, rods or pipes or steel bars in reinforced concrete foundations of buildings.

Wherever reinforced concrete pile foundations exist, they shall be incorporated into the building's earthing system.

Take note of COP 18 (see 4.5.1) for one common earthing system.

4.11.3 COP 71, Restrictions on the use of water or gas pipes for earthing

Water pipes or gas pipes shall not be used as the sole means of earthing but protective equipotential bonding to these pipes is permitted.

Take note of COP 05 on earthing of water pipes and gas pipes.

4.11.4 COP 72, Maintenance of earthing system

The earthing system of electrical installations shall be effectively maintained and checked annually.

4.11.5 COP 73, Minimum size of earthing conductors

The minimum size of earthing conductors buried in the soil and without protection against corrosion shall be 25 mm^2 bare copper. This value can be reduced to 16 mm^2 copper conductor if it is protected against corrosion.

4.11.6 COP 74, Methods of connecting earthing conductors

For connections of earth conductors that are buried in the ground, connections made using exothermic welding is recommended. Connections to earth electrodes that require periodic inspection at earth electrode inspection chambers, connections using clamps may be used.

4.11.7 COP 75, Selection of protective conductors

Every protective conductor must be selected to withstand the prospective fault current and ensure automatic disconnection of supply.

4.11.8 COP 76, Size of protective conductors

In final sub-circuits, the protective conductor shall have I_n connections between switchboards, protective conductors of the following sizes may be used without calculations:

a) Same size as the line conductor if the cross sectional area of the line conductor is less then 16 mm^2.

b) 16 mm^2 if the cross sectional area of the line conductor is more than 16 mm^2 but less than or equal to 35 mm^2.

c) Half the line conductor if the cross sectional area of the line conductor exceeds 35 mm^2, the same size as the phase conductors.

4.12 Protective bonding conductor

4.12.1 COP 77, Size of protective bonding conductors

The cross sectional area for protective bonding conductor connected to the main earthing terminal shall not be less than 6 mm^2 for copper or 16 mm^2 for aluminium.

4.13 Change-over switch of a standby generating set

4.13.1 COP 78, Prevention of parallel operation of standby system with the public supply

When the generating set in the installation is used as a standby system to the public supply system, means of isolation to prevent parallel operations shall be taken.

4.13.2 COP 79, Separate neutral for the standby system

When operating on the standby supply, the neutral of the supply shall be changed.

4.13.3 COP 80, Overcurrent protection for essential services

If a standby generating set supplies essential services fire fighting pumpsets, it shall not be provided with overcurrent protective devices. If an overcurrent protective device is provided, it shall be connected to provide an alarm only.

4.14 Initial verification of installations

4.14.1 COP 81, Initial inspection of installation

Every installation shall be inspected during erection or upon completion prior to being energised.

4.14.2 COP 82, Supervision of work on LV single phase installations

LV installations receiving single phase supply shall be carried out under the immediate supervision of a Wireman with Single Phase Restriction or a wireman with Three Phase Restriction and upon completion, the Wireman shall certify a Supervision and Completion Certificate known as Form G. This a requirement under the Electricity Regulations 1994.

4.14.3 COP 83, Supervision of work on LV three phase installations

LV installations receiving three phase supply shall be carried out under the immediate supervision of a Wireman with Three Phase Restriction and upon completion, the Wireman shall certify a Supervision and Completion Certificate known as Form G. This is a requirement under the Electricity Regulations 1994.

4.14.4 COP 84, Testing of work on LV single phase installations

Upon completion of wiring or rewiring or extension of a single phase LV installation, it shall be tested by a Wireman with Single Phase Restriction or a wireman with Three Phase Restriction authorised to test any installation. The Wireman shall then certify a Test Certificate for the installation known as Form H. This is a requirement under the Electricity Regulations 1994.

4.14.5 COP 85, Testing of work on LV three phase installations

Upon completion of wiring or rewiring or extension of a three phase LV installation, it shall be tested by a Wireman with Three Phase Restriction authorised to test any installation. The Wireman shall then certify a Test Certificate for the installation known as Form H.

4.14.6 COP 86, Testing by Electrical Services Engineer

Upon completion of an installation or extension to an existing installation operating at higher than low voltage, the installation shall be tested by an Electrical Services Engineer and who shall certify a Test Certificate for the installation known as Form H.

4.14.7 COP 87, Condition precedent for receipt of electricity

The installation shall not receive electricity from the electricity supply body until the Supervision and Completion Certificate and Test Certificate has been submitted by the owner or management of the installation to the licensee or supply authority.

4.14.8 COP 88, Insulation tests on LV installations

Insulation measurements shall be carried out on completed LV installations using d.c. voltages. When 500 V d.c. is applied to each circuit, the insulation resistance shall be more than 1 MΩ.

4.14.9 COP 89, Circuit checks

Circuits shall be checked and the circuit interruption/isolation devices verified against the electrical diagrams.

4.14.10 COP 90, Requirement for labelling

All circuits and circuit components shall be clearly labelled using Bahasa Malaysia or English.

4.14.11 COP 91, As-built diagrams

Every completed installation shall have the as-built electrical diagrams of the installation prominently displayed for safety in operation and maintenance. The diagrams shall be endorsed by the professional design electrical engineer.

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