اءوتوريتي كسلامتن كصيحتن دان عالم سكيتر كبغسائن

Safety, Health and Environment National Authority

SAFE USE OF ELECTRICITY AT CONSTRUCTION SITES

Approved Code of Practice and Guidance.

SAFE USE OF ELECTRICITY AT CONSTRUCTION SITES

APPROVED CODE OF PRACTICE (ACOP)

This Approved Code of Practice (ACOP) is issued by the Safety, Health and Environment National Authority [SHENA]. This ACOP is aimed at employers, principals and occupiers who are responsible for the safe use of electricity in all worksites. An ACOP is not legally binding and merely represents advice and guidance on how to comply with the law. If you follow the advice contained in an ACOP, you will be doing enough to comply with the law. You are encouraged to adopt this ACOP where possible unless there are better or similar alternatives or where it is not reasonably practicable to do so.

A person shall not be liable to any criminal proceedings by reason only that he has failed to observe any approved code of practice.

GUIDANCE

This Guidance is issued by SHENA to all worksites. Following the Guidance is not compulsory, other actions and safety measures to ensure compliance with the law are acceptable. However, this Document may serve as a guidance for SHENA Inspectors to verify compliance with the law on site.

DISCLAIMER

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INTRODUCTION

About this Document

This Approved Code of Practice (ACOP) provides practical guidance and clarifications on how to comply with the PART V of the Workplace Safety and Health (Construction) Regulations, 2014 (WSHCR) and should be read together with other relevant WSH Regulations, standards and guidelines on safe use of electricity at workplaces.

Who should read this Document?

The Principal, Employer and Occupier of a work place who are engaged in the safe use of electricity.

As defined in the Workplace Safety and Health Order, 2009 (WSHO 2009):

> **"Principal"** –means a person who, in connection with any trade, business, profession or undertaking carried
>
> (a) to supply any labour for gain or reward; or
>
> (b) to do any work for gain or reward;
>
> **"Employer"** – means a person who, in the course of his trade, business, profession or undertaking, employs any person to do any work under a contract of service.
>
> **"Occupier"** - in relation to any premises or part of any premises, means -
>
> (a) in the case of a factory where a certificate of registration or a factory permit has to be obtained in relation to the premises pursuant to any regulations, the person who is, or is required to be, the holder of that certificate or permit; and
>
> (b) in the case of any other premises, the person who has charge, management or control of those premises either on his own account or as agent of another person, whether or not he is also the owner of those premises;

The Principal, Employer and Occupier are referred to as "You" further in this Document.

Where does WSHCR apply to?

The WSHCR apply to all worksites in Brunei Darussalam. The worksite includes all premises where any building operation or works of engineering construction is being carried out for commercial or business purposes. This can include work done on behalf of the Government, a statutory body or a private individual or organisation. The legal definition of a worksite can be found under Regulation 2 of the WSHCR.

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Legal Basis for WSHCR and ACOP

The WSHCR are regulations made by the Minister under section 64 of the Workplace Safety and Health Order, 2009 (WSHO, 2009) after approval has been obtained from His Majesty the Sultan and Yang Di-Pertuan. The ACOP provision is found in section 39 of WSHO, 2009 and its purpose is to provide guidance and clarifications with respect to the requirements of WSHO, 2009 relating safety, health and welfare at work.

This ACOP and Guidance contain extracts of Parts and Sections under the WSHCR.

Presentation

SUBJECT The subject that is specified in the WSHCR
EXTRACT OF WHSO (CONSTRUCTION) REGULATIONS, 2014 The text Extract from WSHCR is written in *italics* with blue filled background. The section number is referred to i.e. Part 5 Electrical Safety with section number starting with 38
APPROVED CODE OF PRACTICE (ACOP) The ACOP is set out in **bold**.
GUIDANCE The guidance is set in normal fonts.

ABBREVIATION:

ACOP	Approved Code of Practice
BS	British Standards
CPC	Circuit Protective Conductor
DB	Distribution Board
DES	Department of Electrical Services
EIR	Electrical Installation Requirements 2011 – First editions
EN	European Norm
G.I	Galvanised Iron
IEC	International Electrotechnical Commission
IP	Ingress Protection
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MSB	Main Switch Board
PME	Protective Multiple Earth
PVC	PolyVinyl Chloride
PVC/SWA/PVC	PVC insulated, Steel Wire Armoured, PVC Sheathed
RCD	Residual Current Devices
REW	Registered Electrical Worker
TNS	Terre Neutral Separate
TT	Terre Terre
WSHCR	Workplace Safety and Health Order (Construction) Regulations, 2014
WSHO 2009	Workplace Safety and Health Order, 2009
XLPE/SWA/PVC	Cross Linked Poly Ethylene (XLPE) insulated, Steel Wire Armoured, PVC Sheathed

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WSHCR PART V ELECTRICAL SAFETY

1) ELECTRICAL POWER CIRCUITS

A) *REGULATION*

34. (1) It shall be the duty of -

(a) the employer of any person who carries out any work in the course of which the person may come into contact with any part of an electrical power circuit in a worksite; or

(b) the principal under whose direction any person carries out any work in the course of which the person may come into contact with any part of an electrical power circuit in a worksite,

to comply with sub-regulations (2), (3) and (4).

(2) Before any work is carried out at a worksite, the worksite shall be inspected to ascertain whether there is -

(a) any electrical power circuit which any person may come into contact with in the course of his work in the worksite; and

(b) any tool or machine which is connected to any electrical power circuit and which any person may come into contact with in the course of his work in the worksite.

(3) Where there is any such electrical power circuit, tool or machine referred to in sub-regulation (2), appropriate warning signs understood by the persons carrying out the work in the worksite shall be clearly posted and maintained at the place where the circuit, tool or machine is located.

(4) No person shall be permitted to work in a worksite where he may come into contact with any part of an electrical power circuit unless -

(a) he has been advised of the location of the electrical power circuit, the hazards involved and the protective measures to be taken; and

(b) he is protected against electric shock -

(i) by de-energising the circuit and earthing it; or

(ii) by guarding it with effective insulation or other means.

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B) ACOP

34 (2) Inspection

All electrical installations shall be regularly inspected, maintained and safety precautions shall be observed at all times to prevent danger to personnel. The Inspector (DES authorised persons or DES Approved (Specialised/ Contractor/Inspectors) shall complete and submit to DES the typical Periodic Inspection Report for Electrical Installation shown in Appendix 11C of the Department of Electrical Services, "Electrical Installation Requirements 2011 – First editions (EIR)" or later.

Appendix 11C

PERIODIC INSPECTION REPORT FOR AN ELECTRICAL INSTALLATION
(REQUIREMENTS FOR ELECTRICAL INSTALLATIONS – BS 7671 [IEE WIRING REGULATIONS])

DETAILS OF THE CLIENT

Client:

Address:

Purpose for which the report is required: _____

DETAILS OF THE INSTALLATION Tick boxes as appropriate

Occupier:

Installation:

Address: _____

Description of Premises: Domestic ☐ Commercial ☐ Industrial ☐ Other ☐

Estimated age of the Electrical Installation: _____ years

Evidence of Additions or Alterations: Yes ☐ No ☐ Not apparent ☐

If "Yes", estimate age: _____ years

Date of last inspection: _____ Records available Yes ☐ No ☐

EXTENT AND LIMITATIONS OF THE INSPECTION

Extent of electrical installation covered by this report: _____

_____

_____

Limitations (see Regulation 632.2): _____

_____

_____

_____

This inspection has been carried out in accordance with BS 7671:2008 (IEE Wiring regulations), amended to _____
Cables concealed within trunking and conduits, or cables and conduits concealed under floors, in roof spaces and generally within the fabric of the building or underground have not been inspected.

NEXT INSPECTION

I/We recommend that this installation is further inspected and tested after an interval of not more than _____ months/years, provided that any observations 'requiring urgent attention' are attended to without delay.

DECLARATION

INSPECTED AND TESTED BY

Name: _____ Signature: _____

For and behalf of: _____ Position: _____

Address: _____

_____ Date: _____

_____

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SUPPLY CHARACTERISTICS AND EARTHING ARRANGEMENTS Tick boxes and enter details, as appropriate

Earthing arrangements	Number and Types of Live Conductors		Nature of Supply Parameters	Supply Protective Device Characteristics
TN-C ☐	a.c ☐	dc ☐	Nominal voltage, U/U_0 [1] _____V	Type: _____
TN-S ☐	1-phase, 2-wire ☐	2-pole ☐	Nominal frequency, f [1] _____Hz	Rated current_____ A
TN-C-S ☐	2-phase, 3-wire ☐	3-pole ☐	Prospective fault current, I_{pf} [2] _____kA	
TT ☐	3-phase, 3-wire ☐	other ☐	External loop impedence, Z_e [2] _____ Ω	
IT ☐	3-phase, 4-wire ☐		(Note: (1) by enquiry, (2) by enquiry or by measurement)	

PARTICULARS OF INSTALLATION REFERED TO IN THE REPORT Tick boxes and enter details, as appropriate

Means of Earthing

Distributor's facility ☐

Installation earth electrode ☐

Details of Installation earth Electrode *(where applicable)*

Type (e.g. rod(s), tape etc) _____ Location _____ Electrode resistance to earth _____ Ω

Main Protective Conductors

Earthing Conductor: material _____ csa _____

Main protective bonding/ conductors material _____ csa _____

To incoming water service ☐ To incoming gas service ☐ To incoming oil service ☐ To structural steel ☐

To lightning protection ☐ To other incoming service(s) ☐ (state details _____)

Main Switch or Circuit-breaker

BS, Type and number of poles_____ Current rating _____A Voltage rating _____ V

Location_____ Fuse rating or setting _____ A

Rated residual operating current $I_{\Delta n}$ =_____mA, and operating time of _____ ms (at $I_{\Delta n}$) (applicable only where an RCD is suitable and is used as a main circuit circuit-breaker

OBSERVATION AND RECOMMENDATIONS Tick boxes as appropriate

Referring to the attached Schedule (s) of Inspections and Test Results, and subject to the limitations specified at the Extent and Limitations of the Inspection Section

Recommendations as detailed below

☐ No remedial work is required ☐ The following observations are made:

_____

_____

_____

_____

_____

_____

_____

One of the following numbers, as appropriate, is to be allocated to each of the observations made above to indicate to the person(s) responsible for the installation the action recommended.

1 requires urgent attention 2 requires improvement 3 requires further investigation

4 does not comply with BS 7671:2008 amended to _____ This does not imply that the electrical installation inspected is unsafe

SUMMARY OF THE INSPECTION

Date(s) of the inspection:_____

General condition of the installation:_____

_____

_____

_____

Overall assessment: Satisfactory/Unsatisfactory

SCHEDULES (S)

The attached Schedules are part of this docment and this Report is valid only when they are attached to it.

_____ Schedules of Indpections and _____ Schedules of Test Results are attached.

(Enter quantities of schedules attached)

The recommended intervals for periodic inspection and testing on the following types of installation unless other Competent Authorities specifically require shorter intervals, are as follows: -

- **10 years interval for domestic installation (private houses, flats).**
- **5 years interval for commercial properties (shops & offices), educational establishments (Schools, Colleges & universities), hotels & boarding houses.**
- **3 years interval for factories, workshops and agricultural installation.**
- **1 year interval for petrol filling stations, public entertainment areas (theatres & cinemas), public launderettes, places of worship.**
- **6 months interval for construction sites and temporary installation.**
- **Change of occupancy or owner.**

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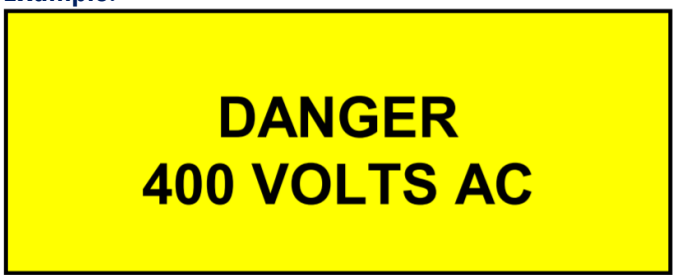
Safety Warning Labels

Labels or other suitable means of identification shall be provided to indicate the purpose of circuit breakers and control gears in the DB / MSB. Such labels are to be properly glued or fixed by screws. Also, all live cables (including neutral) and earth of all outgoing final circuits terminated in the distribution board shall be properly labelled using appropriate cable markers. A danger warning sign (DANGER 400V) shall be installed on all cover.

Example:



"DES – Electrical Installation Requirements, 2011"

C) GUIDANCE

34. (2) Inspection

Before any work is carried out at a worksite, the worksite shall be inspected *by a competent person* appointed by the employer to:

a) Identify, risk assess hazards that is due to electrical power circuit and its usage to mitigate danger to any person that may come into contact with in the course of his work in the worksite; and produce test report for Electrical installation.

b) Identify any tool or machine which is connected or intended to be used to any electrical power circuit and which any person may come into contact with in the course of his work in the worksite; and produce test report for the tools inspected.

Note: A **competent person** is an adequately trained person/s and deemed to have sufficient technical knowledge and qualifications to perform work safely on Power Systems and to appreciate the dangers associated therewith

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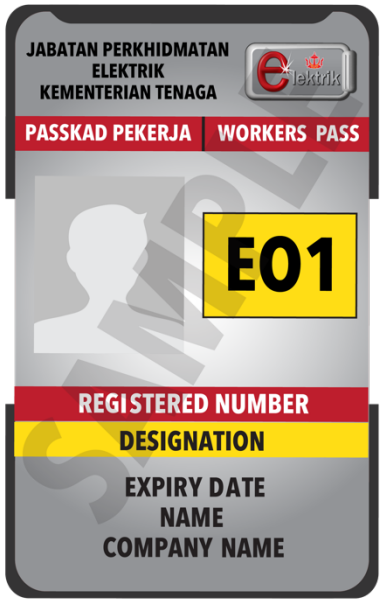
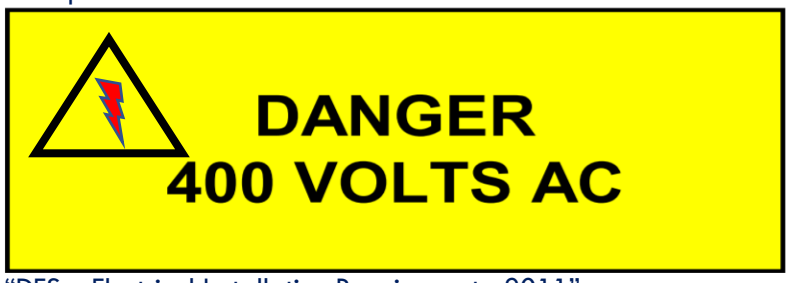


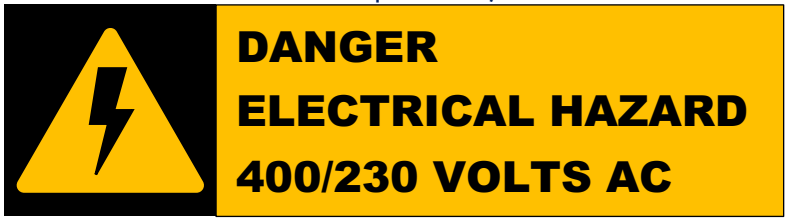
Example of **competent persons** or **DES Approved (Specialised Contractor)** doing such installation works shown are licensed E01 category worker from DES Registered Electrical Worker (REW).

(3) Warning Signs and Labelling
Appropriate warning signs and labels according to its **Highest Voltage levels** shall be clearly posted and maintained where location of the electrical power circuit, tool or machine is located.

Example:



"DES – Electrical Installation Requirements, 2011"



(4) Safety Clearance

Prohibition of works close to electrical power circuits or in the vicinity of live conductors, is the minimum distance a person may encroach such conductors.

Note: Safety clearance with accordance to the "Department of Electrical Services Safety Rules Rev.3" or later and "System Operating Regulations Rev.3" or later are as follows:

- Up to **11kV = 1 metre**
- More than **11kV** and up to **66kV= 2 metres**

(a) No person shall be permitted to work in the vicinity of live conductors at a worksite -

- the hazards involved in such works has been identified;
- the location of the electrical power circuit has been advised and identified,
- and the protective measures to be taken via risk assessment; and

(b) The advice shall be done by a competent person using appropriate tools such as proximity tester etc. to protect against electric shock by-

(i) System of permits shall be used in case of works involving close proximity to electrical power circuits to ensure circuits are Switched off, Isolated, Tested, (also Earthed and Locked-off and Labelled where ever applicable).

(ii) Effectively barricading the area using suitable barriers to minimise encroachment to the vicinity of live conductors.

2) INSTALLATION OF ELECTRIC WIRING AND POWER LINES

A) *REGULATION*

35. (1) It shall be the duty of:

(a) the employer of the person who carries out any work in the course of which the person may come into contact with any electric wiring or cable in a worksite; or

(b) the principal under whose direction any person carries out any work in the course of which the person may come into contact with any electric wiring or cable in a worksite,

to comply with sub-regulations (2) and (3).

(2) All electric wiring in a worksite shall -

(a) be supported on proper insulators; and

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(b) not be looped over nails or brackets.

(3) Subject to sub-regulation (4), no electric wiring or cable shall be left or laid on the ground or the floor of a worksite unless it is -

(a) of the weather-proof type;

(b) provided with adequate protection to withstand the wear and tear to which it may be subjected; and

(c) maintained in good and safe working order.

(4) Sub-regulation (3) shall not apply to a flexible cable which -

(a) does not exceed 3 metres in length; and

(b) is used to connect an electrical equipment to a plug.

(5) It shall be the duty of the occupier of a worksite to ensure that all elevated power lines shall-

(a) have a sufficient vertical clearance where they cross highways, access roads or areas travelled by trucks, cranes, shovels or other similar equipment; and

(b) be at least 5 metres above the ground level.

B) **ACOP**

35 (2) The Electrical Installation shall be carried out in compliance with the latest edition of IET Wiring Regulations for Installation of Electrical Wiring.

35 (5) (a) Meter-board/sealing chamber/Main Switch Board (MSB) located more than 50 metres from DES power source, the aerial PVC insulated cables shall be used and installed on 75-mm diameter x 6 metre-high galvanised iron (G.I) poles.

The maximum span between poles shall be 20 metres.

75-mm (min) diameter x 10 metre-high galvanised iron (G.I) poles shall be used for road crossing.

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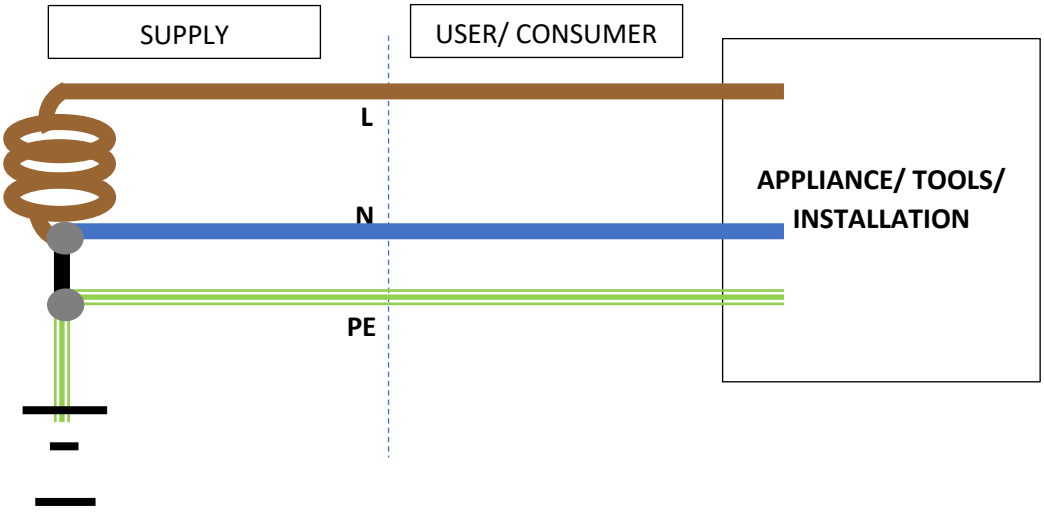
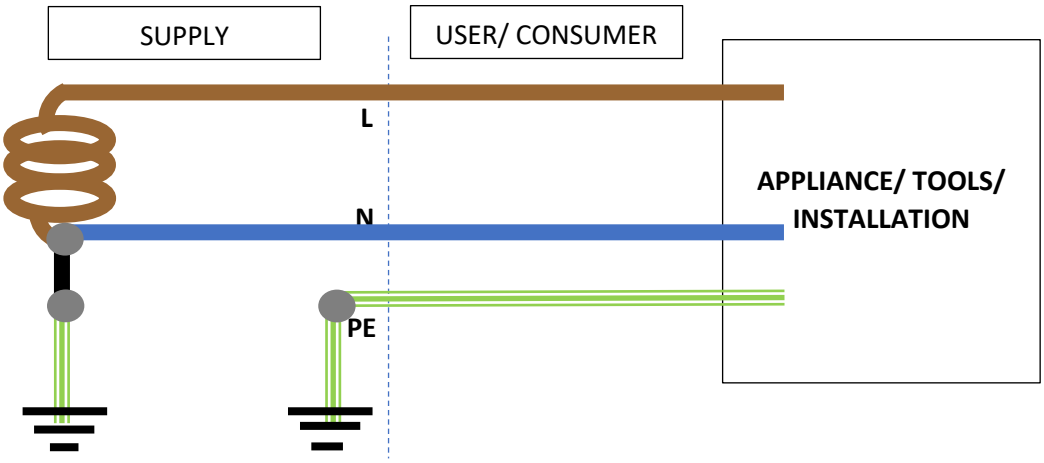
C) GUIDANCE

35. The general electrical wiring installation at construction sites shall be of TNS (Terre Neutral Separate) or TT (Terre Terre) system network configuration with PME (Protective Multiple Earth).

TNS System



TT System



(2) All electric wiring in a worksite shall comply with the existing "Electrical Installation Requirements, 2011- First Editions" or later and "18th Edition IET Wiring Regulation BS 7671:2018" or later.

(a) All unsheathed wiring shall be enclosed in PVC conduits and/or PVC trunking with proper supports and cover to minimise exposure of unsheathed wiring without any protection or covers.

(b) All unsheathed and sheathed wiring shall not be looped over nails or brackets.

(3) Electric cable or wiring intended to be laid on the ground or floor of a worksite shall be -

(a) Recommended cables to be used and not limited to other weather-proof type cable are PVC/SWA/PVC (PVC insulated, Steel Wire Armoured, PVC Sheathed), or XLPE/SWA/PVC (Cross Linked Poly Ethylene (XLPE) insulated, Steel Wire Armoured, PVC Sheathed) and/or as per DES specifications and only waterproof joints are allowed.

(b) Protection from being directly hit by foreign objects, example usage of PVC covers, PVC pipes, PVC conduits, PVC trunking etc.

(c) Periodic inspection to ensure the cables are in good and safe working conditions free from damage, cuts or heavily worn conditions.

(4) For flexible cables which do not exceed 3 metres and used to connect an electrical equipment to a plug:

- unsheathed flexible cables shall not be used in any case.
- In areas where the ground conditions are wet and/or exposed to weather, weather proof cable shall be used.
- Joints for these cables shall be weather proof types.

(5) It shall be the duty of the occupier of a worksite to ensure that all elevated power lines shall -

(a) Recommended poles to achieve required vertical clearance for overhead power lines used for road crossing is by using 75-mm minimum diameter and 10 metre-high galvanised iron (G.I) poles.

(b) Elevated Power lines shall have minimum clearances of 5 metres from the ground level i.e. from minimum sag point to ground.

However, it is recommended in any case to use underground cables protected in pipe sleeves laid to about 100mm from ground level (or other suitable method of laying pipes) for crossing highways, access roads or areas travelled by trucks, cranes, shovels or other similar equipment.

3) BARE WIRES AND EXPOSED LIVE CONDUCTORS

A) *REGULATION*

36. (1) It shall be the duty of the occupier of a worksite where any electrical installation is used in the worksite to ensure –

(a) that the electrical installation is effectively earthed where these have provisions made for earthing;

(b) that any exposed metal part of the electrical installation, other than the current carrying part, which is liable to become energised in the event of a failure in the insulation is effectively earthed; and

(c) where the electrical installation is connected to any bare wire or other uninsulated live conductor, that no bare wires or other uninsulated live conductors are located at any place in a worksite where a person may work or pass, unless

(i) such wires or conductors are effectively insulated or guarded by a fence or other barrier; or

(ii) the person working or passing is an electrical worker licensed under the Electricity Act (Chapter 71) to carry out such electrical works on the wires or conductors.

(2) It shall be the duty of -

(a) the employer of the person who uses any electrical appliance or other current carrying equipment in a worksite; or

(b) the principal under whose direction any person uses any electrical appliance or other current carrying equipment in a worksite,

to ensure

(i) that the electrical appliance or current carrying equipment is effectively earthed where these have provisions made for earthing; and

(ii) that any exposed metal part of the electrical appliance or current carrying equipment, other than the current carrying part, which is liable to become energised in the event of a failure in the insulation is effectively earthed.

B) **ACOP**

36.(1) (a) & (b)

The consumer's Main Earthing Terminal shall be connected using a suitably sized Earthing Conductor to an effective Earth Electrode(s). The Earth Electrode shall be copper bonded steel-core rod or solid copper rod and it shall be driven into the

ground at least 2 metre deep at a practical position near to the consumer's Earthing Terminal.

Only DES approved earth rods (complying with BS 7430:2011+A1:2015 or later) shall be used. For domestic premises, having 3-phase supply not exceeding 100A, 16mm diameter Earth Electrode(s) shall be used.
A minimum of two (2) earthing connections shall be installed from the Main Switch Board (MSB), sub-main, DB or earthing bar to the earth pit(s) to ensure high reliability and integrity of the earthing and bonding system for personal safety requirements.

All water pipe or gas pipe to any building or premises shall NOT be used as an Earthing Electrode. However, all metal pipe shall be bonded for personal safety requirements.

The installation of an Earth Electrode shall be made in a concrete Earthing Inspection Pit, measuring approximately 300mm X 300mm X 300mm. The connection of the Earthing Conductor and the electrode shall be soundly made by a soldered "Furse" / "Cadweld" joint or by a proper heavy duty "Furse" / "Cadweld" cable to rod or tape to rod clamp. A permanent label "SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE" shall be installed at the earth pits and earthing connection bars. The pit shall be filled with sand and covered with a removable heavy-duty cover.

Earthing Inspection Pit

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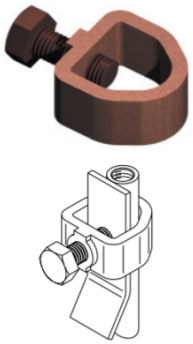
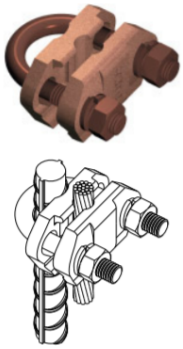
Earth connection Clamps

Furse – Rod to tape clamp (type A)	Furse – Rod to cable clamp (type G)	Furse – Rod to cable clamp (type GUV)
		

For every LV earthing installation, the Earth Electrode Resistance shall not exceed one (1) Ohm. For HV equipment earthing in the substation, the Earth Resistance shall not exceed 0.5 Ohm.

36.(1) I

All Circuit Protective Conductor (CPC) and earthing loops from the DBs including consumer units to the power points, socket outlets, devices, lighting points etc shall be measured and shall comply with BS 7671:2018 or later, minimum acceptable value.

Department of Electrical Services Safety Rules and Regulations are as follows –

a) Up to 11kV = 1 metres
b) More than 11kV and up to 66kV= 2 metres

C) GUIDANCE

36. (1) The general electrical wiring installation at construction sites shall be of TNS and/or TT earthing system network configuration with PME (protective multiple earth).

(a) The Electrical Installation is effectively earthed where these have provisions made for earth.

Earthing Conductor shall be suitably sized in accordance with BS 7671:2018 or later and connected to an effective Earth Electrode(s). The Earth Electrode shall be copper bonded steel-core rod or solid copper rod and it shall be driven into the ground at least 2 metre deep at a practical position near to the Earthing Terminal.

Only DES approved earth rods complies with BS 7430:2011+A1:2015 or later shall be used. For 3-phase supply installations not exceeding 100A, 16mm diameter Earth Electrode(s) shall be used.

For every LV earthing installation, the Earth Electrode Resistance shall not exceed one (1) Ohm. For HV equipment earthing in the substation, the Earth Resistance shall not exceed 0.5 Ohm.

(b) Exposed metal part of the electrical installation, other than the current carrying part, which is liable to become energised in the event of a failure in the insulation is effectively earthed;

All circuit protective conductor and earthing loops impedances from the DBs shall be measured and shall comply with BS 7671:2018 or later, minimum acceptable value this shall include the impedance measurement of consumer units to the power points, socket outlets, devices, lighting points etc.

(c) Where there is the usage of bare wires or other uninsulated live conductor, no person shall work or pass in the vicinity, unless:

(i) Such wires or conductors are effectively insulated or guarded by a fence or other barrier such as barricading using designated barricades to prohibit encroachment to the vicinity of live conductors as follows:

a) Up to 11kV = 1 metres
b) More than 11kV and up to 66kV= 2 metres

(ii) Works on such conductors shall be done/performed by General Workers pass cards holders (Workers registered under the DES REW having completed DES Safety Awareness Training) issued by the DES with/under the full supervision of an Electrical worker who must possess the valid Electrical Worker Pass cards in appropriate category of works (E01, E02, E03 and E05) issued by the Department of Electrical Services.

(2) All electrical appliance/ hand tools to be used at worksite shall be inspected and shall be regularly maintained.

(i) The electrical appliance or current carrying equipment is effectively earthed where these have provisions made for earthing; and

No modifications shall be made to the electrical equipment/apparatus to exclude original provisions intended for earthing.

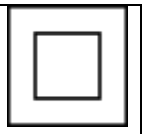
(ii) That any exposed metal part of the electrical appliance or current carrying equipment, other than the current carrying part, which is liable to become energised in the event of a failure in the insulation is effectively earthed.

The usage of Class 0 with reference to IEC 61140 equipment is **not** allowed in any case. Usage of Electrical Equipment/ Apparatus, that do not have its metal chassis connected to earth is **not** allowed.

In IEC 61140, electrical appliances are differentiated according to the protective-earth requirement of the devices. The IEC protection classes are as follows:

Class	Description	Symbol
Class 0	• No protective earth connection. • Single level of insulation between live parts and exposed metalworks • Intended to be used in dry areas only • Appliance metallic chassis are not connected to earth • A single fault might cause dangerous level of current to flow via touch potentials without the presence of the protective earth connection. • Single fault might not trigger the automatic operation of any fuse or circuit breaker.	
Class I	• Protective earth connection connected to chassis • Commonly miniature circuit breaker and residual current devices are used as a protection • 3 cables are used (Live, Neutral and Earth) • Single fault allows dangerously high current through the earth via the earth wires minimizing the amount of current to be flowing through other media especially from touch potentials. • Allows to trip overcurrent devices i.e. circuit breakers, miniature circuit breakers • Allows RCD to trip in case of earth fault.	
Class OI	• Chassis is connected to earth with a separate terminal • MCD and RCD are also used as protective devices against overcurrent and earth faults	

SAFE USE OF ELECTRICITY AT CONSTRUCTION SITES

Class II	• Also known as double insulated electrical appliances • Do not have earth connection • Protection against shock are via double insulation against fault. • User are not exposed to touch potentials	
Class III	• Appliance is designed to be supplied from a separated/safety extra low voltage power source (SELV). • Voltage is low enough that there is no risk of touch potentials to the user	

Class I and above equipment/apparatus are recommended to be used at the worksite, with supplementary Residual Current Devices (RCD) protection in the main switchboard connected to the apparatus.

Typical mark of Class I equipment

Tripping test of the RCD, Miniature Circuit Breaker (MCB), Molded Case Circuit Breaker (MCCB) etc. shall be done periodically to ensure functionality of the protection equipment installed, and test result shall be kept for reference.

4) RESIDUAL CURRENT CIRCUIT BREAKERS AND OVERCURRENT PROTECTIVE DEVICES

A) *REGULATION*

37. It shall be the duty of the occupier of a worksite where any electrical installation is used in the worksite to ensure that –

(a) effective residual current circuit breakers are installed for all temporary electrical installations to provide earth leakage protection; and

(b) overcurrent protective devices with the appropriate ratings are installed in the distribution board to provide overcurrent or short-circuit protection.

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B) **ACOP**

37 (a)

For industrial and commercial premises where there are 13A power socket outlets, a 30mA rated RCD must also be used to protect these final circuits in the distribution board.

The final circuits for the compound / gate / decoration lighting provided separately and independently shall be protected by a 30mA or a maximum of 100mA RCD.

A type S RCD that incorporate a filtering device (built-in) for delay tripping can only be installed for an independent circuit upon recommendation and approval from DES. This type of RCD reduces the risks of undesired tripping due to transient voltages (lightning, line disturbances) and transient currents (from high capacitive circuits).

Where an installation incorporates a RCD, a notice shall be fixed in a prominent position at or near the origin of the installation. The notice shall be in indelible characters not smaller than those illustrated and shown below:

> This installation, or part of it, is protected by a device, which automatically switches off the supply if an earth fault develops. Test quarterly by pressing the button marked 'T' or 'Test'. The device should switch off the supply and can be switched on to restore the supply. If the device does not switch off the supply when the 'T' button is pressed, please seek expert advice.

37 (b)

Only one cable shall be terminated in each outgoing terminal of a MCB or MCCB.

Where a submain cable feeds more than one distribution board or sub-board, its size must not be reduced when feeding a second or subsequent board. The submain cable must have a current rating greater than the circuit breaker protecting it. However, if a circuit breaker is inserted at the point where a reduction cable size is proposed, then the protective device (circuit breaker) must be rated to protect the cable.

All circuit protective conductor (CPC) shall be provided for each individual final outgoing circuit. No looping of CPC is permitted between outgoing final circuits.

Generally, the current rating of a cable in a circuit shall be greater than the current rating of the corresponding protective device at the origin of the circuit.

Cables used for final circuits should be colour coded according to the BS 7671:2018 or later.

At terminations, cables shall be terminated and tightly fitted in the terminals. The insulation of the wire shall have a gap less than 1mm from the metal part of the terminal.

Mark and label on each cable of every circuit at terminations using slip-on marker in the DB as well as at the sockets, switches, isolators, lighting, earthing, control and protective devices etc.

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A set of 'as built' single line diagrams and lighting & power layouts shall be kept within the Distribution Board (DB) / Main Switch Board (MSB) or properly kept in a plastic envelope for protection and hanged near the DB / MSB for future reference and maintenance use.

C) GUIDANCE

37. It shall be the duty of the occupier of a worksite where any electrical installation is used in the worksite to ensure that

(a) To provide earth leakage protection; It is mandatory for all final circuits in the distribution board to be protected by a Residual Current Device (RCD)

The usage of RCD with fixed sensitivity of 30mA and operating time not exceeding 40ms at a residual current of 5 I Δn, is recommended.

The 30mA rated RCD must also be used in the distribution board to protect final circuits where there are 13A power socket outlets used.
The final circuits for the compound lighting provided separately and independently shall be protected by a 30mA or a maximum of 100mA RCD.

(b) Overcurrent protective devices with the appropriate ratings are installed in the distribution board to provide overcurrent or short-circuit protection. MCB ratings shall be properly rated and following BS 7671:2018 or later.

Item	Type of Final Circuit	Cable Size	Rating of MCB
(a)	Lighting	3 X 1C 1.5 sq. mm.	6A/10A
(b)	13A Socket Outlet (radial) **	3 or 4 X 1C 2.5 sq. mm.	16A/20A
(c)	13A Socket Outlet (ring)	6 X 1C 2.5 sq. mm.	32A
(d)	15/20A Outlet	3 X 1C 4.0 sq. mm.	20A
(e)	32A Outlet	3 X 1C 6.0 sq. mm.	32A
(f)	Ceiling Fan	3 X 1C 1.5 sq. mm.	6A

**- refer to BS 7671: 2018, Section 543.1 for cross sectional area for protective conductor sizing.

5) PROHIBITION ON USE OF FUSE

A) *REGULATION*

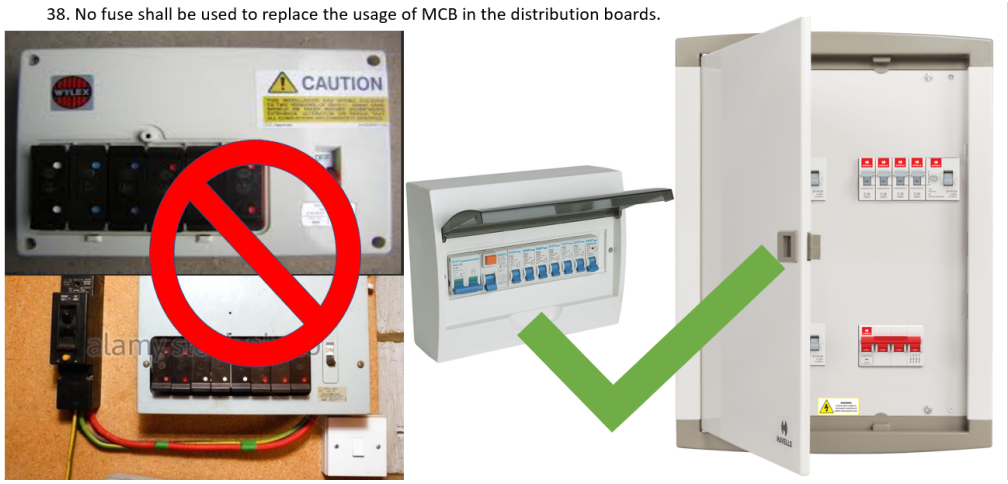
38. It shall be the duty of the occupier of a worksite where any electrical installation is used in the worksite to ensure that no fuse is used in the final circuit of any electrical installation.

SAFE USE OF ELECTRICITY AT CONSTRUCTION SITES

B) GUIDANCE

38. No fuse shall be used to replace the functions of MCB in the distribution boards.

38. No fuse shall be used to replace the usage of MCB in the distribution boards.



6) WELDING SETS

A) *REGULATION*

39. It shall be the duty of -

(a) the employer of the person who uses any welding set in a worksite;

or

(c) the principal under whose direction any person uses any welding set in a worksite,

to ensure that all alternating current welding sets are fitted with an effective voltage limiting device or shock preventor.

B) GUIDANCE

39. All alternating current welding sets are fitted with an effective voltage limiting device or shock preventor. Welding sets shall comply with BS EN 60974-1: 2005, Arc Welding Equipment, Power Sources.

Examples of Voltage Reducing Devices

SAFE USE OF ELECTRICITY AT CONSTRUCTION SITES

VRD = Voltage Reducing Device

Australian Government standards 1674.2 2003 state this voltage must be less than 35 Volts DC and **25 Volts AC**.

Features

- Inline open circuit voltage reducer, which requires no auxiliary power.
- Open circuit voltage is less than 24 volts and always DC.
- AC or DC operation.
- Inbuilt anti-stick circuit switches off the power if electrode freezes in weld.
- Operating time of unit to a safe voltage is within 0.3 seconds.
- Green ready light shows unit is ready to weld.
- Unit constantly monitors OCV, in the event of a fault a red light starts to flash.
- Mounting bracket enables unit to be secured to a wall or machine easily.
- Designed to meet BS EN60974-1 and EN50199.

7) INDUSTRIAL PLUG AND SOCKET-OUTLET

A) *REGULATION*

40. It shall be the duty of the occupier of a worksite where any industrial plug and socket-outlet is used in the worksite to ensure that the plug and socket-outlet used for connecting any electrical equipment to a temporary electrical installation is of heavy duty industrial type.

B) GUIDANCE

40. Where any temporary electrical installation utilises industrial sockets, heavy duty industrial type plug and socket shall be used.

For connecting any electrical equipment to a temporary electrical installation, it is recommended to use heavy duty industrial type plug and socket with Minimum Index of Protection of IP54 sockets if it is exposed to weather.

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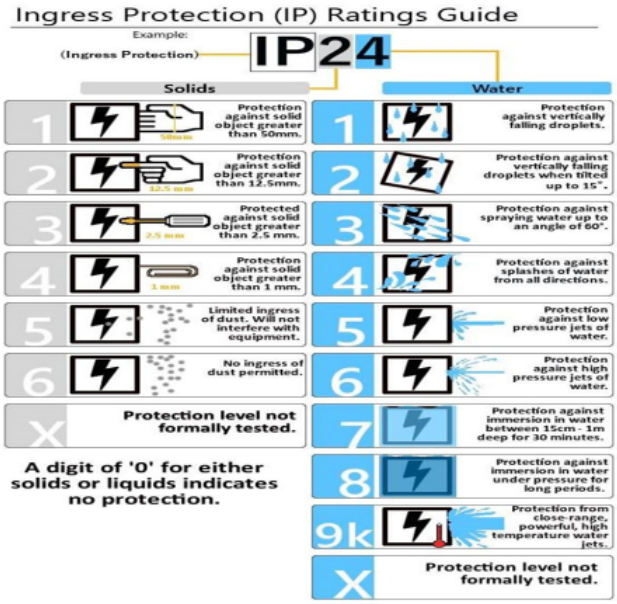
IP (INGRESS PROTECTION or INDEX OF PROTECTION)



INDUSTRIAL PLUGS AND SOCKETS

SAFE USE OF ELECTRICITY AT CONSTRUCTION SITES

8) DISTRIBUTION BOARD AND SOCKET-OUTLET ASSEMBLY

A) *REGULATION*

41. It shall be the duty of the occupier of a worksite to ensure that -

(a) circuit breakers used for the final circuits of any distribution board and socket-outlet assembly in the worksite are housed in an enclosure; and

(b) the enclosure is constructed so as -

(i) to fully enclose all live electrical parts within the enclosure;

(ii) to allow any of the circuit breakers to be switched on or off without having to open the enclosure; and

(iii) to be of weather-proof construction

B) ACOP

41.(a) & (b)

Labels or other suitable means of identification shall be provided to indicate the purpose of circuit breakers and control gears in the DB / MSB. Such labels are to be properly glued or fixed by screws. Also, all live cables (including neutral) and earth of all outgoing final circuits terminated in the distribution board shall be properly labelled using appropriate cable markers. A danger warning sign (DANGER 400V) shall be installed on all cover.

Switchboard or DB shall be provided with insulated busbar to reduce the risk of arc flash or flashover. Where doors/lids of distribution boards or switchboards can be opened without the use of a tool or key, all live conductive parts such as terminals which are accessible if the door/lid is opened shall be behind an insulating barrier which prevents persons from coming into contact with those "LIVE" parts. This insulating barrier shall be flame retardant and provide a degree of index protection of at least IP2X and be removable only by use of a tool. Covers shall be provided for the empty spaces of the MCB slots.

A set of 'as built' single line diagrams and lighting & power layouts shall be kept within the DB / MSB or properly kept in a plastic envelope for protection and hanged near the DB / MSB for future reference and maintenance use.

C) GUIDANCE

41.

(a) circuit breakers used for the final circuits of any distribution board and socket-outlet assembly in the worksite are housed in an enclosure; and

Minimum Index of Protection of IP54 or higher recommended.

(b) the enclosure is constructed so as

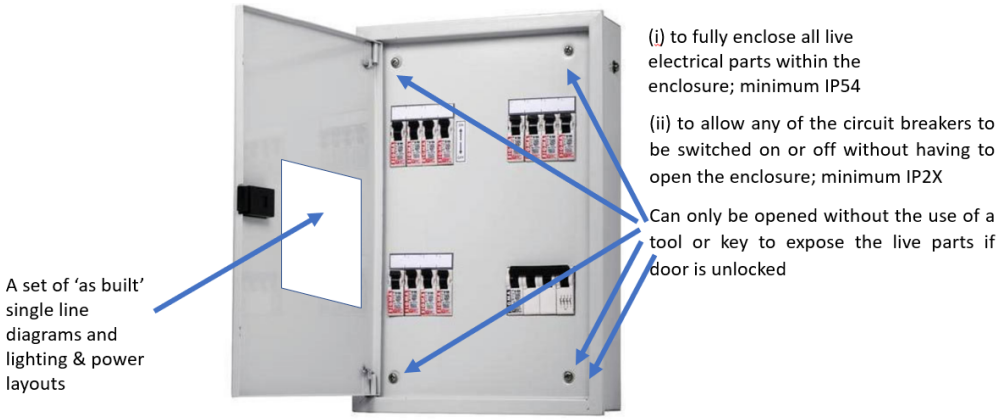
(i), (ii) & (iii)

Switchboard or DB shall be provided with insulated busbar to reduce the risk of arc flash or flashover.

All exposed and live parts which are susceptible to touch are to be insulated behind insulating barrier. This insulating barrier shall be flame retardant and having a minimum degree of protection of IP2X, and only be removable by using appropriate tool. The empty spaces of the MCB slots shall be covered.

The door enclosure to access and operate the MCB and RCD are to be of weather proof construction having a minimum degree of protection of IP54 and as built single line diagrams are to be kept within the MSB for future reference and maintenance use.

• Distribution board.



SAFE USE OF ELECTRICITY AT CONSTRUCTION SITES

Socket Outlet Assembly.

9) ELECTRICAL INSTALLATIONS AND EQUIPMENT USED UNDERGROUND OR IN CONFINED SPACE

A) *REGULATION*

42. It shall be the duty of the occupier of a worksite where any lighting, electric hand-held tools and inspection lamps and lights are used underground or in a confined space to ensure that -

(a) the electricity supply for lighting and electric hand-held tools is provided by means of a step-down transformer having a secondary voltage not exceeding 110 volts centre point earthed; and

(b) the electric hand-held tools and inspection lamps and lights are operated at a voltage not exceeding 55 volts between the conductor and earth

B) GUIDANCE

42. Lower voltages are prescribed for electrical installations and equipment used or works done in confined spaces as follows:

(a) Supply voltage of maximum of 110 Volts centre point earthed via a step-down transformer

(b) 55 Volts between the conductor and earth for the operation of the electric hand-held tools and inspection lamps and lights.

- Supply voltage of maximum of 110 Volts centre point earthed via a step-down transformer (AC, *resulting in 55V AC*)
- 55 Volts (AC) between the conductor and earth for the operation of the electric hand-held tools and inspection lamps and lights.
- *International standard IEC 60364-4, anything below 50VAC (or 120VDC) is low voltage*

SAFE USE OF ELECTRICITY AT CONSTRUCTION SITES

- This is in line with Class III equipment

symbol of class III equipment.

- Cordless power tools are recommended

Additional requirements for compliance to WSHCR, relating to electrical safety but on different parts of the WSHCR as follows:

WSHCR PART X DEMOLITION

1) Preparation of demolition work

A) REGULATION

70. (1) Before commencing any demolition work in a worksite -

(a) all glass and claddings on the exterior of the building to be demolished shall be removed;

and

(b) all gas, electric, water, steam and other supply lines shall be shut off and capped.

(2) Where it is necessary to maintain any power, water, gas or electric lines during demolition in a worksite, such lines shall be so re-located or protected with substantial coverings so as to protect them from damage and to afford safety to every person.

B) GUIDANCE

70. (1) To ensure electric supply to the workplace are de-energised, isolated and cables to the workplace are to be disconnected from the main source.

(2) Where it is necessary to maintain any power, water, gas or electric lines during demolition in a worksite, such lines shall be so re-located or protected with substantial coverings so as to protect them from damage and to afford safety to every person.

SAFE USE OF ELECTRICITY AT CONSTRUCTION SITES

References:

1) *WORKPLACE SAFETY AND HEALTH ORDER, 2009 (S 44/2009)*

2) *WORKPLACE SAFETY AND HEALTH (CONSTRUCTION) REGULATIONS, 2014 (S 35/2014)*

3) *Electrical Installation Requirements 2011 — First Edition, DEPARTMENT OF ELECTRICAL SERVICES, Revision '0', Issue I, DATED 11 JANUARY 2011.*

4) *BS 7671: 2018 Requirements for Electrical Installations – IET Wiring Regulations Edition London: BSI*

(https://shop.bsigroup.com/en/ProductDetail/?pid=00000000030342613&t=r)

5) *BS 7430:2011+A1:2015 – Code of Practice for Protective Earthing of Electrical Installations.*

(https://shop.bsigroup.com/ProductDetail/?pid=000000000030322344)

6) *Earth Rod Clamps,*
(https://www.cablejoints.co.uk/upload/Furse_Earth_Clamps___Furse_Earth_Bars___Furse_Earthing___Furse.pdf)

7) *IEC 61140 – Protection against electric shock - Common aspects for installation and equipment*

(https://webstore.iec.ch/publication/23997)

8) *BS EN 60974-1:2005 – Arc welding equipment. Welding power sources*

(https://shop.bsigroup.com/ProductDetail/?pid=000000000030095684)

9) *IP Rating Guide,* (http://heatingpoint.com/advice-centre/blog/ip-ratings-guide/)