



INDUSTRY GUIDANCE NOTE

TOPIC: GUIDANCE ON THE SAFE USE AND INSTALLATION OF PORTABLE GENERATORS (LESS THAN 10KVA)			Reference Number: 2021/IGN/08
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TABLE OF CONTENTS

1. SUMMARY	2
2. INTRODUCTION	2
3. PURPOSE	2
4. SCOPE	3
5. APPLICABLE LAWS	3
6. ABBREVIATION	3
7. TYPICAL SETUP OF PORTABLE GENERATOR ARRANGEMENT AT CONSTRUCTION WORKSITES	4
7.1 PORTABLE GENERATORS	5
7.1.1 OTHER SAFETY CONSIDERATIONS CONCERNING GENERATORS.....	7
7.2 CABLES FROM GENERATOR TO DISTRIBUTION BOX	7
7.2.1 ELECTRICAL CABLE	8
7.2.2 UNSHEATHED ELECTRICAL CABLES	8
7.2.3 OTHER SAFETY CONSIDERATIONS.....	8
7.3 DISTRIBUTION BOX, RCD AND MCB	8
7.3.1 INSTALLATION OF RCD AND MCB IN THE DISTRIBUTION BOX.....	9
7.4 EARTH LINK — CONNECTION TO THE GENERAL EARTH MASS	10
7.4.1 TNS EARTHING SYSTEM	10
7.5 CONDUCTORS FROM DISTRIBUTION BOX TO LOAD SOCKETS AND ISOLATOR	11
7.5.1 UNSHEATHED INSULATED ELECTRICAL WIRES	11
7.5.2 ISOLATOR SWITCH	12
7.6 LOAD — PORTABLE APPLIANCES	12
7.6.1 CONDUCTORS BETWEEN LOAD SOCKETS / PLUG AND PORTABLE APPLIANCES	12
7.6.2 PORTABLE APPLIANCE / ELECTRICAL APPLIANCES / ELECTRICAL POWERED HAND TOOLS	13
7.6.3 PORTABLE APPLIANCE TESTING (PAT) TESTING AND CERTIFICATION OF THE APPLIANCE BY A COMPETENT PERSON IS RECOMMENDED	13
7.7 TESTING AND INSPECTION	14
7.7.1 TYPICAL PERIODICAL INSPECTION FORM	14
8. TYPICAL SETUP OF PORTABLE GENERATOR ARRANGEMENT AT MOBILE WORKSITES	17
8.1 CIRCUIT PROTECTIVE CONDUCTOR AND OTHER SAFETY CONSIDERATIONS	18
9. COMMON ERROR IN INSTALLATIONS	19
10. REFERENCES	20

1. SUMMARY

This Industry Guidance Note (IGN) provides relevant information on the safe use of Portable Generators with ratings typically less than 10kVA and also informs the user on the safe installation and testing requirements for Portable Generators.

There are safety concerns with the usage of Portable Generators. Fatal accidents or serious injuries might occur from electrocution if there are insufficient mitigation and control measures in place to address the risks of electrocution. Due to its availability in the market and the fact that such equipment is sold in almost all hardware stores in Brunei Darussalam, the usage of Portable Generators in construction sites to support site activities is inevitable. However, the aspects of safety when using such equipment is routinely misunderstood and underestimated. The usage of the portable generators for personal or private use is also a concern due to the lack of basic knowledge on how to install and use Portable Generators safely.

Therefore, this IGN aims:

- (i) To provide recommendations on the type of arrangements to be used and its applications in places and temporary activities such as construction sites, food trucks, temporary stalls or personal use.
- (ii) To ensure the safe use of the Portable Generator with respect to the laws, the procedures which the principal, occupier, self-employed persons, persons who erect, install or modify machinery or equipment and persons in control of machinery for use at work, occupier of common areas and employer should adhere to, as well as other safety precautions and standards.

The Workplace Safety and Health Order, 2009 (WSHO, 2009) imposes duties on occupiers, employers, self-employed persons, principals and persons at work to ensure that the workplace and any machinery or equipment used in the activities shall be safe and without risks to every person within the workplace.

2. INTRODUCTION

Portable Generators are machines that are used to provide temporary electricity. They are commonly used to provide electrical supplies to power up electrical power appliances such as drills, grinders and steel cutters in the construction industry, and to supply power for temporary labour quarters, food stalls, food trucks, temporary worksite lighting, any events that requires power from portable generators and other public use for outdoor activities.

Their small, compact nature and ease of operation provide convenience to the user. Almost everyone are aware of the hazards and the dangers associated with the general use of electricity. However, there is limited understanding on the control of hazards of electricity with regards to Portable Generators as witnessed and found in numerous construction worksites.

3. PURPOSE

This guidance provides recommendations for registered electricians, Qualified Persons and installers of Portable Generators typically for generators with less than 10kVA capacity to follow and to ensure safety of users of electricity from the equipment, in construction worksites, temporary food stalls, portable food trucks and other such locations when used.

4. SCOPE

This guidance is to provide a standard practice for Portable Generator installation in accordance with the applicable laws for carrying out work activities using electrical appliances and Portable Generators in Negara Brunei Darussalam.

5. APPLICABLE LAWS

SHENA would like to remind all principals, employers, occupiers, self-employed persons and persons at work to comply with applicable laws and regulations not limited to those listed below:

- (i) Workplace Safety and Health Order, 2009 (WSHO, 2009) To ensure that the workplace and any machinery or equipment used in the activities are safe and without risks to every person within the workplace, as stipulated under:
 - Section 11 – Duties of occupier of workplace
 - Section 12 – Duties of employers
 - Section 13 – Duties of self-employed persons
 - Section 14 – Duties of principals
 - Section 15 – Duties of persons at work
 - Section 18 – Other Related Duties of occupiers and employers
 - Section 19 – Duties of occupier of common areas
- (ii) Workplace Safety and Health (Risk Management) Regulations, 2014
Principals, Employers and Self-Employed Persons are required to conduct a risk assessment in relation to the safety and health risks posed to any person who may be affected by his undertaking in the workplace.
- (iii) Workplace Safety and Health (Construction) Regulations, 2014
The employer or principal is required to provide adequate safety and health training to any person who carries out manual work or supervisory work in a worksite.
- (iv) Workplace Safety and Health (Incident Reporting) Regulations, 2014
The employer or occupier is required to report any accident in a workplace that leads to death, reportable injury or any dangerous occurrence.

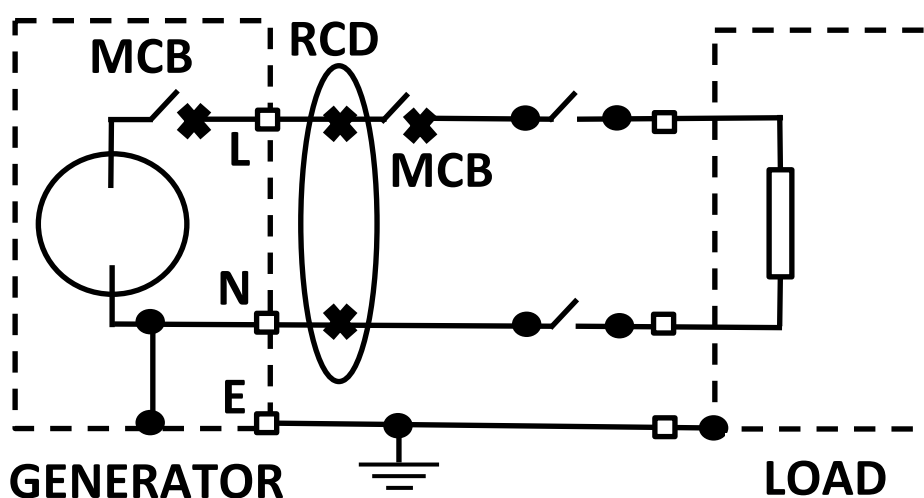
Disclaimer: This IGN is formulated to provide guidance to ensure the safe installation and use of Portable Generators. This includes wiring, earthing arrangements, recommended configurations and its application. It does not relieve the user of other relevant legal requirements regarding the usage and installation of Portable Generators that may be imposed under the laws of Brunei Darussalam or by other relevant authorities.

6. ABBREVIATION

BS	British Standards
DB	Distribution Board
DES	Department of Electrical Services
EIR	Electrical Installation Requirements 2011 – First editions
G.I	Galvanised Iron

IEC	International Electrotechnical Commission
IP	Ingress Protection
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
PVC	PolyVinyl Chloride
PVC/SWA/PVC	PVC insulated, Steel Wire Armoured, PVC Sheathed
RCD	Residual Current Devices
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
EIC	Electrical Installation Certificate

7. TYPICAL SETUP OF PORTABLE GENERATOR ARRANGEMENT AT CONSTRUCTION WORKSITES



L= Live, N= Neutral, E= Earth

Figure 1: Typical setup of Portable Generator

This arrangement is highly recommended to temporary worksites such as construction worksites, temporary labour quarters, temporary site offices and not limited to personal use, etc.

For this guidance the above single line diagram is subdivided into six(6) parts

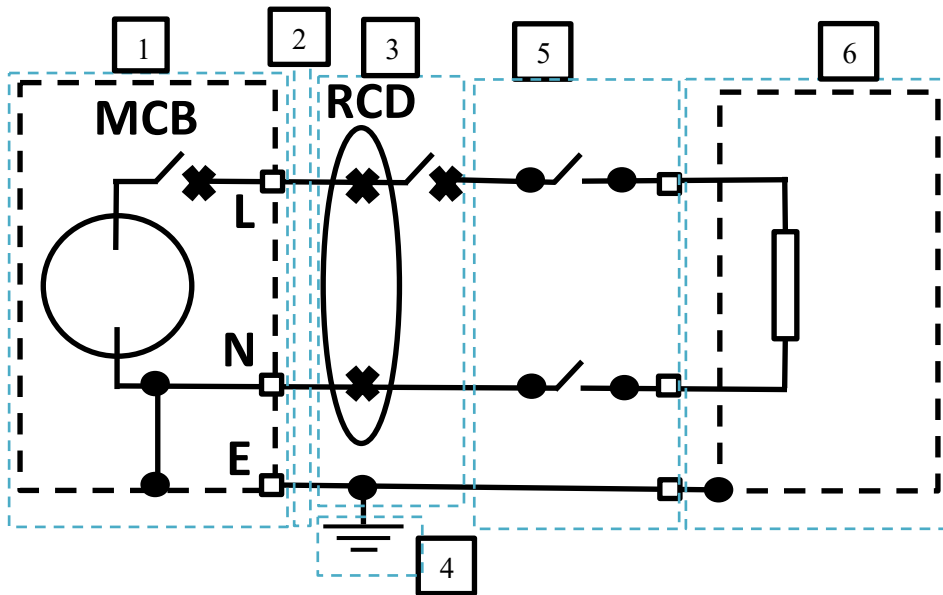


Figure 2: Showing 6 parts of the Portable Generator.

- 1) Portable Generator
- 2) Cables from Portable Generator to Distribution box
- 3) Distribution box, RCD and MCB
- 4) Earth link – Connection to the General Earth Mass
- 5) Cables from Distribution Box to Load sockets and Isolator.
- 6) Load – Portable Appliances

7.1 PORTABLE GENERATORS

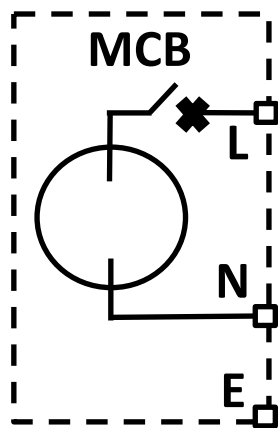


Figure 3: Single Line Diagram and Sample of Portable Generator with built-in MCB

Note:

Most of the Generators available at the market are only equipped with built-in MCB and supplied without RCD. This is a safety concern to the user of the portable generator as the users are not protected against electric shock.

There are also Portable Generators with dual voltage (110/220 Vac) capability and the user of the portable generator must ensure the correct voltage is selected.

Manufacturers of Generators normally do NOT bond the neutral wire from the Generator winding to the metal frame of the Generator and the terminal of the earthing. A qualified electrician will be able to connect/bond the neutral wire of the Generator winding to the earth terminal of the connection and the metal frame of the Generator. This is done for the purpose of installing RCD and its intended operation as a safety device against electric shock.

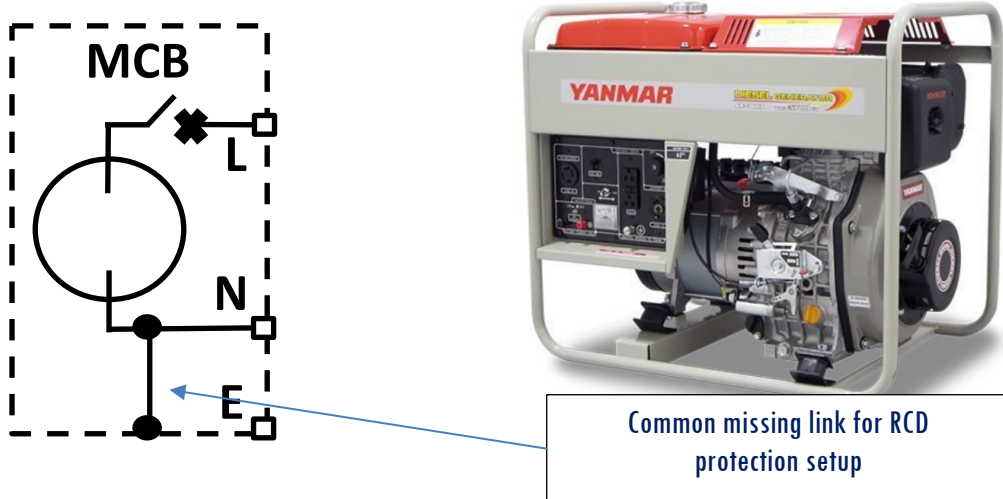


Figure 4: Common Missing Link for Portable Generator

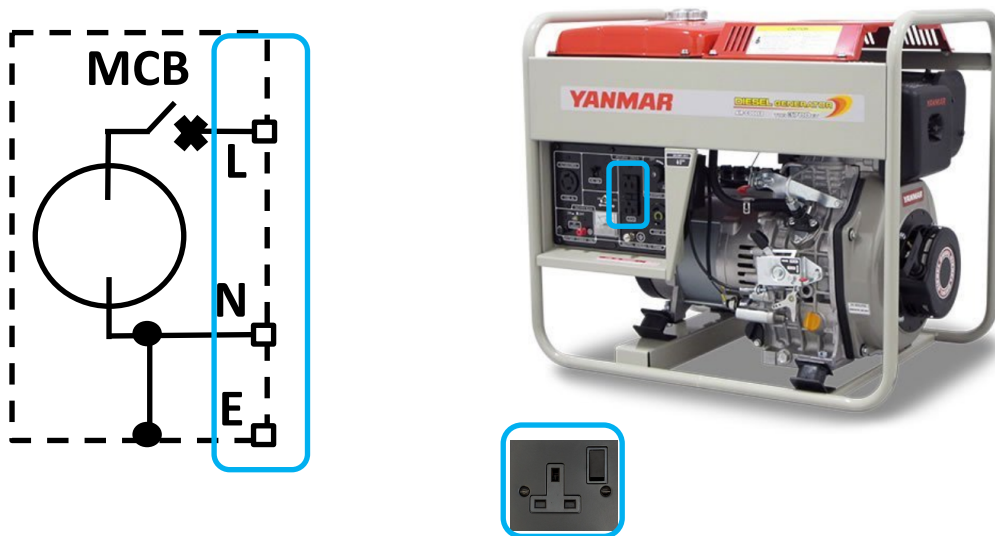


Figure 5: Connection point to the generator



- Not suitable to be used in unshaded areas
- No IP rating
- Use only in dry areas away from contact with water



- Recommended use of industrial plug and sockets
- Minimum IP54 rating

Figure 6: Plug and Sockets

7.1.1 OTHER SAFETY CONSIDERATIONS CONCERNING GENERATORS

- Operate Generator in a well-ventilated area and avoid operating Generator inside a house or enclosure. This is to prevent carbon monoxide poisoning from the gas produced by the exhaust of the Generator.
- Never connect the Generator to the home wiring system to prevent backfeed to the distribution grid. This is to prevent overloading and unsafe paralleling to the distribution networks.
- Never overload a Generator and ensure the load connected to the Generator does not exceed the capacity of the Generator. Overloading a generator might cause overheating and leads to electrically induced fire.
- Never refuel the Generator during running operation and ensure that the Generator is switched off before refueling.
- Always place the Generator in a dry location. This reduces the risk of electric shock.
- Barricade the Generator with barricades of at least one(1) metre perimeter of the Generator at the construction sites to prohibit encroachment.
- In a common setup, hazards of electrical shock still exist in the part of the circuit from the Generator to the RCD. Precautions should be taken when operating the Generator because this part of the circuit is not protected by RCD.
- The RCD is highly recommended to be installed as close as possible to the Generator.

7.2 CABLES FROM GENERATOR TO DISTRIBUTION BOX

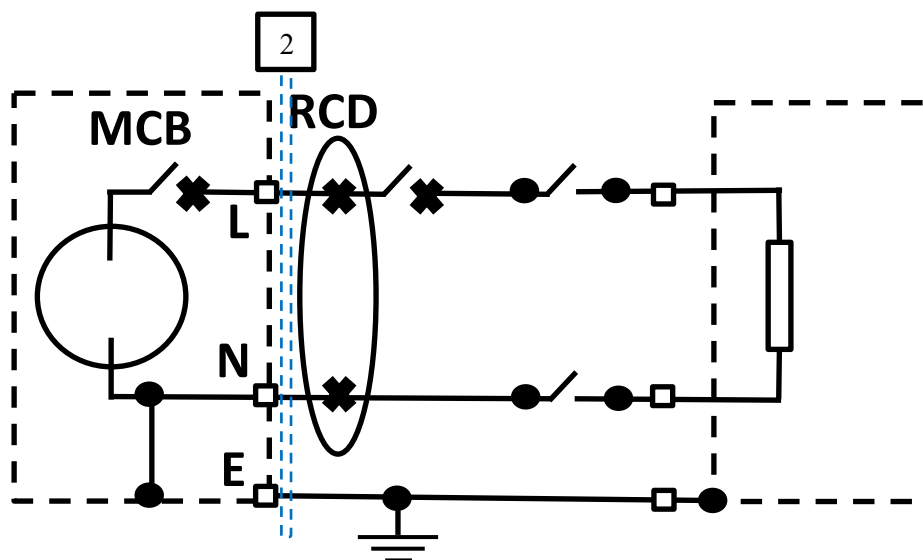


Figure 7: Location of cables connecting Generator to the Distribution box

In all cases, electrical cables, wirings and overcurrent protective devices shall be rated according to the capacity of the Generator which comply with the existing “DES, Electrical Installation Requirements, 2011- First Editions” or later,

and "18th Edition IET Wiring Regulation BS 7671:2018" or later standards. All wiring shall never be looped over nails or brackets.

Where a distribution box(DB) is used for installation, it is highly recommended to install the DB as close as possible to the generator to minimize risks of electrical shock.

7.2.1 ELECTRICAL CABLE

Electric cable or wiring intended to be laid on the ground or floor of a worksite shall follow the practices listed below:

- (a) Recommended cables to be used and not limited to other weather-proof type cables 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 specifications from the Department of Electrical Services (DES).
- (b) Protected from mechanical damage or being directly hit by foreign objects, example usage of rigid PVC covers, PVC pipes, PVC conduits, PVC trunking etc.
- (c) Periodic inspection and insulation tests to ensure the cables are in good and safe working conditions free from damage, cuts or heavily worn conditions.

7.2.2 UNSHEATHED ELECTRICAL CABLES

It is recommended to use the cables as described in section 7.2.1 Electrical Cable.

7.2.3 OTHER SAFETY CONSIDERATIONS

Proper termination of cables using proper lugs or similar, should be tightly fitted in its terminals.

7.3 DISTRIBUTION BOX, RCD AND MCB

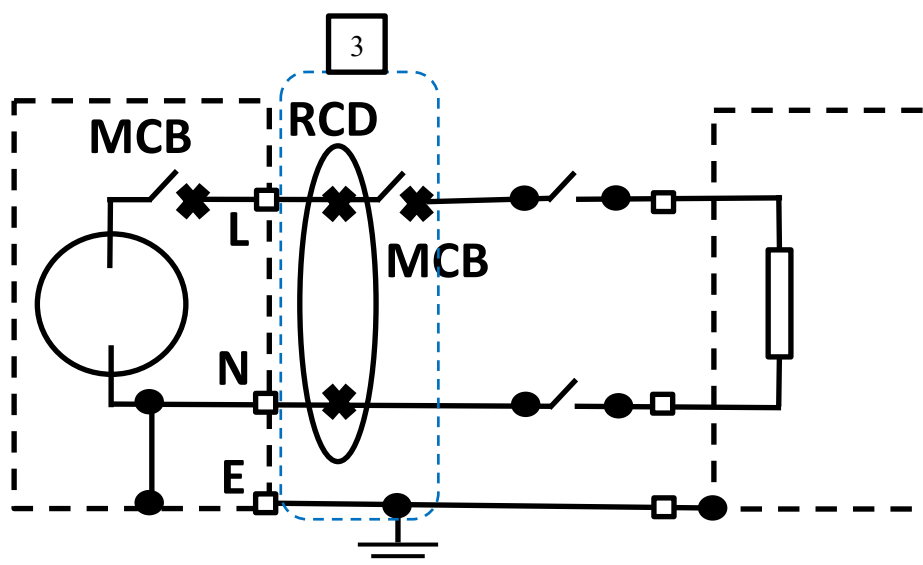


Figure 8: Location of Distribution box

7.3.1 INSTALLATION OF RCD AND MCB IN THE DISTRIBUTION BOX



Figure 9: Distribution box

- 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) and complies to IEC 61008.

The usage of RCD with fixed sensitivity of 30mA and operating time not exceeding 40ms at a residual current of $5 I_{\Delta n}$, 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.

- 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.

For every LV earthing installation, the Earth Electrode Resistance shall not exceed one (1) Ohm. Minimum of two (2) earthing connections shall be installed from the DB to the earth pit(s).

Earth Inspection Pit shall be installed to prevent damage to the connection of Earth cables to the Earth rods.



Figure 12: Earth Inspection Pit

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 shall be effectively bonded and 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.

7.5 CONDUCTORS FROM DISTRIBUTION BOX TO LOAD SOCKETS AND ISOLATOR

In common installations, the type of conductors used from the distribution box to the Load Sockets are unsheathed insulated electrical wires installed in rigid PVC conduit.

It is recommended to use the cables as described in section 7.2.1 Electrical Cable, if cables are to be laid on the floor.

7.5.1 UNSHEATHED INSULATED ELECTRICAL WIRES

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

- a) All unsheathed Insulated Electrical Wires shall be enclosed in PVC conduits and/or PVC trunking with proper support and cover to minimise exposure of unsheathed wiring without any protection or covers.
- b) All unsheathed and sheathed Insulated Electrical Wires shall never be looped (supported) over nails or brackets.



Recommended use of industrial plug and sockets
Minimum IP54 rating

Figure 13: Industrial Plug and Sockets

c) The use of cables as described in section 7.2.1) Electrical Cables are recommended.

7.5.2 ISOLATOR SWITCH



Figure 14: Isolator Switch

A properly rated Isolator Switch is to be used to provide an additional isolation point apart from Moulded Case Circuit Breaker (MCCB) in the Distribution box. This is to be placed close to the load for emergency purposes.

7.6 LOAD – PORTABLE APPLIANCES

This section provides recommendation for the safe usage of portable appliance.

7.6.1 CONDUCTORS BETWEEN LOAD SOCKETS / PLUG AND PORTABLE APPLIANCES

It is recommended to use Sheathed Insulated flexible cables complying with H07RN-F (BS EN 50525-2-21) type or equivalent heavy duty flexible cable for low voltage application (IET wiring regulation BS7671:2018, 704.522.8.11).

a) unsheathed Insulated flexible wires shall NOT be used in any case.

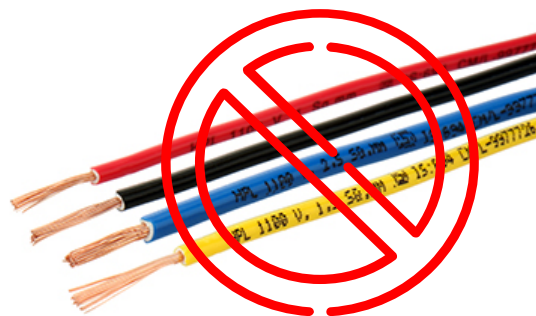


Figure 15: Unsheathed Insulated Flexible wires

- b) The length of the flexible cable shall **NOT** exceed three(3) metres.
- c) Proper plug shall be used.
- d) In areas where the ground conditions are wet and/or exposed to weather, weather proof cables shall be used.
- e) Choose a suitable rating for the flexible cables.

7.6.2 PORTABLE APPLIANCE / ELECTRICAL APPLIANCES / ELECTRICAL POWERED HAND TOOLS

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

- a) The electrical appliance or current carrying equipment is effectively earthed where these have provisions made for earthing; and
- b) No modifications shall be made to the electrical equipment/ apparatus to exclude original provisions intended for earthing. 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 use of Class 0 and Class 01 with reference to IEC 60335-1 equipment is **NOT** allowed in any case. Usage of Electrical Equipment/ Apparatus, that does **NOT** have its metal chassis connected to earth is **NOT** allowed.






Figure 16: Examples of Hand Tools

7.6.3 PORTABLE APPLIANCE TESTING (PAT) TESTING AND CERTIFICATION OF THE APPLIANCE BY A COMPETENT PERSON IS RECOMMENDED

In IEC 60335-1, 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	<ul style="list-style-type: none"> ▪ 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 	n/a

Class 0I	<ul style="list-style-type: none"> ▪ Appliance having an earth terminal and appliance are connected using a two wire supply chord without earthing conductor and plug without earthing contact. 	n/a
Class I	<ul style="list-style-type: none"> ▪ 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 Live to Earth 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 II	<ul style="list-style-type: none"> ▪ Also known as double insulated electrical appliances ▪ Do not have earth connection ▪ Protection against shock are via double insulation against fault ▪ Users are not exposed to touch potentials 	
Class III	<ul style="list-style-type: none"> ▪ 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 higher Class of equipment/apparatus are recommended to be used at the worksite, with supplementary Residual Current Devices (RCD) protection in the DB connected to the apparatus.



Typical mark of Class I equipment

7.7 TESTING AND INSPECTION

Tripping tests of the RCD via a RCD Tester, mechanical operation test (on, off) on the Miniature Circuit Breaker (MCB), mechanical operation test (on, off) on the 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.

7.7.1 TYPICAL PERIODICAL INSPECTION FORM

The Portable Generator and its wiring installations shall be regularly inspected, tested, maintained and safety precautions shall be observed at all times to prevent danger to personnel. The Inspector (DES authorised persons or DES Approved (Specialist/ Contractor/ Inspectors)) shall complete and provides the Occupier/ User 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.

Note: It is highly recommended that the Occupier/ User of the portable generator to perform inspections and testing to produce an Electrical Installation Certificate (EIC) upon first completion and prior to the use of the electrical installation. For further information on the EIC, please refer to [Appendix 11A](#) of the Department of Electrical Services, “Electrical Installation Requirements 2011 – First editions (EIR)” or later.

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 <small>Tick boxes as appropriate</small>	
Occupier: _____	
Installation: _____	
Address: _____	
Description of Premises:	Domestic <input type="checkbox"/> Commercial <input type="checkbox"/> Industrial <input type="checkbox"/> Other <input type="checkbox"/>
Estimated age of the Electrical Installation:	_____ years
Evidence of Additions or Alterations:	Yes <input type="checkbox"/> No <input type="checkbox"/> Not apparent <input type="checkbox"/>
If “Yes”, estimate age:	_____ years
Date of last inspection:	_____ Records available Yes <input type="checkbox"/> No <input type="checkbox"/>
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: _____
_____	_____
_____	_____

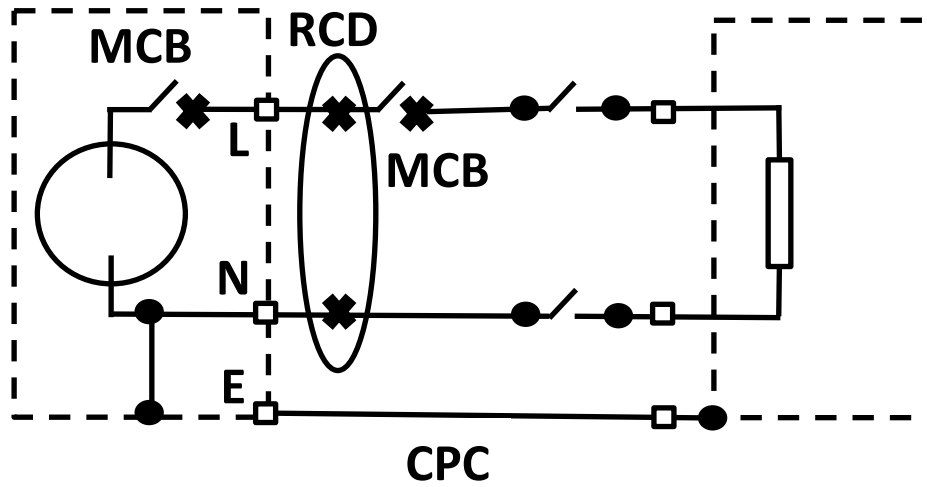
SUPPLY CHARACTERISTICS AND EARTHING ARRANGEMENTS <small>Tick boxes and enter details, as appropriate</small>			
Earthing arrangements	Number and Types of Live Conductors		Nature of Supply Parameters
TN-C <input type="checkbox"/>	a.c. <input type="checkbox"/>	dc <input type="checkbox"/>	Nominal voltage, $U/U_0^{(1)}$ _____ V
TN-S <input type="checkbox"/>	1-phase, 2-wire <input type="checkbox"/>	2-pole <input type="checkbox"/>	Nominal frequency, $f^{(1)}$ _____ Hz
TN-C-S <input type="checkbox"/>	2-phase, 3-wire <input type="checkbox"/>	3-pole <input type="checkbox"/>	Prospective fault current, $I_{pf}^{(2)}$ _____ kA
TT <input type="checkbox"/>	3-phase, 3-wire <input type="checkbox"/>	Other <input type="checkbox"/>	External loop impedance, $Z_e^{(2)}$ _____ Ω
IT <input type="checkbox"/>	3-phase, 4-wire <input type="checkbox"/>		<small>(Note: (1) by enquiry, (2) by enquiry or by measurement)</small>
SUPPLY PROTECTIVE DEVICE CHARACTERISTICS			
Type: _____			
Rated current _____ A			
PARTICULARS OF INSTALLATION REFERED TO IN THE REPORT <small>Tick boxes and enter details, as appropriate</small>			
Means of Earthing		Details of Installation earth Electrode (where applicable)	
Distributor's facility <input type="checkbox"/>		Type _____	Location _____
Installation earth electrode <input type="checkbox"/>		(e.g. rod(s), tape etc _____)	Electrode resistance to earth _____ Ω
Main Protective Conductors			
Earthing Conductor: material _____	csa _____		
Main protective bonding/ conductors material _____	csa _____		
To incoming water service <input type="checkbox"/>	To incoming gas service <input type="checkbox"/>	To incoming oil service <input type="checkbox"/>	To structural steel <input type="checkbox"/>
To lightning protection <input type="checkbox"/>	To other incoming service(s) <input type="checkbox"/>	(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 $I_{\Delta n}$) <small>(applicable only where an RCD is suitable and is used as a main circuit circuit-breaker)</small>			
OBSERVATION AND RECOMMENDATIONS <small>Tick boxes as appropriate</small>			Recommendations as detailed below
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			
<input type="checkbox"/> No remedial work is required <input type="checkbox"/> 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. <input type="checkbox"/> 1 requires urgent attention <input type="checkbox"/> 2 requires improvement <input type="checkbox"/> 3 requires further investigation <input type="checkbox"/> 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 document and this Report is valid only when they are attached to it.			
_____ Schedules of Inspections and _____ Schedules of Test Results are attached.			
<small>(Enter quantities of schedules attached)</small>			

Figure 17: Appendix of IIC of the DES, "Electrical Installation Requirements 2011 – First editions (EIR)"

The recommended periodic inspection and testing intervals for construction sites and temporary installation is six(6) months, unless other Competent Authorities specifically require inspection and testing to be done otherwise.

8. TYPICAL SETUP OF PORTABLE GENERATOR ARRANGEMENT AT MOBILE WORKSITES



CPC= Circuit Protective Conductor

Figure 18: Single Line Diagram of unearthened System

Note: An unearthened system installed in this arrangement and this arrangement is also suitable for short term use (less than 24 hours) such as powering up mobile worksites such as temporary food stalls, mobile trucks, events or lighting for outdoor activities. Also, this arrangement is only to be used only if, it is impractical to provide earthing subject to compliance of section 8.1



Figure 19: Foodtruck with Portable Generator Installation

For this guidance, the above single line diagram is also subdivided into six(6) parts.

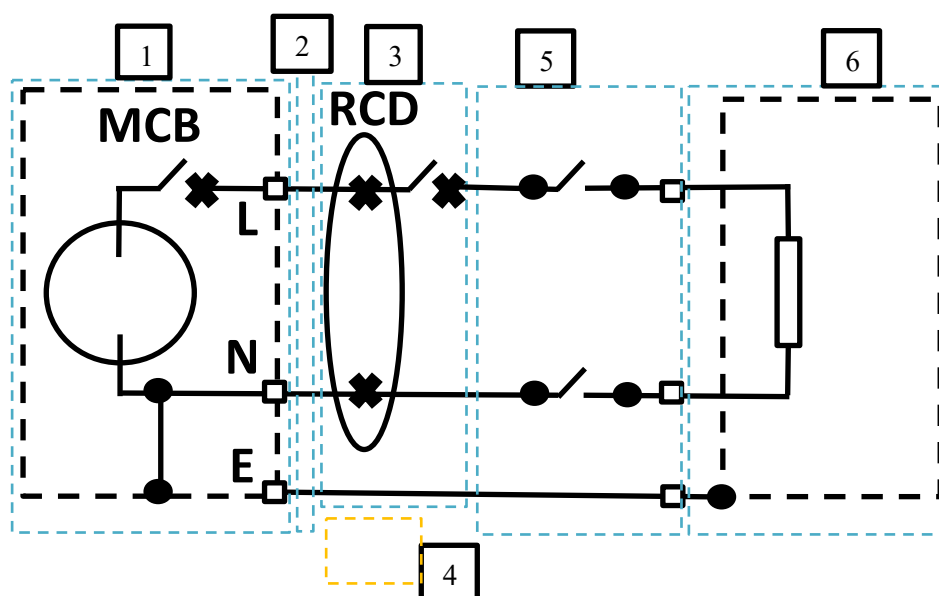


Figure 20: Single Line Diagram of unearthed System

The guidance for this arrangement is similar to the above as per the following table:

NO.	SUBJECT	REFER TO SECTION
1)	Generator	7.1
2)	Cables from Generator to Distribution box	7.2
3)	Distribution box Isolator, RCD and MCB	7.3
4)	Earth link — no Earth pit	Refer to 8.1 below
5)	Cables from Distribution Box to Load sockets	7.5
6)	Load — Portable Appliances	7.6
7)	Testing and Inspection	7.7

8.1 CIRCUIT PROTECTIVE CONDUCTOR AND OTHER SAFETY CONSIDERATIONS

- There is no earth pit in this particular arrangement.
- RCD should be installed as close as possible to/at the Generator because there is no RCD protection from the generator winding to the RCD.
- All exposed conductive parts should be connected to the main earthing terminals of the Generator and the installation should conform to BS 7671:2018+A1. The Generator and the appliance must be electrically bonded.
- All earth wires should be connected to the earth terminals before the RCD protection.
- Socket outlets outside the unit these circuits should be protected by RCDs with a rated residual operating current not exceeding 30 mA and an operating time not exceeding 40 ms at a residual current of 5 I_{Δn}.
- Refer to section 7.1.1 Other Generator Safety Considerations concerning Generators.

9. COMMON ERROR IN INSTALLATIONS

This section provides information on common errors that have been encountered during site inspections by SHENA. This is one of the main causes of failure of operation of the RCD during site trip testing.

Unearthed System with common error

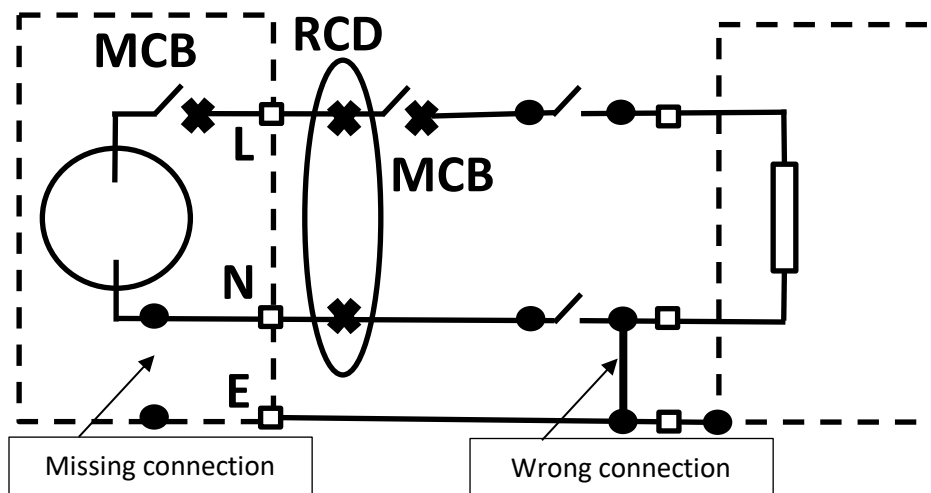


Figure 21: Single Line Diagram of unearthed System with common error

TNS Earthing System with common error

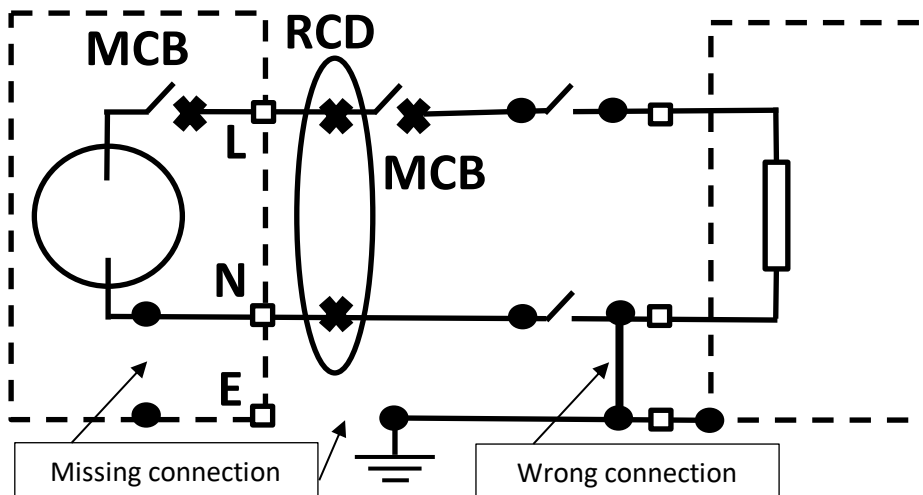


Figure 22: Single Line Diagram of TNS System with common error

The common error in installations as mentioned in Sections 7 and 8 is the existence of Earth Connection to the load side of the RCD neutral as indicated on the single line above. Installers are recommended to disconnect this connection and recheck all wiring connection if the RCD fails to trip during testing.

Another common error is a missing connection between Neutral and Earth on the Generator side.

10. 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
5. BS 7430:2011+A1:2015 — Code of Practice for Protective Earthing of Electrical Installations.
6. IEC 61140 — Protection against electric shock - Common aspects for installation and equipment
7. IEC 60335-1 — Specification for safety of household and similar electrical appliance, General Requirements
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