

ELECTRICAL WORKSHOP - TEST EQUIPMENT AND TOOLS

DEP 70.08.10.13-Gen.

August 2005

DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design, layout and equipping of an electrical workshop facility and for the provision of tools and instruments required to perform maintenance and inspection of electrical equipment.

In this DEP references are made to specific Manufacturers' equipment. It is not intended to preclude the use of other equivalent products.

This DEP is a revision of the DEP of the same number dated December 1992; a summary of the main changes is given in (1.5).

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company and, if necessary, to Contractors and Manufacturers/Suppliers nominated by them.

This DEP is intended for use in oil refineries, chemical plants, gas plants, exploration and production facilities and, where applicable, supply/marketing installations.

When DEPs are applied, a Management of Change (MOC) process should be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. Based on the potential impact on design, construction and maintenance costs, the Principal may decide to consult with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction and commissioning for the project. The Principal may sometimes undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant, authorised to act for the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

portable equipment

equipment that can be moved whilst in operation or can easily be moved from one place to another while connected to the supply

NOTE: Extension leads, plugs and sockets, and cord sets which supply portable equipment are also classed as portable equipment since they operate in the same environment and are subject to the same use as the equipment they serve

transportable equipment

equipment that can be moved by a means of transport or by hand while disconnected from the supply

1.4 CROSS REFERENCES

Cross-references to other parts of this DEP are shown in brackets. Referenced standards are listed in (5).

1.5 SUMMARY OF CHANGES TO THIS DOCUMENT

The major changes to this DEP are listed below:

Section	Description
1.3.2	Specific definitions updated
Appendix 1	MESC coding deleted Equipment specification and type/model updated Manufacturer / Vendor website added
Appendix 2	MESC coding deleted Equipment specification and type/model updated Manufacturer / Vendor website added
Appendix 3	MESC coding deleted Equipment specification and type/model updated Manufacturer / Vendor website added
Appendix 4	MESC coding deleted Equipment specification and type/model updated Manufacturer / Vendor website added
Appendix 5	MESC coding deleted Equipment specification and type/model updated Manufacturer / Vendor website added
Appendix 9	Drawing and specification updated

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the DEP Administrator at standards@shell.com. Shell staff may also post comments on this DEP on the Surface Global Network (SGN) under the Standards/DEP 70.08.10.13-Gen. folder. The DEP Administrator and DEP Author monitor these folders on a regular basis.

2. ELECTRICAL WORKSHOP FACILITY

2.1 GENERAL

The following recommendations for electrical workshops are normally applicable to a new process plant facility when located in an area where comparable overhaul/repair services may be unavailable from local industry.

Where supporting services are available from local industry, the workshop and the equipment installed may be reduced to meet the specific plant's outstanding needs in terms of day-to-day maintenance, shutdown activities and emergency repairs.

The electrical workshop is a facility dedicated to the maintenance, repair and testing of electric motors, switchgear, handheld electrical equipment, temporary lighting, high voltage and/or low voltage protection relays, etc. The electrical workshop usually forms part of a complex of facilities which include the workshops for the mechanical and instrumentation disciplines.

In addition to the central workshop for a large process plant facility, which is distributed over a large area, small, satellite workshops may have to be provided close to the process units to meet their maintenance requirements.

As indicated above, the maintenance tasks carried out in the electrical workshop are varied and require sufficient floor space and adequate access to the plant. The most space-consuming activity is the overhaul of electric motors, especially during a shutdown period when a number of motors may need to be overhauled at the same time. For reasons of access and safety, part of the facility should be dedicated to a motor laydown area (external) and a motor test bench (bay). The workshop will also require sufficient space for the storage of tools, site test equipment and frequently used spares.

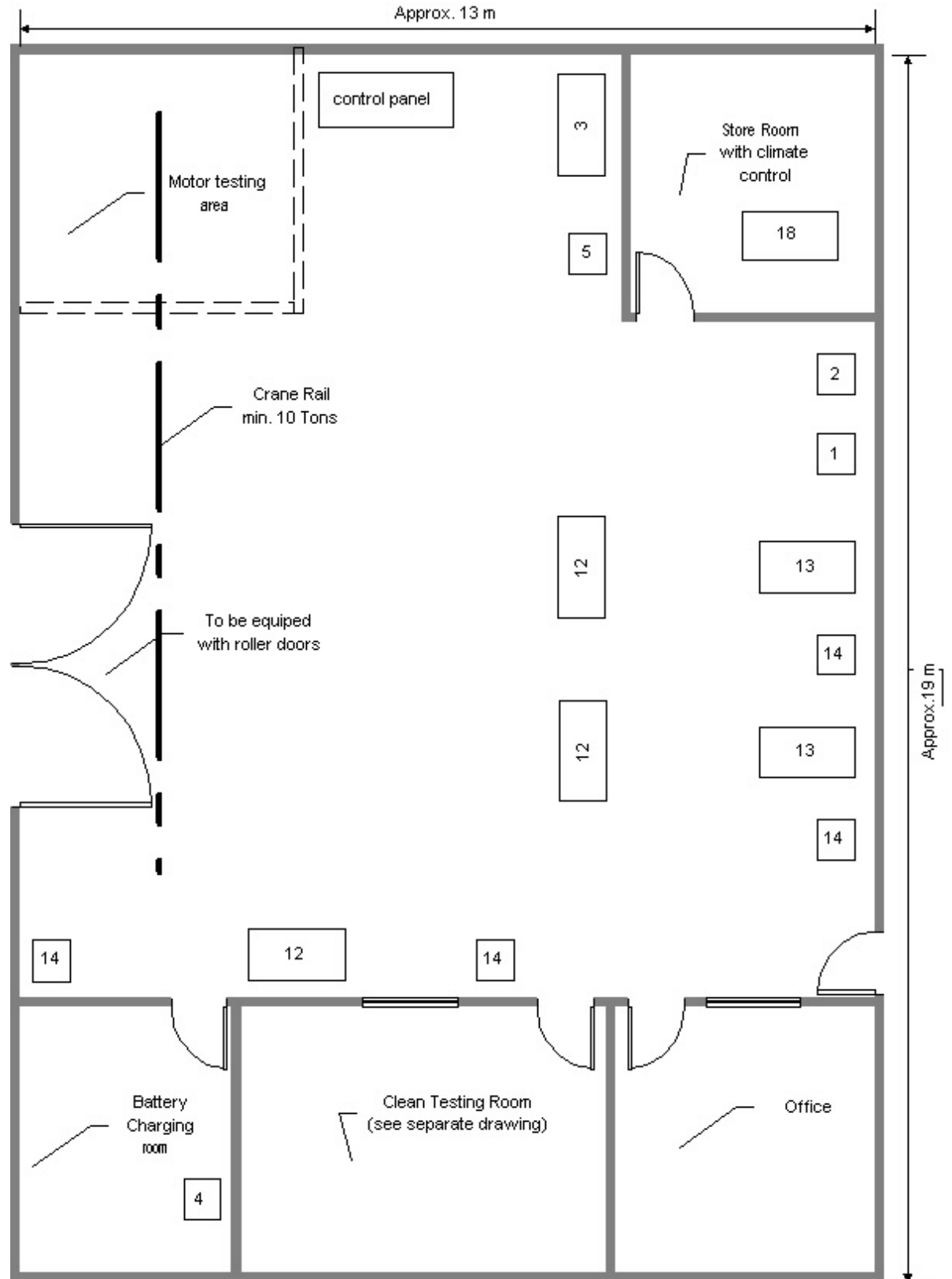
2.2 ELECTRICAL WORKSHOP

The floor space for the electrical workshop should be at least 250 m², based upon the need to perform the following (see Figure 1):

- Inspection, maintenance and repair of low voltage motors and high voltage motors up to 1.0 MW.

NOTE: The rewinding of electric motors is normally carried out in a third-party repair facility.

- Test running of low voltage motors up to 185 kW at no-load (horizontal or vertical mounting).
- Inspection, maintenance and repair of electrical equipment, e.g. lighting fittings, distribution boards, small generators (up to 150 kVA) and temporary supplies equipment.
- Testing and repair of various types of protection relays (LV/HV).
- Training of electrical maintenance staff.



Key: Refer to Appendix 1.

Figure 1 Electrical workshop layout

Typical space requirements:

- Supervisor's office
- Main workspace
- Test room (clean workshop)
- Motor test bay (or test bench)
- Battery charging room or segregated area
- Store for consumables and test equipment (HVAC controlled)
- Equipment cleaning area (motors etc., external to the workshop)
- Equipment laydown area (external to workshop)

To facilitate the foregoing activities, the workshop should at least be provided with the permanent services listed below.

For details of the maintenance equipment to be installed in the workshop reference is made to Appendix 1.

Permanent Services:

- Electric motor driven hoist, capacity 10 t, and rail mounted.
- Equipment air (air driven tools) and potable water supply (Hot and Cold).
- Socket outlets for general use, rating 16 A, 2P + E, IEC 60309.
- Socket outlets for welding purposes, rating 63 A, 3P + E, IEC 60309.
- Socket outlets for test purposes meeting the following requirements:
 - Rating 32 A, 3P + N + E, switched
 - MCB and 30 mA residual current device, IEC 60309.
 - Rating 63 A, 3P + N + E, switched
 - MCB and 30 mA residual current device, IEC 60309.
- Power supplies with local isolation for fixed items of electrical equipment.
- Lighting installation to meet functional requirements of area.
- Main switchboard with sufficient capacity to serve the total workshop facility including the mechanical and instrument workshop when forming part of the total complex (refer to DEP 33.67.01.31-Gen. for switchgear requirements).
- Concrete surfaced laydown area, outside the workshop, for cleaning electric motors with steam or high-pressure water and instrument air outlets. The area shall be provided with a contaminated water drain connection.
- Fire fighting and first aid equipment.
- HVAC systems for the supervisor's office, staff offices, test room and workshop, depending on climatic conditions.

NOTE: A 30 mA residual current device shall protect each of the circuits for the general purpose and welding outlets.

2.3 TEST ROOM

The test room facilities should be designed for the purpose of testing protection relays, small general items of electrical and electronic equipment and transformer oil sampling. The test room shall have a floor area of at least 24 m².

The room should be provided with workbenches and power supplies as generally described below and illustrated in Figure 2. For details of fixed electrical equipment shown in Figure 2,

refer to Appendix 1. For details of the electrical test equipment to be provided refer to Appendix 2.

Test bench power supplies (wall mounted above each bench):

Eight general socket outlets, rating 16 A, 2P + E, 220-240 V (ac), IEC 60309;

Two socket outlets, rating 32 A, 3P + N + E, 380-415 V (ac), IEC 60309;

One socket outlet, rating 16 A, 2P + E, 50 V (ac), IEC 60309.

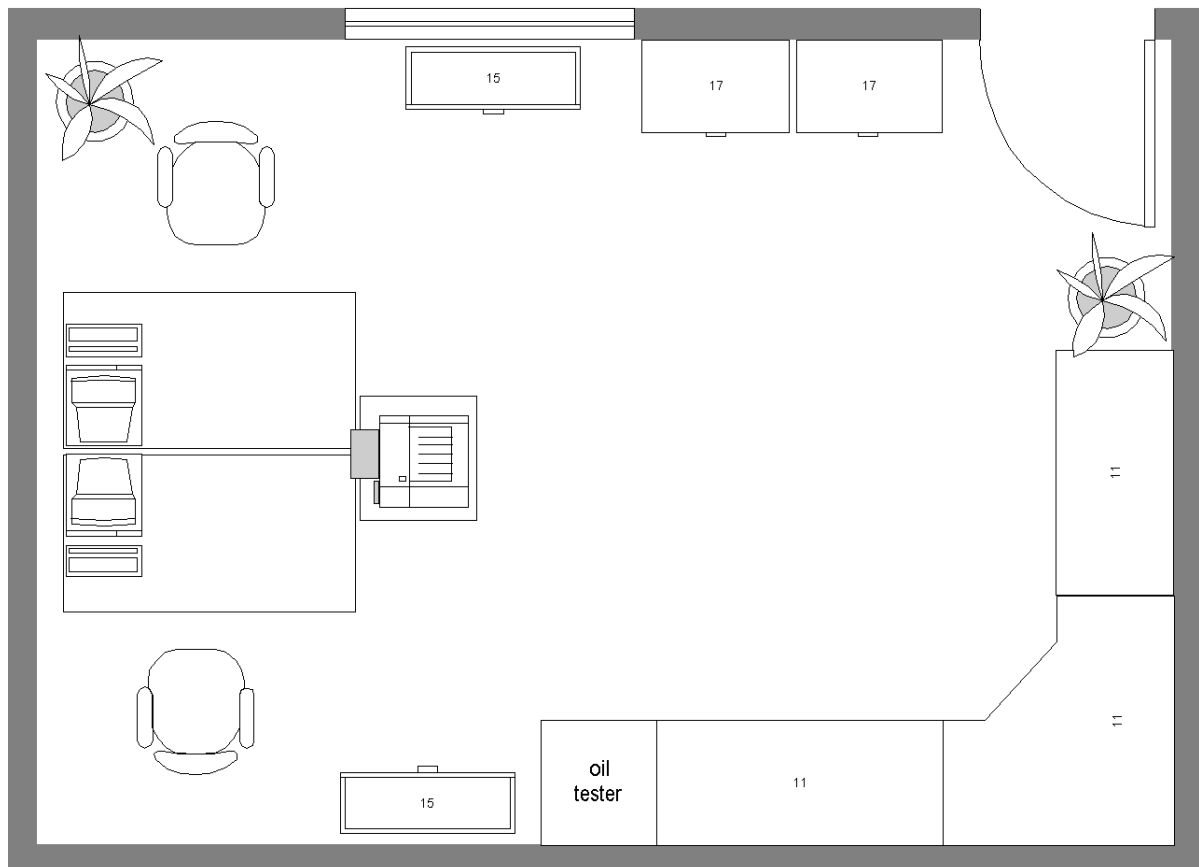
All power outlets, with the exception of the 50 V (ELV) (ac) outlet, shall be equipped with MCB and 30 mA residual current device protection.

The 50 V (ac) socket outlets shall be supplied via a dedicated isolation transformer.

Note: Alternative voltages, test sockets, and other provisions may be agreed upon locally.

Power supplies shall be provided with local isolation switches for fixed items of electrical test equipment.

Cabinets shall be provided for the storage of test equipment, test data and records.



Key: Refer to Appendix 1.

Figure 2 Electrical test room

2.4 MOTOR TEST BAY

The motor test bay is a segregated area of the electrical workshop with facilities specifically designed for the safe testing of electric motors and shall have a minimum floor area of at least 18m².

The motor test bay shall be fenced off from the remaining workshop area with the control and monitoring panel located outside the fence within visual range (Figure 1).

The general requirements for the motor testing facilities are listed below. For detailed requirements for the switchboard and socket outlets, refer to Appendix 9:

- Steel mesh fence with sliding gate access.
- Steel bedplate (fixings for clamps and bolts for vertical and horizontal motors).
- Socket outlets (3) 3 P.E. for connection of motor under test.
- Motor test control switchboard in accordance with DEP 33.67.01.31-Gen.
- Warning lamp (flashing during testing).
- Emergency stop push button, mounted inside motor test bay and one stop push button mounted at the control panel.
- Common earthing busbar (wall-mounted inside test bay).

2.5 EARTHING REQUIREMENTS

The electrical workshop, and the mechanical and instrument workshops, shall be provided with a common earthing ring with a cross-sectional area of at least 70 mm².

All metallic fixed items of electrical equipment, including test benches, shall be earthed to the common earthing ring via a protective conductor with a cross-sectional area of at least 16 mm².

An earthing busbar shall be installed inside the test bay and shall be connected to the common earth ring via two separate protective conductors, each with a cross-sectional area of at least 25 mm².

All items of electrical equipment including the motor bedplate and the surrounding fence shall be earthed to the earthing busbar via protective conductors, each with a cross-sectional area of at least 16 mm².

All earthing connections shall be physically protected and the terminations shall be visible to facilitate inspection.

For details of typical earthing arrangements, refer to the standard drawings S 68.003 and S 68.004 listed in section 5.

2.6 LIGHTING INSTALLATION

Fluorescent lighting fittings should be used for general lighting. However, in the main workshop and exterior areas, high-pressure sodium fittings supplemented with fluorescent fittings, where appropriate, should be selected.

In addition to the general lighting, local lighting may be required for workbenches and machines where more detailed work is performed. In these situations, wall mounted adjustable fittings should be used. The power supply circuit to these local, adjustable fittings shall be protected by a 30 mA residual current device.

A proportion (25 %) of the normal lighting shall be connected to the emergency lighting system and, where applicable, supplemented with escape lighting at exit doors.

2.6.1 Illuminance levels

The illuminance levels, measured at the working plane of 1 m above the floor level in a horizontal plane, should be at least as follows:

Area	Illuminance (lux)	
	Normal	Emergency
Workshop:		
General	250	5
Battery charging area	250	-
Motor test bay	250	-
Store room	150	-
Work benches	400	-
Office	400	-
Test room:		
General	250	5
Test benches	400	-

3. TOOLS AND EQUIPMENT FOR ELECTRICAL MAINTENANCE

3.1 GENERAL

A listing of typical requirements for tools intended for general maintenance and testing of plant electrical equipment is included in Appendices 2 and 3.

In addition, there will normally be a requirement for special tools and test apparatus designed for the maintenance of specific items of electrical equipment, e.g. a tool set for switchgear maintenance. These tools and instruments should be included in the order for the particular equipment.

NOTE: For substations, there will be a requirement for items of test equipment, e.g. voltage test sticks and phasing sticks. Where applicable, these shall normally be stored in the substation.

3.2 PERSONAL TOOLS AND INSTRUMENTS

In general, the technician requires a set of personal tools and basic test instruments to assist in day-to-day maintenance activities. A listing of typical requirements is included in Appendix 4.

4. PORTABLE ELECTRICAL EQUIPMENT

4.1 GENERAL

The listing of typical portable and transportable electrical equipment is included in Appendices 5 and 6. For additional information on utilisation, reference shall be made to DEP 33.64.10.10-Gen.

Equipment, tools and power supply cables shall be subject to inspection and test at a frequency based on the recommendations of the Manufacturer and local conditions of usage. In the absence of recommendations from the Manufacturer regarding the test procedures and the frequency with which they are to be carried out, the requirements of DEP 63.10.08.11-Gen., as referred to below, should be followed.

A registration system shall be implemented to control the inspection and test work.

Damaged equipment or cables shall not be used until permanent repair or replacement has been effected.

The storage, issue and maintenance of the portable and transportable electrical equipment should be the responsibility of the electrical workshop supervisor.

For the requirements of inspection and testing of portable equipment refer to DEP 63.10.08.11-Gen.

4.2 WELDING APPARATUS

For electric arc welding requirements, reference shall be made to IEC 60974 and the Shell Safety Committee Publication *Welding and Cutting*.

Preference shall be given to direct-current welding equipment.

If alternating-current welding equipment is used, the open circuit voltage between the electrode holder and the work piece shall be limited to 50 V maximum. If a separate voltage-limiting device (relay) is used it shall be housed in an enclosure which requires the use of a tool to gain access. Alternatively, alternating-current welding equipment which is switched automatically to a direct-current output voltage when operating on open circuit is acceptable.

4.3 DIESEL/GASOLINE DRIVEN GENERATOR SETS (TRANSPORTABLE)

4.3.1 General applications

Transportable generators may be used to supply power to locations where there is no local mains power supply, e.g. tank farms. Unit ratings will normally be in the range of 2.5 kVA to 5 kVA.

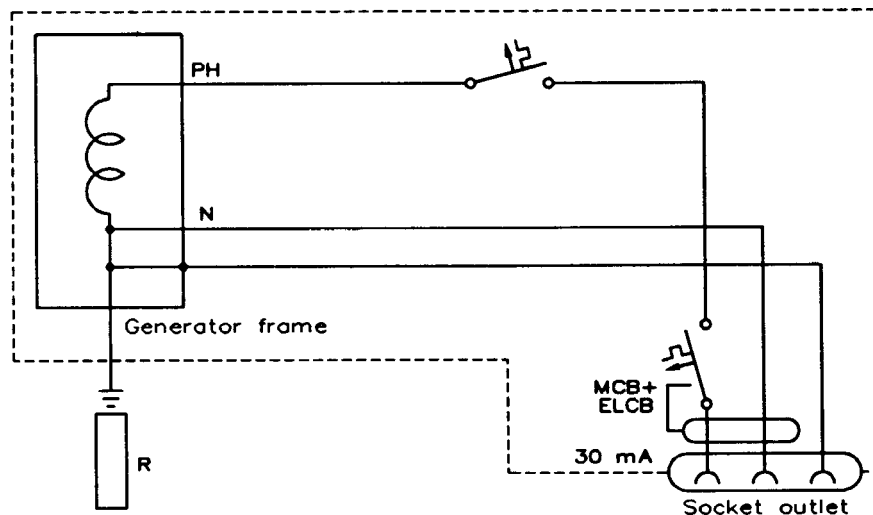
When generators are used in areas where there are no earthing facilities, the generator shall be equipped with an insulation-monitoring relay. This relay shall be arranged to disconnect the output power in the event of insulation failure of the connected equipment. Where local earthing facilities are available, e.g. plant-earthing electrode pits, then the neutral point of the generator shall be connected to the electrode via a flexible protective conductor and bolted connection.

The output of the generator shall be provided with a circuit breaker providing overcurrent and overload protection together with a 30 mA residual current device (see Figure 3).

4.3.2 Welding generators

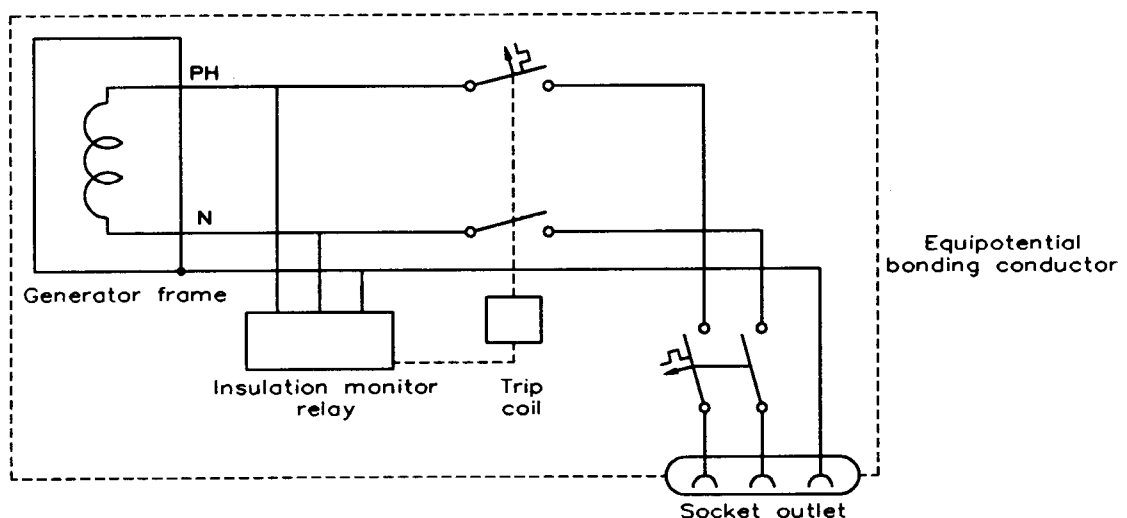
Transportable welding generators are often provided with an auxiliary single phase winding supplying a 110 V or 220/230 V socket outlet for the use of hand held tools, e.g. grinders. These generators are constructed with the auxiliary winding insulated from the main winding and the frame. As these generators are not normally intended to be earthed and are not normally equipped with an insulation monitoring relay, the connection arrangement for the auxiliary socket outlet indicated in Figure 4 will provide an acceptable safe system.

Only Class 2 hand tools to IEC 60745 shall be used in association with welding generator auxiliary supplies.



- NOTES:
1. R = the earth electrode resistance = U/I ohm (100 ohm maximum)
where U = safe to touch voltage
 I = nominal trip current of residual current device (RCD).
 2. The cable between the generator and the outgoing circuit shall be protected against mechanical damage since it is not protected by the residual current device (RCD).

a) Earthed systems (TN-S)



- NOTES:
1. The generator and distribution circuit shall be connected as indicated.
 2. An insulation-monitoring relay shall be installed which shall automatically disconnect all phases of the generator output if the insulation breaks down.
 3. Overcurrent and short circuit protection for the generator shall be located as close as possible to the generator.
 4. The phase(s) and neutral of the outgoing circuit shall be disconnected by the protective devices.

b) Unearthed systems (IT)

Figure 3 Mobile generators in temporary installations

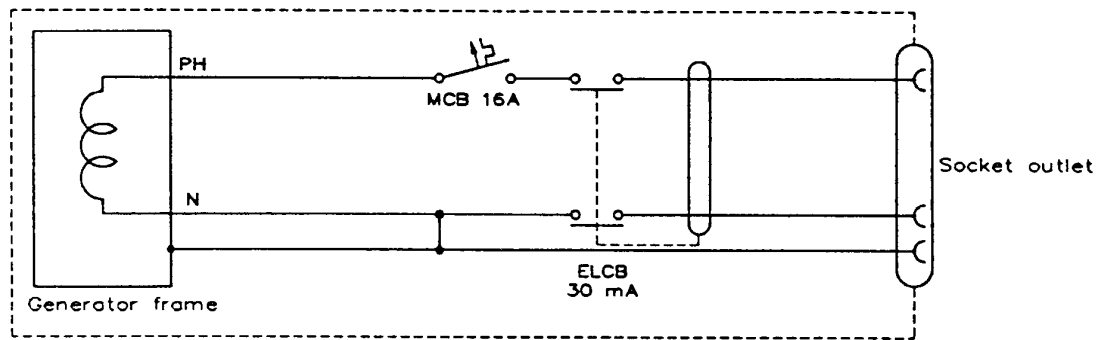


Figure 4 Welding generator - auxiliary power supply socket

5. REFERENCES

In this DEP, reference is made to the following publications:

- NOTES:
1. Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.
 2. The DEPs and most referenced external standards are available to Shell users on the SWW (Shell Wide Web) at <http://sww05.europe.shell.com/standards/>.

SHELL STANDARDS

Electrical engineering guidelines	DEP 33.64.10.10-Gen.
Low-voltage switchgear and controlgear assemblies (amendments/supplements to IEC 60439-1)	DEP 33.67.01.31-Gen.
Field inspection of electrical installations and equipment	DEP 63.10.08.11-Gen.
Shell Safety Committee - "Welding and Cutting"	

STANDARD DRAWINGS:

Typical mounting details of earthing connections	S 68.003
Earthing Boss	S 68.004

INTERNATIONAL STANDARDS

Low-voltage fuses - Part 1: General requirements	IEC 60269
Plugs, socket-outlets and couplers for industrial purposes	IEC 60309
Degrees of protection provided by enclosures (IP Code)	IEC 60529
Isolating transformers and safety isolating transformers	IEC 60742
Safety of hand-held motor-operated electric tools	IEC 60745
Safety requirements for arc welding equipment	IEC 60974

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