Guardian
ELECTRICAL COMPLIANCE
SAFE PEOPLE | SAFE PLACES | SAFE SYSTEMS

Safe Working on LV Electrical Systems Handbook

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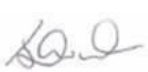
Issued by; John Quick signed;



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INTRODUCTION

1.1 PURPOSE OF THIS ELECTRICAL HANDBOOK

The consequences of shock, or serious burns from contact with LOW VOLTAGE SYSTEMS may be serious and, in some circumstances, fatal. Notwithstanding the fact that graded operatives receive craft training which reinforces this message, the Company is under a statutory obligation to provide instruction and information. This Electrical Handbook is specifically designed to give guidance to staff to prevent death or personal injury to any person from electrical causes in connection with work activities.
This document is to be implemented by all COMPANY personnel to ensure:

1. The safety of all personnel engaged in electrical installation work.
2. The adequacy and effectiveness of electrical installations.
3. Compliance with Statutory Regulations.

1.2 INJURIES

The term injury in this context means death or injury to persons (not necessarily operatives themselves) from the following:

- electric shock
- electric burn
- fires of electrical origin
- electric arcing; or
- explosions initiated or caused by electricity.

1.2.1 Electric Shock

The human body responds in several ways to electrical current flowing through it. The sensation of shock is only one such effect and this can be extremely painful. When a shock is received, the electric current may take multiple paths through the body and its intensity at any one point is difficult or impossible to predict. The passage of the electric current may cause muscular contractions, respiratory failure, fibrillation of the heart, cardiac arrest or injury from internal burns. Any of these can be fatal.

1.2.2 Electrical Burns

Electric burns are due to the heating effect caused by the passage of electric current through body tissues. They are most commonly associated with electric shock and often occur in and on the skin layers at the point of contact with the electrical conductors which give rise to the electric shock.

1.3 SAFETY OBJECTIVES

The following objectives are considered basic to electrical safety:

1. To develop, implement and maintain safe working practices which would prevent a person receiving electric shock.

2. To prevent risk of burns by avoiding conditions under which arcing could occur.

3. To ensure that site operatives are fully aware of the specific working environment, working areas, the scope and nature of the work to be carried out.

4. To ensure that those assigned to carry out the work are SKILLED to undertake it.

1.4 COMPANY POLICY

The Guardian Electrical Health and Safety policy document includes a commitment to the adoption and implementation of safe systems of work. This Electrical Handbook forms part of that framework in order that the safety of persons is assured by the practice of safe working procedures as detailed in Part 3 of this document.

1.5 CUSTOMER'S RULES

Where site working must be undertaken in compliance with any customer's own safety rules then the latter may prevail provided that the AUTHORISED PERSON is satisfied that they comply with Statutory Regulations and provide safe working conditions.

In this case the AUTHORISED PERSON is responsible for ensuring that all COMPANY personnel are instructed in the requirements of the customer's procedures and the use of their documentation. Alternatively, customer safety rules may be used in conjunction with Company procedures provided the two documents are consistent.

Should the customer's safety rules be found to be unsatisfactory the AUTHORISED PERSON must inform the customer's representative and recommend that the COMPANY procedures and documents will be used.

In all cases where the customer presents his safety rules for use, the agreement between the COMPANY and customer over which procedures and documents are used, shall be in writing.

DEFINITIONS

2.1 CORPORATE DEFINITIONS

2.1.1 Company

Guardian Electrical Compliance Ltd

2.1.2 Major Site

1. Anywhere the company has a Site establishment comprising huttage, or welfare arrangements, which are likely to remain in place for the foreseeable future due to the company undertaking on going work.

2. Any site where work is being carried out that is deemed to be 'notifiable' in accordance with the provisions of CDM 2015.

3. Any site where work is being carried out, the nature of which is such that the provisions of this Electrical Handbook are deemed essential to safe working. This would apply where existing systems or equipment etc. are deemed to be potentially dangerous or in an uncertain condition.

2.2 ELECTRICAL INSTALLATION AND COMPONENTS

2.2.1 Circuit Conductor (Electricity At Work Regulations 1989)

Any conductor in a SYSTEM which is intended to carry electric current in normal conditions, or to be ENERGISED in normal conditions, and includes a combined neutral and earth conductor, but does not include a CONDUCTOR provided solely to perform a protective function by connection to earth or other reference point.

2.2.2 CONDUCTOR (Electricity At Work Regulations 1989)

A conductor of electrical energy.

2.2.3 ELECTRICAL EQUIPMENT (Electricity At Work Regulations 1989)

"ELECTRICAL EQUIPMENT" includes anything used, intended to be used or installed for use, to generate, provide, transmit, transform, rectify, convert, conduct, distribute, control, store, measure or use electrical energy.

2.2.4 SYSTEM (Electricity At Work Regulations 1989)

"SYSTEM" means an electrical SYSTEM in which all the ELECTRICAL EQUIPMENT is, or may be, electrically connected to a common source of electrical energy, and includes such source and such equipment.

2.2.5 EXTRA-LOW VOLTAGE (ELV) (BS7671:2018)

A voltage, "normally not exceeding 50V ac or 120V ripple free dc whether between conductors or to EARTH".

2.2.6 LOW VOLTAGE (LV) (BS7671:2018)

A voltage normally exceeding EXTRA-LOW VOLTAGE but not exceeding 1000 volts ac or 1500 volts dc between CONDUCTORS and not exceeding 600 volts ac or 900 volts dc between CONDUCTORS and EARTH.

2.2.7 LOW VOLTAGE (LV) ELECTRICAL EQUIPMENT

EQUIPMENT which is normally connected to a LOW VOLTAGE electrical supply.

2.2.8 HIGH VOLTAGE (HV)

Any voltage exceeding LOW VOLTAGE.

2.2.9 HIGH VOLTAGE (HV) ELECTRICAL EQUIPMENT

Equipment which is normally connected to a HIGH VOLTAGE electrical supply.

2.3 SYSTEM CONDITIONS

2.3.1 LIVE

Electrically charged by being connected to a LOW VOLTAGE electricity supply or having a charge retained by capacitance.

2.3.2 ENERGISE

Make LIVE.

2.3.3 DEAD

Electrically discharged by being disconnected from any electrical supply and not having any charge retained by capacitance.

2.3.4 DE-ENERGISE

Make DEAD.

2.3.5 ON

The status of a switch which is closed or ELECTRICAL EQUIPMENT which is LIVE.

2.3.6 OFF

The status of a switch which is open or ELECTRICAL EQUIPMENT which is DEAD.

2.3.7 EARTH (BS 7671:2018)

The conductive mass of the EARTH, whose electric potential at any point is conventionally taken as zero.

2.3.8 EARTHED

Connected to EARTH by conductors of sufficient current carrying capacity to sustain the prospective short circuit current at the equipment without damage, until the protective device has disconnected the circuit, in the event of EARTHED equipment becoming connected to an electrical supply.

2.3.9 ISOLATED

Electrically disconnected and separated from LIVE ELECTRICAL EQUIPMENT by opening of a switch or disconnection, or removal of part of the circuit.

2.4 PERSONS

2.4.1 SKILLED PERSON (electrically) (BS7671:2018)

A person who possesses, as appropriate to the nature of the electrical work to be undertaken , adequate education, training and practical skills, and who is able to perceive risks and avoid hazards which electricity can create.

Note 1: The term “electrically” is assumed to be present where the term “skilled person” is used
Note 2: Regulation 16 of the Electricity at Work Regulations 1989 requires persons to be SKILLED to prevent danger and injury. The HSE publication HSR25 provides guidance on this.

2.4.2 AUTHORISED PERSON

A SKILLED PERSON who is considered by the COMPANY Management to have the necessary experience, personal qualities and training to make LOW VOLTAGE ELECTRICAL EQUIPMENT DEAD for the purpose of working safely, and working on or near LIVE conductors safely for the purpose of inspection and test. An AUTHORISED PERSON shall have received instruction in the procedure for the issue of the necessary documentation.

2.5 OTHER SAFETY TERMINOLOGY

2.5.1 HAZARD

An environmental condition providing risk from moving objects, explosives, combustibles, insecure access, contact with hot/corrosive/noxious solids/liquids/gases, etc, which requires SPECIFIC PRECAUTIONS to be taken.

2.5.2 DANGER

Risk of injury or possible risk to health provided by a HAZARD or from contact with LIVE ELECTRICAL EQUIPMENT.

2.5.3 CAUTION NOTICE

An approved notice warning of need for caution against interference with ELECTRICAL EQUIPMENT to which it is attached, to prevent such interference causing DANGER to a WORKING PARTY.

2.5.4 DANGER NOTICE

An approved notice warning of DANGER to persons approaching the area or interfering with the ELECTRICAL EQUIPMENT to which it is attached. The notice should indicate the nature of the DANGER by wording or by standard symbols.

2.5.5 WORK PERMIT

A WORK PERMIT for use on or near LOW VOLTAGE ELECTRICAL EQUIPMENT issued by an AUTHORISED PERSON, to a SKILLED or AUTHORSISED PERSON in charge of work with which DANGER is associated. The WORK PERMIT will detail the work to be undertaken, the ISOLATION(S) effected, barriers erected, CAUTION and DANGER NOTICES posted and SPECIFIC PRECAUTIONS to be taken. When the AUTHORISED PERSON is the WORKING PARTY he may issue a WORK PERMIT to himself.

2.5.6 SPECIFIC PRECAUTIONS

Details, to be entered on a WORK PERMIT, of actions to be taken to guard against DANGER within the working area.

2.6 SAFETY LOCKS

A lock with a unique key which is used to lock off a switch mechanism in the "OFF" position or a switching device in the "ISOLATED" or "EARTHED" position, or to lock closed a cover which prevents access to LIVE CIRCUIT CONDUCTORS.

2.6.1 SAFETY KEY

A key which is required to open a closed SAFETY LOCK. Only one SAFETY KEY at a particular site shall operate any SAFETY LOCK at that site. No SAFETY KEY shall operate more than one lock at a site.

2.6.2 KEY SAFE

A lockable safe for retention of the SAFETY KEYS, applicable to SAFETY LOCKS which have been used to render apparatus safe prior to the issue of a WORK PERMIT. The KEY SAFE door is retained closed by a number of locks each with individual unique keys. The KEY SAFE door can be opened only when all the door locks have been unlocked. When each lock is unlocked it prevents the removal of its key.

2.6.3 KEY SAFE KEYS

Keys to the KEY SAFE door locks. One key is used to lock a KEY SAFE door lock and is issued to the holder of each WORK PERMIT for which the relevant SAFETY KEYS are held in the KEY SAFE. Only one KEY SAFE KEY at a particular site shall operate any KEY SAFE door lock at that site. No KEY SAFE KEY shall operate more than one KEY SAFE door at that site. The KEY SAFE door cannot be opened to give access to the retained SAFETY KEYS until all WORK PERMITS have been returned together with the relevant KEY SAFE keys.

2.6.4 CONTROL KEY

This is one of the KEY SAFE keys which is specially labelled to distinguish it from the other KEY SAFE KEYS. The designated CONTROL KEY is not issued with a WORK PERMIT but is used for other safety control purposes. The uses are commonly:-

1. Retention by a person who has overall responsibility for safety control.

2. Where the number of KEY SAFE KEYS available for issue from a KEY SAFE is less than the number of WORK PERMITS required to be issued, then the CONTROL KEY is retained in another KEY SAFE from which further KEY SAFE KEYS are then available for issue.

3.1 WORK ON EQUIPMENT AFTER ENERGISATION

3.1.1 The consequences of shock, or serious burns from short circuits, associated with LOW VOLTAGE SYSTEMS may be serious and in some circumstances fatal.
Wherever possible, work on LV ELECTRICAL EQUIPMENT shall be done while it is DEAD.

Regulation 13 of the Electricity at Work Regulations 1989 states the following:-

"Adequate precautions shall be taken to prevent LV ELECTRICAL EQUIPMENT, which has been made dead in order to prevent DANGER while work is carried out on or near that equipment, from becoming electrically charged during that work if DANGER may thereby arise."

3.2 PROCEDURES FOR SAFE WORKING

3.2.1 Regulation 14 of the Electricity at Work Regulations 1989 states the following:-

"No person shall be engaged in any work activity on or so near any LIVE CONDUCTOR (other than one suitably covered with insulating material so as to prevent DANGER) that DANGER may arise unless:-

a) it is unreasonable in all the circumstances for it to be DEAD, and

b) it is reasonable in all the circumstances for him to be at work on or near it while it is LIVE; and

c) suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent INJURY."

3.2.2 The Health and Safety at Work etc Act 1974 legislates conditions to ensure safe working which may be summarised as follows:-

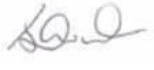
i) ***It is the duty of every employee while at work to take reasonable care for the health and safety of himself and other persons who may be affected by his acts or omissions at work, and, as regards any duty imposed on his employer, to co-operate with him to enable that duty to be complied with.***

ii) ***It is the duty of every employer to ensure the safety at work of all employees by providing systems of work that are safe; providing information, instruction, training and supervision; maintaining safe conditions and providing safe means of access and egress; providing and maintaining a safe working environment.***

iii) ***It is the duty of the employer to ensure that persons in his employment are not exposed to risk to their safety and it is the duty of a self-employed person to ensure that he and other persons are not exposed to risks to their safety.***

iv) ***It is the duty of any person who erects or installs any article for use at work to ensure that nothing about the way in which it is erected or installed makes it unsafe.***

v) ***It is the duty of any person who supplies any substance for use at work to ensure that the substance is safe, to carry out any testing and examination necessary and to take steps necessary to secure that there will be available adequate information about tests carried out and conditions necessary to ensure that it will be safe when properly used.***



3.2.3 PROCEDURES FOR THE USE OF CERTIFICATE TO TEST LIVE LOW VOLTAGE EQUIPMENT (LGHS06)

This set of procedures lays down the requirements for the issue of the Certificate to Test Live Low Voltage Equipment. It is recognised that in order to perform specific tests required under EaWR 1989 and BS 7671:2018 as amended, there is a necessity to work on live conductors.

Work activities for which there is a necessity to work on Live conductors are:

a) Measurement of Prospective and Short Circuit Currents

b) Measurement of Earth Fault Loop Impedance

c) Measurement of Voltage

d) Voltage monitoring equipment

e) Harmonics monitoring equipment

f) Identification of circuits.

3.2.4 Limitations of Use

The certificate is NOT to be used for the purpose of isolating equipment for working parties, isolation of particular equipment shall only be sanctioned by the use of a PERMIT TO WORK (LGHS05).

3.2.5 Authorised Persons

A Person who is considered by the Company to have the necessary experience, personal qualities and training to make Low Voltage Electrical Equipment DEAD, and recognise the risk involved when performing tests on LIVE circuit conductors working safely. The Authorised Person shall have received instruction in the procedure for the issue of the necessary documentation to the WORKING PARTY.

3.2.6 Issue of the certificate

Authorised Persons only may issue the Certificate to Test Live Low Voltage Equipment to other Authorised Persons.

The Person issuing the certificate will determine in agreement with the Person receiving the Certificate the following:

a) That the work to be undertaken falls within the Work Activities defined in 3.5.3 of this Electrical Handbook.

b) The type and extent of any PPE equipment required as indicated by Guardian Electrical Safe Working Procedures

c) That an applicable Method Statement and where appropriate, suitable Risk Assessments are available to those carrying out the work

3.2.7 Demarcation

Suitable barriers are to be utilised to provide a demarcation area around the Switch Gear or Distribution Equipment on which live testing is being undertaken.

3.2.8 Posting the certificate

The certificate shall be posted adjacent to the work area in order to warn third parties of the work being undertaken. This is in addition to any other warning signs or notices required by the Method Statement issued for the work.

3.2.9 Cancellation

Upon completion of the work activity the clearance and cancellation sections are to be completed by the persons issuing and receiving the certificate.

3.2.10 Switching

The following switching operations may be carried out by a SKILLED PERSON as instructed by his supervisor:-

a) Opening of a switch or operation of a control device for functional disconnection of an electrical supply.

b) Closing of a switch or operation of a control device for functional connection of an electrical supply.

3.2.11 Switching by Authorised/Skilled Person

The following switching operations may be carried out only by an AUTHORISED PERSON or by a SKILLED PERSON under the PERSONAL SUPERVISION of an AUTHORISED PERSON:

a) Opening of a switch and applying a SAFETY LOCK in the “OFF” or “ISOLATED” position to make a CIRCUIT DEAD for safe working on LV ELECTRICAL EQUIPMENT in that circuit.

b) Removal of SAFETY LOCKS and closing of a switch to RE-ENERGISE a circuit after working on LV ELECTRICAL EQUIPMENT in that circuit.

3.2.12 Work on LIVE LV Electrical Equipment

Any work to be carried out on LV ELECTRICAL EQUIPMENT subsequent to it being made LIVE, which involves the removal of covers, opening of doors, removal of barriers or in any other way makes possible contact with CIRCUIT CONDUCTORS, shall be carried out only under cover of a WORK PERMIT. The WORK PERMIT will be issued by the AUTHORISED NOMINATED PERSON, who will have ensured that the LV ELECTRICAL EQUIPMENT has been made safe.

3.2.13 Work not permitted

Under no circumstances will the following type of work involving LIVE supplies be permitted:-

a) Disconnection & removal of LIVE incoming supply cables to distribution boards, isolators, etc.

b) Any modifications to LV ELECTRICAL EQUIPMENT which could give access to LIVE CIRCUIT CONDUCTORS.

c) Connection/disconnection of outgoing CIRCUIT CONDUCTORS in LV ELECTRICAL EQUIPMENT which gives access to LIVE exposed busbars or terminals.

d) Cable jointing on LIVE LOW VOLTAGE cables.

3.3 WORKS REQUIRING ISSUE OF A PERMIT TO WORK

3.3.1 Energised circuits

The circuits and areas where WORK PERMITS must be issued are amplified below:-

a) Generator, including stored power packs, prime mover for generator

b) UPS, including stored power packs

c) LOW VOLTAGE switchboard inclusive of incoming bus-section and outgoing circuit breakers, fuse switches, miniature circuit breakers etc.

d) Outgoing cables from LOW VOLTAGE switchboard to **REMOTE** motors, distribution boards, control panels, etc.

e) Outgoing cables from 415V T.P. & N distribution boards to **REMOTE** three phase motors, heaters, etc.

f) Any work within plant control panels including incoming or outgoing supply and control circuits which give access to exposed LIVE terminals.

g) Any construction/maintenance work by other trades in switchrooms where either LOW VOLTAGE and/or HIGH VOLTAGE supplies are present. All such areas should be locked and keys retained by the permit holder when unoccupied.

The foregoing includes new or maintenance work on main switchpanels requiring switching operations, locking-off to make safe, fitting of protective barriers, etc.

Permits therefore ARE required when the SKILLED or AUTHORISED PERSON considers that he is not in full control of the area due to factors such as:

- Equipment to be isolated is outside the room, building, or location of the supply disconnection point.
- Undertakings by third parties within the area to be worked on.
- For other reasons determined by the SKILLED or AUTHORISED PERSON.

3.4 WORK PERMITS ISSUED ON A DISCRETIONARY BASIS

The issue of WORK PERMITS are discretionary, where no DANGER will arise, in the considered view of the SKILLED or AUTHORISED PERSON required to work on that part of the system that has been made dead as follows:-

a) Connection, disconnection or maintenance work on motors, distribution boards and panels where **LOCAL** isolator facilities are provided adjacent to or forming part of the equipment.

b) Connection/disconnection of outgoing sub-circuit cables from sub-distribution equipment with means of isolation by withdrawing local fuses and/or miniature circuit breakers.

c) Connection, disconnection, testing and maintenance of sub-circuit cables and connected apparatus associated with lighting, power and motor supplies etc.

Warning Note: This also includes lamp replacement. Special precautions may also need to be taken where unusual HAZARDS exist such as separate emergency lighting circuits or where 415 volts may be present at lighting switches.

d) Work on sub-circuits for the purpose of LOW VOLTAGE tests, subject to the appropriate LIVE working precautions being taken.

NOTE: WARNING NOTICES should be posted at all times when work is being carried out.

3.5 MAKING LV ELECTRICAL EQUIPMENT SAFE FOR WORKING ON

3.5.1 Communication

Two way radio communication may be used as follows:

- Verification of 230 volt final circuits in Building services i.e. lighting, small power etc.
- Indication of supplies to remote switchboards, distribution boards, control panels and motors prior to isolation following Safe Working Procedure 3.8.1 b) to g)

3.5.2 Precautions

The AUTHORISED PERSON who has been requested to issue a WORK PERMIT to allow work to be carried out on LV ELECTRICAL EQUIPMENT which has previously been made LIVE and where the work exposes the WORKING PARTY to the possibility of contact with ELECTRICAL CONDUCTORS shall:-

a) Identify the work to be done and any LV ELECTRICAL EQUIPMENT and CIRCUIT CONDUCTORS which may be exposed.

b) As far as possible ISOLATE all such CIRCUIT CONDUCTORS, apply SAFETY LOCKS (wherever possible), to prevent unauthorised re-connection of the CIRCUIT CONDUCTORS and apply CAUTION NOTICES at all points of ISOLATION, indicating that men are working.

c) Where LV ELECTRICAL EQUIPMENT may be exposed but cannot be ISOLATED, securely fix barriers to prevent accidental contact and apply DANGER NOTICES indicating the presence of exposed LIVE CIRCUIT CONDUCTORS.

d) By use of an approved test instrument and proving unit prove and demonstrate to the WORKING PARTY that the CIRCUIT CONDUCTORS to be worked on are DEAD. (See 5 step diagram “Proving Dead” in this Electrical Handbook”).

e) Show the WORKING PARTY where temporary barriers have been applied and indicate the LIVE CIRCUIT CONDUCTORS which have been exposed.

f) Produce a WORK PERMIT detailing the nature of the work, the points where ISOLATION has been effected, CAUTION and DANGER NOTICES applied and the name of the person in charge of the WORKING PARTY.

g) Determine that the person who is to receive the WORK PERMIT fully understands the content, signs and recipient and receives a copy of the WORK PERMIT.

3.5.3 Receiving Permit

The person who is to receive the WORK PERMIT shall verify to his own satisfaction that the circuit is DEAD prior to signing the PERMIT.

3.5.4 Applied safety locks

The keys to any SAFETY LOCKS applied will be retained by the AUTHORISED PERSON in his possession or in a KEY-SAFE until he removes the SAFETY LOCKS.

3.5.5 Requirements for Working Party

Where the work being done by a WORKING PARTY requires the ISOLATION of more than one CIRCUIT CONDUCTOR at different ISOLATION points, then separate WORK PERMITS will be issued for each ISOLATION point.

3.5.6 Common circuit isolation

Where more than one WORKING PARTY is covered by common CIRCUIT ISOLATIONS, separate WORK PERMITS will be issued to each WORKING PARTY and all WORK PERMITS will be cleared and cancelled before the removal of CAUTION and DANGER NOTICES, removal of SAFETY LOCKS and RE-ENERGISATION of any CIRCUIT CONDUCTORS.

3.6 SAFETY PRECAUTIONS PRIOR TO STARTING WORK

3.6.1 Precautions

The person in charge of the WORKING PARTY shall ensure, where necessary, that the following safety precautions are established prior to starting work:-

a) Any automatic fire extinguishing equipment is switched to manual control, CAUTION NOTICES applied and the fire officer informed.

b) Instructions for the treatment of electric shock are displayed.

c) The WORKING PARTY has knowledge of the siting and correct use of the fire fighting apparatus.

d) Working spaces and access ways in the working area are free from obstruction.

e) LV ELECTRICAL EQUIPMENT to be worked on has been ISOLATED, proved to be DEAD by the AUTHORISED NOMINATED PERSON and caution notices displayed.

f) Any LIVE CIRCUIT CONDUCTORS which have been exposed by the removal of covers are guarded by temporary barriers and DANGER NOTICES displayed.

g) All necessary drawings and specifications required for the work are available.

h) All members of the WORKING PARTY are fully informed and understand the work to be undertaken.

i) Members of the WORKING PARTY are SKILLED to perform the tasks assigned to them.

j) Should the working area be subject to environmental HAZARDS the WORK PERMIT will identify the HAZARDS present and the SPECIFIC PRECAUTIONS to be taken.

k) A WORK PERMIT has been received covering the work to be undertaken.

l) The WORKING PARTY understand the conditions and parameter of the WORK PERMIT and are made aware that these must not be altered, varied or exceeded.

3.6.2 Work permit retention

The person in charge of a WORKING PARTY shall retain in his possession all WORK PERMITS issued to him until the completion of the relevant work, any necessary testing and restoration of covers and barriers. He will then sign the clearance section of the WORK PERMIT and return it to the AUTHORISED NOMINATED PERSON.
(Also see 3.13.3)

3.7 SAFETY PRECAUTIONS AFTER COMPLETING WORK

3.7.1 Restoration of supply

The person in charge of the WORKING PARTY shall ensure that the following restoration work has been carried out:-

a) Waste materials, tools and any other extraneous materials have been removed from inside equipment.

b) All terminations are tight.

c) Any temporary safety EARTHS which have been applied are removed.

d) All barriers and covers are in place and secured.

e) All LV ELECTRICAL EQUIPMENT doors are closed.

f) All tools and materials have been removed from the work area.

g) Any automatic fire extinguishing equipment is switched to automatic control, the relevant CAUTION NOTICES removed and the fire officer informed.

h) All members of the WORKING PARTY have left the working area.

i) All access doors to work area are locked as necessary.

j) The WORK PERMIT has been signed as cleared and returned to the AUTHORISED PERSON.

3.7.2 Required tests

The AUTHORISED PERSON shall determine that all necessary tests have been carried out and documented, extraneous materials removed, temporary barriers removed, covers fixed, doors closed and the WORK PERMIT signed as cleared.

3.7.3 Cancellation of Work Permit

The AUTHORISED NOMINATED PERSON shall then cancel the WORK PERMIT issued for work, remove CAUTION and DANGER NOTICES which have been displayed and remove SAFETY LOCKS which have been applied.

3.7.4 Functional test

The CIRCUIT CONDUCTORS which have been ISOLATED will then be ENERGISED as a functional test, after which the LV ELECTRICAL EQUIPMENT will be left switched “ON” or “OFF” as required.

3.8 ACCESS BY OTHER TRADES

3.8.1 Vicinity

When work is to be undertaken, in the vicinity of exposed LIVE ELECTRICAL EQUIPMENT, by persons from other trades, then access will be limited by the issue of a WORK PERMIT by the AUTHORISED PERSON.

3.8.2 Issue of Work Permit

WORK PERMITS to other trades will only be issued to their nominated representative who will be deemed to be their SKILLED PERSON.

3.8.3 Accidental contact

Prior to issue of the WORK PERMIT, barriers will be erected, as necessary, to protect against accidental contact with exposed LIVE LV ELECTRICAL EQIUPMENT and to protect from interference or damage.

3.8.4 Specific precautions

The WORK PERMIT will detail the nature and limits of the work, SPECIFIC PRECAUTIONS to be taken and the date and time after which the WORK PERMIT is invalid. Should the work be incomplete at this time a new WORK PERMIT must be obtained.

3.8.5 Receipt of Work Permit

The WORK PERMIT will be signed as received and understood by the sub-contractor's SKILLED PERSON, who, on completion or suspension of the work, will sign the clearance section and return the WORK PERMIT to the issuer.

3.8.6 Cancellation of Work Permit

The AUTHORISED NOMINATED PERSON will arrange removal of related temporary barriers and cancel the WORK PERMIT.

3.9 WORK ON LIVE LV ELECTRICAL EQUIPMENT

3.9.1 Exceptional circumstances

Although the foregoing procedures are designed to ensure that any member of a WORKING PARTY cannot make contact with LIVE CIRCUIT CONDUCTORS, it is acknowledged that exceptions may arise.
These are:

a) when it is not practicable to carry out the work with the CIRCUIT CONDUCTORS DEAD, e.g. where for the purposes of testing it is necessary for the CIRCUIT CONDUCTORS to be LIVE;

b) where other hazards are created by making the CONDUCTORS DEAD, such as to other users of the system, or for continuously operating process plant etc;

c) where there is a need to comply with other statutory requirements;

d) where the level of risk involved in working LIVE and effectiveness of the precautions available are set against economic need to perform that work, recognising the experience and skill of the assigned operatives.

3.9.2 Safeguards

Whenever such work takes place the following safeguards must be effected by the AUTHORISED PERSON:-

a) the use of people who are properly trained and SKILLED to work on LIVE LV ELECTRICAL EQUIPMENT safely;

b) the provision of adequate information to the person carrying out the work about the LIVE LV ELECTRICAL CONDUCTORS involved, the associated electrical SYSTEM and the foreseeable risks;

c) the use of suitable tools, including insulated tools, equipment and protective clothing;

d) the use of suitable insulated barriers or screens;

e) the use of suitable instruments and test probes;

f) accompanied by another person(s) if the presence of such persons could contribute significantly to ensuring that injury is prevented;

g) the restriction of routine LIVE test work (e.g. product testing) to specific areas and the use of special precautions within those areas, such as isolated power supplies, non-conducting locations, etc;

h) effective control of any area where there is DANGER from LIVE ELECTRICAL CONDUCTORS.

3.10 ABSENCE OF WORK PERMIT HOLDER

3.10.1 Named Person

Should the named person to whom a WORK PERMIT is issued leave the workplace containing the EQUIPMENT named on the WORK PERMIT, the work must cease.

3.10.2 Cancellation and replacement

If it is intended that work should continue after the WORK PERMIT holder has left the workplace, then the WORK PERMIT must be returned to the AUTHORISED PERSON, who will cancel that WORK PERMIT and issue a new WORK PERMIT to the person who will subsequently be in charge of the work.

3.10.3 Cancellation due to absence

Should a WORK PERMIT holder leave the workplace without returning the WORK PERMIT for cancellation and it is required that the named work should continue, the AUTHORISED PERSON must review the safety procedures detailed in sections 3.8 and 3.9.

The AUTHORISED PERSON will then clear and cancel the record copy of the WORK PERMIT himself and record the reason for doing so. A replacement WORK PERMIT will then be issued to the WORKING PARTY in the normal manner detailed in section 3.9.

Every effort must be made to ensure that should the original WORK PERMIT holder return to the workplace, he is made aware that his WORK PERMIT has been cancelled and that no further work must be undertaken in relation to that WORK PERMIT.

3.10.4 Replacement Work Permit

The replacement WORK PERMIT must be returned to the AUTHORISED PERSON for cancellation.

3.11 WORKING IN THE VICINITY OF LIVE HIGH VOLTAGE ELECTRICAL EQUIPMENT

On some installations circumstances may dictate that HIGH VOLTAGE and LOW VOLTAGE ELECTRICAL EQUIPMENT are installed within close proximity.

As soon as any HIGH VOLTAGE ELECTRICAL EQUIPMENT has been ENERGISED and made LIVE then access to the vicinity of the LIVE HIGH VOLTAGE ELECTRICAL EQUIPMENT has to be strictly controlled. Such controls would normally limit access to the vicinity of HIGH VOLTAGE ELECTRICAL EQUIPMENT under the applicable permits as relevant to the nature of the work to be undertaken

3.11.5 Precautions and controls

If there are COMPANY or Customer HIGH VOLTAGE AUTHORISED PERSONS on site to control access for work in the vicinity of HIGH VOLTAGE ELECTRICAL EQUIPMENT then this function shall be undertaken by the AUTHORISED NOMINATED PERSON with the following limitations:-

a) There must be no EXPOSED LIVE HIGH VOLTAGE CONDUCTORS in the area in which work is to be undertaken.

b) All access to the area shall be under cover of a WORK PERMIT issued by an HV AUTHORISED PERSON to the WORKING PARTY. Work must stop if the supervisor is not present.

NOTE: This includes COMPANY/Customer Personnel and all other persons that require access including main/subcontractors.

c) The WORK PERMIT shall not permit any work on or associated with the HIGH VOLTAGE ELECTRICAL EQUIPMENT, switchgear, cables etc., including non electrical work e.g. working in cable trenches containing LIVE cables to seal duct entries etc.

d) Work on LOW VOLTAGE ELECTRICAL EQUIPMENT in the vicinity of LIVE HIGH VOLTAGE ELECTRICAL EQUIPMENT shall be under the general procedures of this document. However, the WORK PERMIT covering such work shall clearly identify the limitations of the work to be undertaken and any specific safety measures that need to be adopted in addition to those which would normally be exercised.

e) If it is considered necessary by the HV AUTHORISED PERSON the WORK PERMIT shall clearly state any work which shall not be undertaken.

f) Those in receipt of the WORK PERMIT must fully understand all the implications, limitations and ensure strict compliance.

Detail that may be considered to be entered is as follows:-

i) Do not use switchgear for access purposes or as a substitute for scaffolding, steps or ladders.

ii) Do not remove cable trench covers.

iii) Do not touch, stand on or lay tools on cables or cable trays.

iv) Do not touch or operate any switchgear unless specifically instructed to do so

v) Precautions must be taken to avoid liquid ingress to any switchgear, accidental or otherwise, i.e. paint, drinks, solvents etc.

vi) Keep switch room locked at all times unless in attendance.

vii) Do not remove any barriers, safety signs or warning notices.

3.12 WORKING WITHIN POTENTIALLY EXPLOSIVE ATMOSPHERES.(excluding Mines)

Potentially explosive atmospheres occur in onshore and offshore petrochemical plants and refining plants. They are also found in distilleries, paint spraying plants, flourmills, woodworking machine plants, the water industry and petrol forecourt environments. Failure to ensure safe working practices in these circumstances could result in the ignition of explosive gases or dust clouds leading to injury or even fatalities.

3.12.1 Regulations

The regulations and guidance notes that govern the equipment installed, and inspection process that must be adopted in these atmospheres are;

a) Equipment - ATEX 95 Directive (SI 182 1996)

b) Worker Health and Safety – ATEX 137 Directive

c) Dangerous Substances and Explosive Atmosphere Regulations 2002 (**DSEAR**)

d) The Engineering Equipment and Materials Users Association (**EEMUA**)

e) COMP'Ex' is a national joint training initiative developed and implemented by the Engineering Equipment and Material Users Association (EEMUA) and JTL and is supported by the Health and Safety Executive (HSE).

3.12.2 Area classification.

Potentially explosive atmospheres are subdivided into two main groups and are categorised as follows.

a) Gases and vapours zones 0,1,2

b) Combustible dusts zones 20,21,22

The equipment that may be installed, operated, and maintained is further subdivided into protection types. The choice of which protection type to adopt is based on minimising the **risk** of an explosion. Details of zones, protection types, and gas sub-divisions are listed in the EEMUA Practitioners Handbook.

3.12.3 General requirements for Installation, inspection and testing of equipment.

a) The explosive atmosphere must be clearly identified by the client by means of a legible sign, and information supplied on the classification of the zone to include a site drawing identifying the extent of the zone.

b) The design for additions or alterations to an EX area will have taken into account the classification of the gases etc likely to be present within the installation.

e) Operatives **must** have a valid COMPEX certificate of competency which in the applicable units (EX01-EX10) for the area where equipment is to be installed or testing is to be performed.

3.12.4 Installation work zones 0, 1, 2

Reference should be made to the current version of EEMUA Practitioners Handbook for Electrical Installation, Inspection and Maintenance, in Potentially Explosive Atmospheres.

a) Prior to commencement of work the Operatives will understand **exactly** what they are required to do, confirm that the apparatus they are to install complies with job specification, and have satisfied themselves that they are SKILLED to do the work.

b) The Operatives will have read and understood any site rules or procedures, and received a site induction if applicable to that installation.

c) All tools, plant, and equipment must be in sound condition, free from defects, and suitable for use in a **potentially explosive atmosphere**.

d) Equipment containing batteries of any description are not allowed within an area marked on site drawings as zone 0, 1, or 2.

e) Exceptions to this rule may be batteries in metal cased watches, specified hearing aids, heart pacemakers, and certified intrinsically safe test equipment or torches.

f) Relaxation of the rules for tools, plant, and equipment in zoned areas may be permitted where it has been ventilated to remove the potentially explosive atmosphere. Appropriate measures **must** be taken to ensure that the atmosphere remains clear of any explosive gases or vapours.

g) **No** other potential sources of ignition are permitted within the zoned area including matches, or cigarette lighters and **MOBILE TELEPHONES.**

h) A permit to work **must** be issued by the client or their nominated representative prior to commencement of installation work within the potentially explosive atmosphere. This should indicate that the atmosphere within the area has been vented, and tested by monitors capable of detecting the explosive gas/vapour.

i) Whilst working within the area continuous monitoring **must** be undertaken with the appropriate instrument to detect a build up of the potentially explosive substance.

j) In the event of an audible alarm being raised by the monitor operatives must vacate the area to a place of safety and inform the person responsible for the installation.

k) Upon completion of installation work all covers and seals must be fitted or replaced and checks made to ensure that the installation complies with the job specification. In the event of discrepancies being identified these must be recorded and the persons responsible for the installation informed.

l) Completion certificates must be signed by the applicable persons to confirm that the installation has been designed, installed, and tested to meet the requirements for potentially explosive atmospheres.

3.12.5 Inspection and testing of zones 0, 1, 2

Reference should be made to the current version of EEMUA Practitioners Handbook for Electrical Installation, Inspection and Maintenance, in Potentially Explosive Atmospheres.

a) Prior to commencement of work the Operatives will understand **exactly** what they are required to do, and have satisfied themselves that they are SKILLED to do the work.

b) The Operatives will have read and understood any site rules or procedures, and received a site induction if applicable to that installation.

c) All tools, plant, and equipment must be in sound condition, free from defects, and suitable for use in a **potentially explosive atmosphere**.

d) Equipment containing batteries of any description are not allowed within an area marked on site drawings as zone 0, 1, or 2.

e) Exceptions to this rule may be batteries in metal cased watches, specified hearing aids, heart pacemakers, and certified intrinsically safe test equipment or torches.

f) Relaxation of the rules for tools, plant, and equipment in zoned areas may be permitted where it has been ventilated to remove the potentially explosive atmosphere. Appropriate measures **must** be taken to ensure that the atmosphere remains clear of any explosive gases or vapours.

g) **No** other potential sources of ignition are permitted within the zoned area including matches, or cigarette lighters and **MOBILE TELEPHONES.**

h) A permit to work **must** be issued by the client or their nominated representative prior to commencement of inspection work within the potentially explosive atmosphere. This should indicate that the atmosphere within the area has been vented, and tested by monitors capable of detecting the explosive gas/vapour.

i) Whilst working within the area continuous monitoring **must** be undertaken with the appropriate instrument to detect a build up of the potentially explosive substance.

j) In the event of an audible alarm being raised by the monitor operatives must vacate the area to a place of safety and inform the person responsible for the installation.

k) Prior to undertaking any tests within the area a thorough visual inspection appropriate to the zone type and equipment **must** be undertaken (form's MASP 01 and MASP 04) to ensure that covers are in place, and applicable earthing arrangements have been followed.

l) Continuity tests are to be carried out to the metal casing of equipment and extraneous conductive parts of the installation to ensure that they are adequately earthed.

m) **The test instruments that perform earth fault loop impedance and prospective fault current tests introduce current into the system to measure earth fault paths. There is a possibility that these induced fault currents could discharge to other earthed equipment within the area, thus producing a spark. This discharge spark is liable to ignite any potentially explosive atmosphere.**

Live testing within the zoned area **is not permitted** unless it has been proven that the atmosphere is free from explosive gases or vapours.

n) In the event of non-compliances being identified these must be recorded and the persons responsible for the installation informed.

o) Upon completion of the inspection and test the appropriate certificate must be signed by the person(s) undertaking the test to confirm that the installation has been tested to meet the requirements for potentially explosive atmospheres.

Lockout Tagout Procedure

Lockout Tagout is a planned safety procedure that disables the energy supply to electrical distribution equipment, individual circuits, industrial machinery and equipment whilst electrical testing work is in progress. The aim of this system is to effectively protect workers from the dangers created by live machinery or electricity, therefore lowering the overall level of risk when working with this equipment.

Guardian standard procedure for implementing Lockout Tagout is laid out below. All steps should be carried out either by a single authorised employee or the employer, and company regulations must be followed at all times when implementing the Lockout Tagout procedure.

Step 1: Preparation
Prepare for a shut down of energy source. Identify the type of energy used (e.g. electrical) and the potential risks, considering the type and magnitude of the energy and how it can be controlled.

Step 2: Notification
Locate the isolator(s) / MCCB / MCB and prepare to 'lock off' energy source. Inform any operators and supervisors who may be affected by isolating the circuit, distribution equipment, or machinery and make them aware of the work being carried out. Ensure all affected staff understand the lockout procedure.

Step 3: Shut-down
Turn off the circuit, equipment or machine, following established procedures and ensuring that there are no increased hazards from equipment stoppage. Isolate equipment from energy sources, by disconnecting switches, circuit breakers.

Step 4: Lock Off
Lock off energy source in the safe/off position, at each isolating device, using the proper lockout devices. Apply a lock so no one can turn the switch/isolator or MCCB/MCB whilst the work is in progress. Warn against accidental use by attaching lockout warning tags. If several employees are working on the same equipment, make sure each puts in place their own identification label and own safety padlock.

Where more than one working party is involved they will apply their own safety lock. This will require the use of a multi hasp to enable multiple safety locks to be applied. All locks will be identified by use of notice to indicate who has applied the safety lock.

Step 5: Test
Check all of the electrical connections/circuits to ensure energy is completely isolated.

Step 6: Undertake electrical test
Perform the required electrical tests associated with BS 7671 requirements, insulation resistance and conductor continuity tests.

Step 7: Return to service

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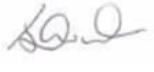
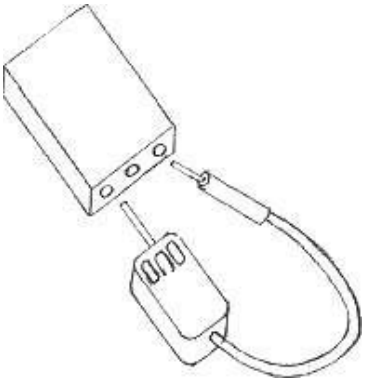


When the work is completed take off the lockout/tagout devices and proceed to test, ensuring that all tools and electrical lockout devices have been removed. Lockout devices must be only be removed by the person who applied them- if several employees are working on the same piece of equipment, they must individually remove their lockout device. The person in control of the work must remove their lock last. Warn all workers before re-energising, check the work area to ensure all employees are at a safe distance from the equipment, and restore the energy supply to the circuit / equipment / machine.

Warning and Caution notices

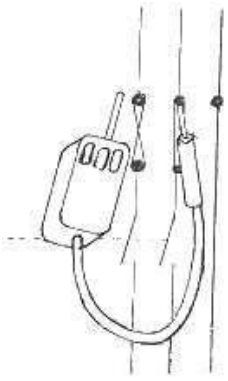
Proving Dead

Step 1
Prove test instrument is
Functioning correctly using
Proving unit.



Step 2
Test line (phase) to neutral

Secure means of isolation



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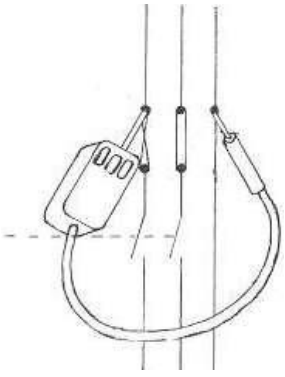
Step 3
Test line (phase) to earth

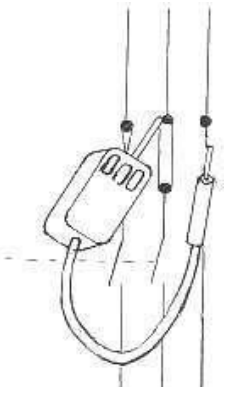
Secure means of isolation



P N E

Step 4
Test neutral to earth

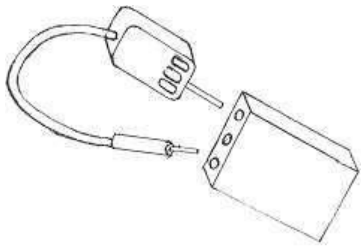
Secure means of isolation

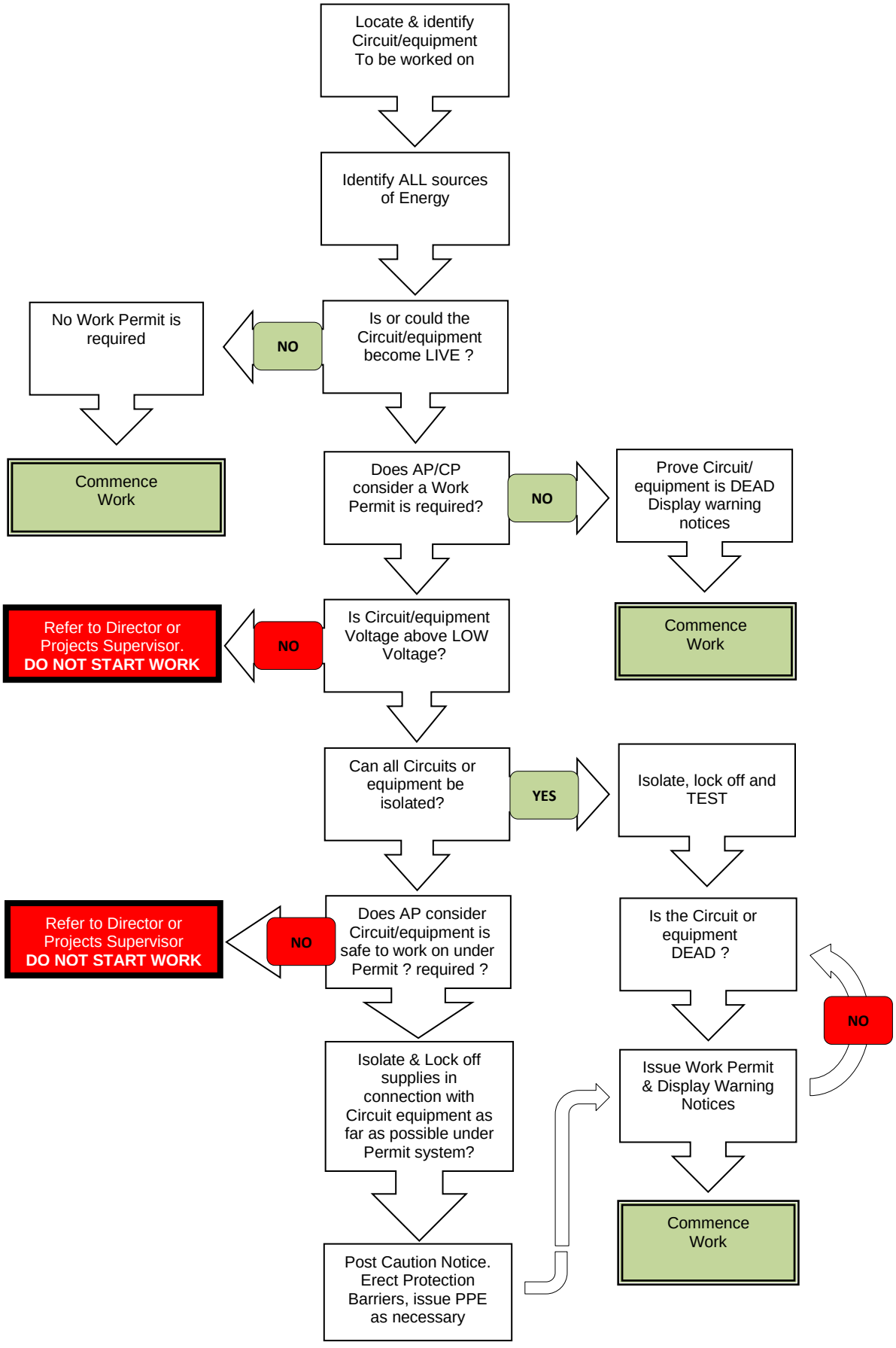


P N E

NOTE
For 3 phase circuits test all phases separately
And between phases

Step 5
Reprove test instrument
Using proving unit.
If test instrument does Not illuminate, check both pieces of equipment, and perform test sequence again





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Arc Flash Precautions

It is generally accepted that in the wider subject of electrical injury in the workplace, the likelihood of arc flash is minimal. However, should arc flash occur, damage to property and personnel tends to be far greater than with other electrical injuries in the workplace. There are a host of factors from the surrounding environment to equipment suitability and age that play a part in the likelihood of an arc flash event.

An arc flash is usually caused by inadvertent contact between an energised conductor such as a bus bar or wire with another conductor or an earthed surface. When this occurs, the resulting short circuit current can vaporise the conductors and produce strong magnetic fields that blow the conducting objects apart.

The resultant fault current ionises the air and creates a conducting plasma fireball with arc temperatures that can reach upwards of 20,000 degrees centigrade at its centre (4 times the surface temperature of the sun), which will immediately vaporize all known materials close to the arc immediately and the incident energy emitted may ignite the worker's clothing and/or cause body burns to the worker even without igniting the clothing. Severe injury and even death can occur, not only to persons working on the electrical equipment, but also to people located nearby.

Arc flash injury can include external burns (i.e. severe burns to the skin), internal burns and intoxication from inhaling hot gasses and vaporised metal, hearing damage, eye damage and blindness from the ultraviolet light of the flash as well as many other devastating injuries. Depending on the severity of the arc flash, an explosive force known as an arc blast may also occur. This is due to the rapid expansion of air and vaporised materials, dispelling a force that may exceed 100 kiloPascal (kPa) and could cause the propulsion of molten metal, equipment parts and other debris at speeds of up to 300 metres per second (m/s).

Many organisations have undertaken an Arc Flash analysis in accordance with NFPA 70E and IEEE 1584.

Equipment is rated for potential magnitude of fault and resultant energy discharge. The analysis is completed by the provision of warning notices indicating the potential arc flash incidence level and safety precautions, predominantly approach distance and PPE.

ARC Flash PPE acts as a thermal barrier to prevent the heat from an Arc causing incurable second degree burns it is also non-flammable and non-melting so it will not catch fire or melt in the event of an Arc.

You should always wear natural fibre e.g. cotton underwear with Arc Flash PPE as garments made from artificial fibres e.g. nylon garments may burn or melt.
PPE is not effective unless it is all in place, this includes :-

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Incident Energy Levels from 0 to 8 cal/cm² Level 1 PPE *All items to have minimum Arc Rating or Arc Thermal Performance Value (APTV) of 8 cal/cm²*	
Description	Image
Long sleeve shirt Full length trousers	
Balaclava	
Face shield	
Safety glasses or goggles	
Hearing protection	

Jacket (13.6 cal/cm2), Trousers (13.6 cal/cm2), Polo Shirt (4.3 cal/cm2), T-Shirt (4.3 cal/m2) Arc Glove (12.1 cal/cm2), Balaclava (4.3 cal/cm2), Face Shield, Hard Hat, Ear Defenders, Leather Industrial Shoes.

The figures in brackets refer to the Arc Thermal Protective Value (ATPV) of the PPE and is a measure of the amount of incident energy from an Arc that the PPE affords protection from.

With everything in place, engineers are afforded a high degree of protection from the thermal effects of an Arc nonetheless if you have any concerns about a particular installation you should always ask for an Arc Flash Assessment to be carried out.

Arc Flash PPE should be worn whenever energised switchgear or panels are open and exposed, energised conductors are present.

Body position is important always stay as far from exposed energised conductors as possible, when switching stand to the side if possible.

Limit the number of personnel in and around switchgear and distribution panels to the minimum needed to complete the work.

Arc Flash PPE is not a suit of armour, do not carry out any work that you would not consider if you were not wearing PPE.

PPE should always be laundered in strict accordance with manufacturer's instructions, heavy dirt or oil contamination may affect performance. Any tears or damage should be repaired strictly in accordance with manufacturer's instructions.

When working within installations that have been the subject of an arc flash survey and analysis, engineers must adhere to the precautions listed on the warning label.

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This includes;

- Approach distance, limited, restricted, prohibited.
- Provision of temporary screens or barriers if required.
- The use of arc flash rated PPE that exceeds the incidence level indicated.