Technical Bulletin 118

Title: Safe electrical isolation of gas appliances

Date issued: 30 January 2018

Note: *This version of Technical Bulletin (TB) 118 replaces the version originally published 1 July 2016 which is now withdrawn. This version has been reviewed and where appropriate revised to ensure that it remains both current and relevant.*

This Technical Bulletin provides guidance to Gas Safe registered businesses/engineers on the safety precautions to take when working on appliances and the safe electrical isolation of gas appliances

Note 1: *The health and safety enforcing authorities in all geographical areas covered by Gas Safe Register, i.e. Great Britain (GB), Northern Ireland, Isle of Man and Guernsey, regard the guidance in this Technical Bulletin (TB) as a 'best practice' requirement and would expect all Gas Safe registered businesses/engineers to apply the requirements of this TB when and where appropriate circumstances/relevant appliances are encountered. For details of current health and safety legislation, gas safety legislation, building legislation and industry standards for the geographical areas covered by Gas Safe Register, see the Legislative, Normative & Informative Document List (LNIDL)[(1)] at: https://www.gassaferegister.co.uk/sign-in/ - login and visit the Technical Information area.*

Introduction

Electric shock is defined in BS7671 (IET Wiring Regulations) as a dangerous physiological effect resulting from the passage of electric current (Amps) through a human body or livestock. Sometimes this 'passage of current' can lead to nothing more than some small discomfort to the person receiving the shock, while at other times it can **kill** the person receiving the shock.

Electrical shock

In reality, there are many factors that will play a part in determining the extent of injury received from an electric shock, including luck. Many people experience electric shock at some time in their life. Fortunately for most of them, bodily contact is broken by reflex action before too much current has passed through the body.

No-one is immune from an electric shock, as electrocutions prove; the electric shock may not injure or kill the person receiving it, but there are other hazards that could prove harmful e.g. falling off a step ladder. **Figure 1** (below) illustrates the passage of electrical current through the human body.

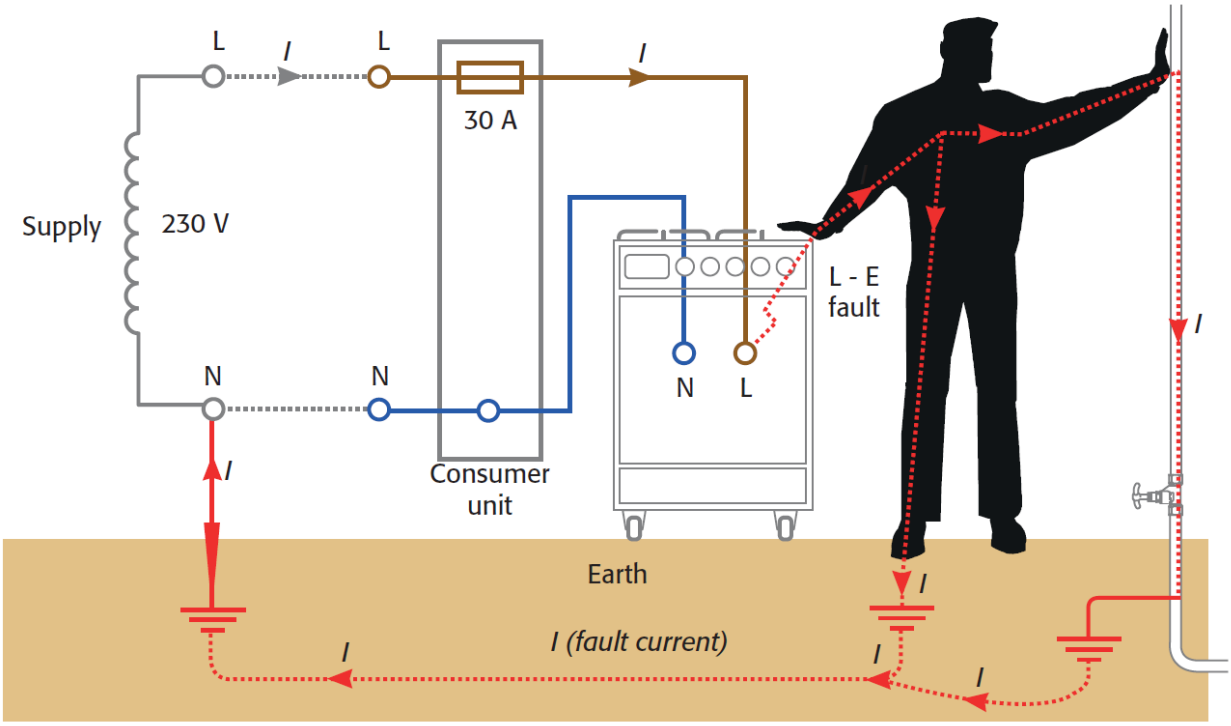

Figure 1 – The passage of electrical current through the human body

A person making direct contact between line and neutral will not normally cause an over-current protective device e.g. fuse or circuit-breaker to operate, as body impedance (resistance) is normally quite high, (approximately around 500 Ohms from hand to foot). A person making contact between line and earth will produce a small increase in current, which again is unlikely to be detected by over-current protective devices.

However, if a Residual Current Device (RCD) is installed in the circuit, there will be an imbalance between the line and neutral currents that can be detected by a sufficiently sensitive RCD.

Not everyone would have the same level of shock from the same source; it would depend on variables such as the individual's body resistance, his or her health, clothing etc. However, it is generally accepted that around 50mA (0.05 Ampere) is the lethal level. Below this level, contact with a live source normally pushes us away from that source. Above 50mA the muscles may contract or freeze and we may be unable to break contact. Also, interruption of the heart's rhythm could take place and its beating may stop altogether. Burns to the parts of the body in contact with the source can occur, together with burning of internal organs and loss of breathing which may leave long-term health issues.

Legislation -

Health and Safety at Work etc Act 1974 (HSWA) (United Kingdom)

The HSWA applies to everyone concerned with work activities including employers, the self-employed and employees. The duties are expressed in general terms so that they apply to all types of work activities and work situations. Every employer has a duty to ensure, as far as is reasonably practicable, the health, safety and welfare at work of their employees (see **Note 2**).

Note 2: *Similar requirements apply in other geographical areas covered by Gas Safe Register (see also **Note 1**).*

Electricity at Work Regulations 1989 (EWR) (Great Britain (GB))

The EWR came into force on 1 April 1990 (see **Note 2**). The purpose of the Regulations is to require precautions to be taken against the risk of death or personal injury from electricity in work activities. The Regulations are made under the Health and Safety at Work Act (HSWA). Regulation 13 of EWR covers the precautions that need to be taken on equipment that has been made dead.

Safe Isolation

In the case of many gas appliances, the means of electrical isolation can be adjacent to the appliance and could be in the form of a plug and socket-outlet, or switched fused connection unit, which is under the direct control of the competent person carrying out the work. These devices can be used for the isolation of the appliance without further precautions being taken, provided that there is no risk that the supply could be re-instated by others.

Regulation 14 of EWR requires that:

"*No person shall be engaged in any work activity on or 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*** *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."

'Dead' working should be the normal method of carrying out work on electrical equipment as required under regulation 14 of the *Electricity and Work Regulations 1989(EWR) (Great Britain (GB))*. Live working should only be carried out in certain circumstances where it is unreasonable to work dead, for example fault finding and testing. When fault finding and testing, there are instances where the electrical equipment needs to be live, therefore suitable precautions need to be taken to prevent injury.

The Health & Safety Executive (HSE) provide guidance in Engineering Information Sheet No 35 (Revision 1) - Safety in electrical testing – service and repair of domestic appliances. The information sheet contains specific advice about avoiding injury during the servicing and repair of domestic appliances normally operating from a 230 Volt supply, including gas appliances with an electrical supply.

The guidance is for those who carry out electrical testing during the service and repair of domestic appliances. It is also relevant to those who manage this type of work.

The information sheet can be downloaded here - http://www.hse.gov.uk/pubns/eis35.pdf and the key points include;-

Test areas - In all circumstances, you must create a safe working environment for testing. A test area in which the work is to be done should be defined.

When working in a customer's home, determine the steps necessary to create a safe working environment.

- Consider erecting a temporary barrier to prevent unauthorised people approaching the danger area.
- Allow plenty of space to work in. If you do get a shock while working in a cramped area, you may be less able to break contact quickly, if at all, or are more likely to hit something. Remove (or move away from) any objects that may pose a hazard. For example, if an appliance is situated in a corner, consider pulling it out to work on it.
- Make sure that everyone in the home is aware of the dangers arising from the testing work, and that they follow any precautions that are necessary.

- Ask for children and pets to be kept away from the area.
- Never leave equipment or an appliance unattended when it is in a dangerous condition (eg with live conductors exposed).

Test equipment - Test equipment should be of a proprietary design and be manufactured to BS EN 61010,1 BS EN 615572, or BS EN 61243-3.3

Power supply earthing - When working on Class I (earthed enclosure) equipment such as a gas appliance, it is important that the earthing of the power supply to the equipment is adequate and efficient. In customers' premises, this is likely to be unknown so it is important to carry out a test to demonstrate the effectiveness of the earthing. The safe way to do this is to measure the **earth loop impedance** of the power supply using an instrument designed for that purpose (see **Figure 2**). Make sure that you know how to use the testing device and how to interpret the results obtained. If the test indicates an inadequate earth, the customer must be informed that the work cannot continue until it has been rectified.

Remember that simple 'Go/No go' plug-in testers will, in general, only provide a polarity check and an indication that an earth may be present, but not its effectiveness.

Figure 2 – An example of an Earth Fault Loop Impedance Tester

Figure 3 – An example of a 'Volt Stick'

'Safe' to Touch

Due to a number of fatalities over the years, it has become custom and practice within the gas industry to use a single-pole or non-contact live-circuit detector, sometimes referred to as a Voltage Stick (see **Figure 3**), before touching appliances and pipework to ensure a dangerous voltage is not present due to fault before touching the gas equipment.

HSE Guidance Note 38 (Electrical test equipment for use on low voltage electrical systems – fourth edition) states these devices should **only** be used for identifying live equipment, not for proving its dead. Therefore, further appropriate tests must be used to prove equipment is electrically dead prior to undertaking work.

Guidance on safe isolation of electrical equipment (including appliances) when carrying out work

The means of isolation for the equipment must be under the control of the person carrying out the work. This can be achieved in a number of ways:

- Posting warning notices at the point of isolation: **and**
- Use of locking devices for plugs or switched fused connection units; **or**

- If the means of isolation is adjacent to the equipment and is visible whilst working on the equipment, no further precautions are required.

If the isolation of a circuit breaker is required then a proprietary locking device with a padlock needs to be used and not insulating tape. The person carrying out the work should retain the key to the padlock at all times.

Where fuses are used, then removing the fuse and where applicable the fuse carrier is a suitable means of isolation, providing the person carrying out the work retains the fuse and where the carrier cannot be withdrawn, a lockable fuse insert is used.

Warning notices should also be posted to warn others that work is being carried out and replacement of the fuse should not occur.

Important: *The neutral coming into the installation of a TT System may not be at earth potential, therefore when working on a TT System it is essential that the means of isolation being used disconnects* ***all*** *the live conductors (line and neutral).*

Proving electrically dead

Once the means of isolation has been identified and following the isolation of the equipment, it is vitally important that the equipment be checked to ensure it is electrically dead before work commences. The use of an approved voltage indicator is required to prove that the equipment is dead; this could be a proprietary test lamp, or a two-pole voltage detector (see **Figure 4**). The Health and Safety Executive (HSE) recommends, (HSG85[(2)]) that a multi meter is **not** used for proving dead.

Figure 4 – Typical 2 Pole Voltage Indicator

Figure 5 – An example of a Proving Unit

It is important to test the approved voltage indicator on a known supply or proving unit (see **Figure 5)** before and after use and that when testing the equipment, testing is carried out between all live conductors (live and neutral) and live conductors to earth.

Safe isolation procedure

The following procedure can be used as a guide to ensure the correct procedure is followed when isolating a piece of electrical equipment such as a gas boiler. However before any work is carried out a risk assessment needs to be completed and PPE used as needed to ensure safety.

Stage 1 - With the responsible person's permission, ensure it is safe and acceptable to isolate the equipment. Remove the load from the circuit by turning off the equipment if at all possible by operating any on/off switches.

Switched fused connection unit
Turn off the switch and remove the fuse carrier where possible. If the fuse carrier is not the removable type then remove the fuse from carrier and secure the carrier in the open position if it is not adjacent to the equipment being worked on (see **Figure 6**). The fuse needs to be kept by the person carrying out the work.

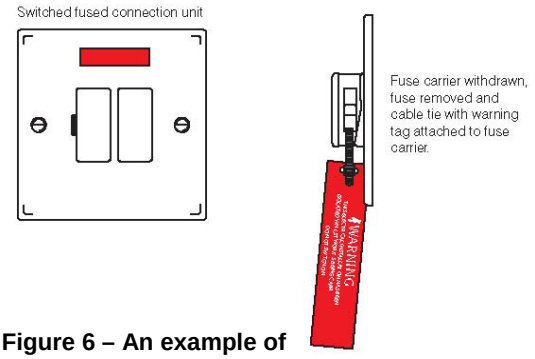

Figure 6 – An example of securing a fuse carrier

Plug and socket outlet - Switch off the socket-outlet (if switched) and remove the plug. Remove the plug top fuse if at all practicable. If the plug and socket-outlet is not adjacent to the equipment being worked on then the plug will need to be secured against inadvertent reconnection by another person. There are a number of proprietary devices on the market for this.

Stage 2 - Test the voltage indicator on a known source/supply before use, for example on a proving unit.

Stage 3 - Using the proven voltage indicator, check that there are no dangerous voltages present between the following connections:

- Earth and line;
- Neutral and line;
- Earth and neutral.

It is also important to check all other terminals such as a pump over-run, switched live and any other external connection to the equipment are 'dead'.

Important: *When checking between the earth and all live conductors, including the neutral, it is important that the earth connection be made first and removed last to prevent a dangerous voltage appearing on the tip of the voltage indicator.*

Stage 4 - Reprove the voltage indicator on the known source to ensure the voltage indicator is functioning correctly.

Further information and guidance

It is important that the person carrying out the work is competent to undertake the task in hand. They should also be aware of any specific requirements that may be placed upon them by the type of environment they are working in, for example, there may be a need for a 'Permit to Work' to be issued/granted in certain circumstances.

Note 4: *For information about the dangers of cables buried in walls etc., see TB 117[3].*

Further guidance can be found at the following websites:

- www.hse.gov.uk/electricity/
- http://www.hse.gov.uk/pUbns/priced/gs38.pdf
- https://www.electricalsafetyfirst.org.uk/mediafile/100370766/Best-Practice-Guide-2-Issue-3-.pdf
- http://www.hse.gov.uk/pubns/eis35.pdf
- http://www.hse.gov.uk/pubns/indg354.pdf

Note 5: *For general information about the process behind the development of Gas Safe Register Technical Bulletins and the expectations for all Stakeholders, see TB 1000[4] at: https://www.gassaferegister.co.uk/sign-in/ - login and visit the Technical Information area.*

Bibliography

(1) *LNIDL - Gas Safe Register Legislative, Normative & Informative Document List*

(2) *HSG85 - Electricity at work - Safe working practices (HSE Books)*

(3) *TB 117 - The dangers of cables buried in walls and partitions*

(4) *TB 1000 – An introduction to Gas Safe Register Technical Bulletins*

Note: *Gas Safe Register Technical Bulletins and the Legislative, Normative & Informative Document List can be viewed at: https://www.gassaferegister.co.uk/sign-in/- login and visit the Technical Information area*

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