



# S A F E T Y B U L L E T I N – No. 23

## MANUAL METAL ARC WELDING – ELECTRICAL SAFETY

### Introduction

Electric arc welding is a particularly versatile industrial process that is widely practised everyday by persons employed in construction, manufacturing, production and maintenance. As with other industrial processes, arc welding can be carried out safely and need not present any appreciable risk, providing adequate precautions are taken to control hazards.

Hazards include fire, explosion, asphyxiation, radiation, burns, heat stress, falling, foreign bodies, and electric shock. Each hazard may affect persons other than the welder, and collectively are too extensive to discuss here. This bulletin deals with safeguards for preventing electric shock.

### Welding Circuit

Prevention of electric shocks commences with a thorough understanding of the welding circuit and maintaining an ongoing awareness of the electric current path. **Figure 1** shows the general arrangement of a typical AC welding circuit connected to a 'transformer type' welding power source. Equally, the welding circuit could be energised by a motor driven 'rotary type' power source, and the current could be DC.

It is vital to ensure that the **output welding circuit** remains electrically insulated from the frame of the power source, and from any input or auxiliary output power circuits.

### Electric Shock

The effect of electrical current through the body depends largely upon the magnitude and duration of the current, and the path taken. Any current exceeding 30 mA AC is considered injurious to health if not rapidly disconnected.

The output voltage of an AC welding power source is restricted to 80 volts, and under adverse conditions circuit resistance through the human body can be as low as 200 ohms.

$$\text{Ohm's Law: Current} = \frac{\text{Voltage}}{\text{Resistance}} = \frac{80}{200} = 400 \text{ milliamps}$$

Clearly a welding current electric shock can prove fatal.

## Accidents

A welder working inside a leach tank at an Indonesian mine was electrocuted in October 1996 when an insulation fault developed within the welding power source. The accident occurred when the victim made simultaneous contact with the welding return circuit and metallic parts of an electric hand lamp that was 'earthed' in the usual manner. The hand lamp was connected to an auxiliary 240 volt outlet of the welding power source, and was free of defects. **Refer Fig. 2.**

In New Zealand during 1995 an experienced welder working in a chute received a fatal electric shock when he risked changing an electrode with an ungloved hand.

Further electrocutions are detailed in AS1674.2 - Appendix D.

An arc welding fatality has not been recorded in Western Australia since 1988. However, there has been a number of 'near misses', and a staggering 400 arc welding injuries (all types) were the subject of workers compensation claims across all industries during 1996.

A high incidence of electric shocks to apprentices/trades assistants injured while holding in place items being 'tacked' by the welder requires urgent attention. (**Refer Fig. 3**).

## Safeguarding

Preventing electric shock is as rudimentary as confining the welding current to the welding circuit by means of electrical insulation, and avoiding all situations where the welding circuit can be completed by a path through a person's body.

Some of the do's and don'ts:

### Equipment

- welding power sources and accessories should all conform with the relevant Australian Standard.
- the electrical rating of equipment must be adequate for the duty and not exceeded.
- any moveable power source supply cord should be of the minimum practicable length, flexible, and earth-leakage protected.
- an isolating switch should be mounted on or adjacent to a 'transformer type' welding power source.
- two or more welders working in the same location requires the power sources to be 'phased' in a way that minimises the voltage between electrode holders; (or an effective barrier must be in place).
- any auxiliary output circuits provided on welding power sources must be connected in accordance with AS2790 and provided with earth leakage protection as per Mines Safety and Inspection Regulation 5.24.

### Practice

- persons carrying out welding operations must be competent.
- protective footwear, gloves and clothing must be worn, and kept dry.
- switch off the electricity supply before moving power sources and prior to connecting/disconnecting welding leads.
- inspect welding leads accessories and connections regularly, and do not use if defective.

- protect welding leads from damage and keep clear of other persons.
- never loop welding leads around the body, or put the electrode holder under the armpit.
- the work lead must always be secured to the work (or table) and never connected to building structures, pipes or electrical earthing conductors.
- insulate yourself from the ground and the work wherever practicable.
- always wear dry welder's gloves when changing electrodes or holding a workpiece in place. Applies equally to assistants.
- remove the electrode from the holder and switch off when not required.
- do not weld while standing in water or out in the rain, and change any clothing, gloves or footwear that become wet.
- do not abuse equipment or cool the electrode holder by immersing in water.
- maintain good housekeeping and REPORT ALL DEFECTS.

### **Confined Spaces**

- the all round presence of metalwork and often cramped hot and wet conditions demands additional precautions when welding in confined spaces. Electric shocks in confined spaces are usually serious and often fatal.
- adhere to the recommendations detailed in AS2865.
- work in accordance with a permit system which safeguards against all hazards.
- use of DC power sources or AC power sources which automatically reduce the open circuit voltage to 32 volts are preferred, and should be located outside the confined space.
- electrode holders must be of the all-insulated kind in accordance with AS2826 (type A).
- lighting should be extra-low voltage, or earth-leakage protected if otherwise.
- work from dry wooden formwork and avoid physical contact with surrounding metalwork whilst welding.
- the welder must be constantly observed by an assistant positioned outside the confined space.
- the assistant must be trained in rescue and resuscitation and have a readily accessible means for isolating the welding current.
- the welding circuit must remain de-energised until the welder is ready to commence welding, and when changing electrodes.
- the welding power source must be isolated as soon as the work is complete and when the welder leaves the workplace for any reason.
- maintenance and repairs to welding equipment should not be carried out within the confined space.

### **Maintenance**

- an electrical worker should inspect and test the welding power source at least quarterly, and the welding leads/accessories monthly.
- testing must ensure that the output welding circuit is electrically insulated from the frame of the power source and from any input or auxiliary output power circuits. At least 1 megohm insulation must be maintained.

- testing must ensure that the electrical resistance between the earth terminal of the power source and 'earthed' metallic parts does not exceed 0.1 ohms (AS1966).
- welders should externally inspect the welding power source leads and accessories daily, and report defects.
- all repairs to equipment are to be carried out by an electrical worker.
- maintenance checks must be regular, periodic and systematically carried out on an ongoing basis.

## Summary

Detailed above are the main considerations when safeguarding against manual arc- welding electric shocks. The risks associated with the other hazards referred to should be eliminated or controlled in a systematic manner.

Employers and managers are reminded of their duty to ensure that all persons carrying out welding operations (including the so-called 'multi-skilled') are competent, that welding plant is maintained in a safe condition, and that safe systems of work are adhered to.

For further information, refer:

- : AS1674.2 (1990) - Safety in welding and allied processes.
- : AS2865 (1995) - Safe working in a confined space.
- : Health and Safety in Welding (1994) Technical Note 7 published by the Welding Technology Institute (09) 354 7797.

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Att: Fig 1-3

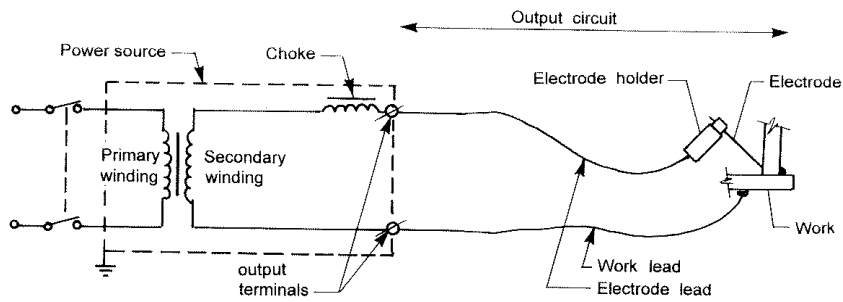


Fig. 1 A.C. Welding circuit - Transformer Type

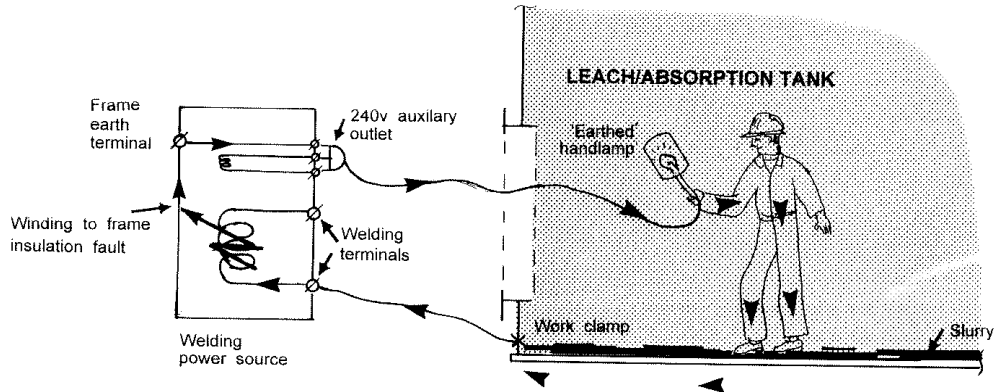


Fig. 2. Indonesian arc welding fatality

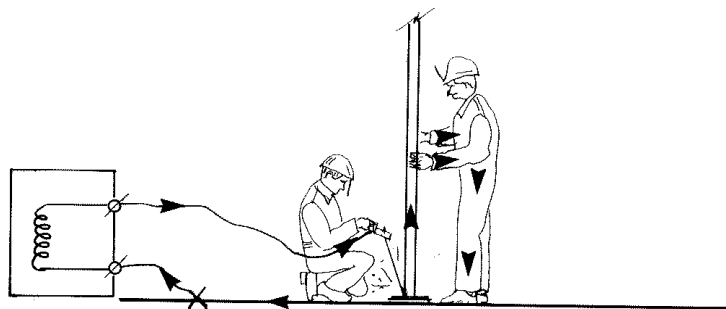


Fig. 3. Assistant holding workpiece in place