

## ELECTRICAL ENGINEERING SAFETY | INFORMATION SHEET NO.2

# Basic welding practices

December 2013

**Information Sheets are developed by the inspectors of electrical engineering in response to issues identified during site electrical engineering audits at extractive mines and questions raised by the mine operators. They are provided as guidance material for mine operators in the development of electrical safety standards.**

### Background

Electric welding is an activity carried out at most if not all mine sites.

The industry continues to experience an unacceptable number of electric shock incidents from electric welding activities each year.

Each incident of electric shock has the potential to result in a fatality. Mines that carry out electric welding activities must develop and implement safe work practices for electric welding if the risk of electric shock from electric welding is to be managed.

### Purpose

The purpose of this information sheet is to provide the industry with information for the development of safe working practices for electric welding.

### Scope

The scope of the information sheet is to provide mine operators with guidance material to assist in the development of mine site processes, standards and procedures for the management of electrical safety during electrical welding activities at mine sites.

### Objective

This information sheet is intended to give the user a starting point to identify and manage electrical welding safety at the mine site by providing a step-by-step approach in identifying hazards, assessing risks and implementing controls.

The philosophy of the document conforms to the NSW Mine Safety Operations publications "Risk Management Pocket Guide" and the "General Workplace Inspection Checklist".

This information sheet highlights the prescribed hazards from the Work Health and Safety Regulation 2011.

### Reference documents

AS 1674.2 - Safety In Welding And Allied Processes – Part 2

Electrical Engineering Decision Sheet 12.2

[www.resources.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0005/256487/EES-Decision-Sheet-12.2-Selection-of-welding-machines.pdf](http://www.resources.nsw.gov.au/__data/assets/pdf_file/0005/256487/EES-Decision-Sheet-12.2-Selection-of-welding-machines.pdf)

Welding Technology Institute of Australia – Technical Notes

## Definitions

**Welder:** A person who performs welding (including tack welding) or cutting operations.

**Welding machine:** A device that supplies welding current and has output characteristics that are suitable for arc welding or allied processes.

## Classification of welding areas (environment)

### Welding categories at a mine site:

All electric welding areas at a mine should be managed as Category C unless a detailed and documented risk assessment, carried out by the mine, has determined the work area can be reclassified.

It is unlikely that a Category A environment will exist at a mine site.

**Category C** environments are those where the risk of an electric shock or electrocution by arc welding is greatly increased due to reduced body impedance of the welder (clothing damp due to moisture or perspiration) and there is a significant risk of the welder contacting the work piece or other parts of the welding circuit.

Category C environments include, but are not limited to, trenches, underground welding tasks, splash zones, wet work areas or where the ambient temperature is 32°C or greater.

**Category B** environments are those where there is a significant risk of the welder contacting the work piece or other parts of the welding circuit and where the ambient temperature is less than 32°C (reduced likelihood of clothing being damp due to moisture or perspiration) and:

- a) freedom of movement is restricted, so that an operator is forced to perform welding activities in a cramped position (e.g. kneeling, sitting, lying), with physical contact with conductive parts (e.g., the work piece); or
- b) there is a high risk of accidental or unavoidable contact by the operator with conductive element, which may or may not be in a confined space as defined in AS/NZS 2865.

In Category B environments it is recognised that there is an increased risk of electric shock and include general fabrication activities, large work pieces, steel structures, inside pressure vessels, processing tanks and conductive confined spaces. Under some conditions, e.g. hot weather and/or working in direct sun light, a category B environment could become a category C environment.

**Category A** environments are environments where:

- a) the risk of an electric shock or electrocution by arc welding is low;
- b) normal work practice is used; and
- c) it is not possible for a welder or any other worker to be in contact with the work piece, in the event of being in contact with a live part of the welding circuit.

Category A environments require considerable effort to insulate the welder and others from the work piece. The type of work would typically be bench-top welding where the work piece is small and /or is a repetitive operation in an area such as a workshop. Under some conditions a category A environment could become a category B environment. E.g. change of weather conditions – cool at start (in the morning) and increased temperature during the day causing the welder to sweat freely.

## Hazards

The hazards associated with electric welding are to be identified using a detailed and documented risk assessment process. Risk assessment team members should include personnel with experience and skills that will contribute to the outcome of the assessment, i.e. electrical engineer, OH&S representative, electrician, welder, mechanical engineer, observer.

The development of standards and procedures for the management of electric welding should include the actions and controls identified during the risk assessment.

In accordance with AS1674.2, observers are to be used where electric welding is carried out in damp or wet and areas and areas classified as confined space.

General hazards that personnel could be exposed to during electric welding activities are detailed in the table below.

Hazards to consider for Category B areas
Electric shock from the power supply equipment and cables
Electric shock from the welding machine output power – The electrode and work piece are to be regarded as electrically alive
Radiation burns to eye or body from welding arcs.
Asphyxiation or illness – due to inhalation of gasses created during welding
Fall while working at heights
Eye injury due to flying materials
Slips trips and falls around work site
Fire to the surrounding environment
Burns – due to heating of work piece, weld spatter, hot molten material or ignition of clothing.

Additional hazards to consider for Category C areas (includes CAT B hazards)
Electric shock – Increased perspiration resulting in lower body electric resistance
Electric shock – Welder becoming part of the welding circuit
Electric shock – Work conducted in damp or wet area
Electric shock – Work conducted in a confined space

## Electric welding competencies

### Welders

Welders should be competent in electric welding. The competency requirements for personnel to carry out electric welding should be established and documented by the mine to include:

#### Qualifications

The qualification requirements of personnel to carry out electric welding should be specified by the mine. The qualifications applicable to electric welding are those provided by a recognised training provider, i.e. TAFE, Welding Technology Institute of Australia.

#### Knowledge

Welders should have first aid training and an understanding of electrical safety to minimise the hazards associated with electric welding that includes:

- How electric shocks are received while conducting electric welding
- The conditions that increase or decrease the severity of electric shocks
- The dangers of stray welding currents and how to avoid them
- The various types of Hazard Reduction Devices available
- The application of the Hazard Reduction Devices
- Danger in the use of multiple welding machines working in close proximity
- Danger in the use of generator welding machines fitted with multiple voltage outputs

#### Skills

The welder should have the skills required to safely carry out the task. The skills should be obtained through and from a suitably qualified training provider. The skills of a welder, in conjunction with the welder's experience, should be reviewed by the mine operator to determine the suitability of the person to perform the task.

#### Experience

The work experience of a welder should be reviewed by the mine operator and used to determine the ability of personnel to carry out the task, particularly where specialised work is to be performed, i.e. pressure vessel welding, structural welding.

### Authorisation

Electric welding activities should be restricted to personnel that have appropriate competencies. Personnel that have been assessed as possessing the required competencies should be issued with a written authorisation by the mine operator to carry out those tasks.

### Observer

An observer is required where electric welding is carried out in damp or wet areas and/or confined space. An observer is to be trained in electrical welding hazards and is to be competent to:

- implement control measures during the welding activity
- implement control measures in an emergency
- rescue the welder carrying out the welding activity, if necessary (including CPR).

## Equipment and requirements

### Considerations for safe welding

<b>Considerations for Category B areas</b>
D.C. welding machines used in preference to A.C. welding machines
Power supply protected by an RCD.
Ventilated work place.
Welding equipment that has current inspections
Clean and dry work area
Fit for purpose PPE
Arc barrier screen(s)
Welding equipment in good condition
Welding machine fitted with a Hazard Reduction Device–HRD (VRD, ZRID or equivalent or Hand piece trigger switch fitted to MIG and similar type welding machines)
Equipment required for confined spaces – includes confined space permit (Refer AS2865), hot work permit, an observer, rescue equipment and a Welding Safety Switch in the electrode lead.
Use of type A electrode holder / Isolator style electrode holder.
Insulation material – rubber mats, duckboards etc.
Welding machines with 240 volt outlets are used with consideration to safety issues detailed in Technical Reference EES 013.

<b>Additional considerations for Category C areas (includes CAT B hazards)</b>
Equipment required for confined space work – including an observer, rescue equipment, ventilation fan to cool the welder, gas detection equipment (flammable gas, deficiency of oxygen etc.)
Safety equipment required for damp and wet work areas – includes an observer, Welding Safety Switch in the electrode lead, insulation material, duck boards, tarpaulins (or equivalent).
Dry change of clothes, gloves and foot ware for the welder.
For confined space welding – ventilation fan for air quality and to cool the welder.

## Electric welding preparation steps

Preparation steps – Category B areas
Welder to be dressed in dry fire resistant clothing that covers the legs and arms.
Welder has steel cap rubber soled safety footwear. The steel cap of the footwear is to be totally covered.
Welding gloves are to be in good condition, dry and fitted to both hands.
Leads and components (electrode holders, cable connectors and earth clamps etc.) have been inspected for damage. Damaged leads and components not to be used, but tagged out of service and removed for repair or discarded.
Leather cushions, rubber matting, wooden duckboards or other means will be used to insulate the welder from any damp floor areas any exposed parts of the work piece.
Where necessary, welding arc screen(s) are in position.
The welding machine is fitted with a Hazard Reduction Device.
If a VRD is fitted, test the VRD for correct operation.
Check correct operation of the VRD by voltmeter and/or indicator lights – ex. GREEN (reduced voltage output) RED (full voltage output).
Welding machine is powered from an outlet protected by a 30 milliamp RCD.
The welding machine is to have an “S” in a square on the nameplate to identify compliance with AS 60974.1. If the marking is not on the nameplate, the application of the welding machine should be re-assessed.
For confined space welding activities – A permit for confined space entry is required.
An observer is to be present for confined space and/or wet area tasks.
Where required, apply a Hot Work Permit

Additional preparation steps – Category C areas (includes CAT B hazards)
The work piece is to be isolated and tagged and locked out, Note: The work piece is the equipment that is to be welded.
Check leads for correct size and lengths i.e. to control risk of excess voltage drop.
Where an observer is required, the power supply to the electrode lead is to be de-energised before an electrode is changed, ie. Operate the electrode lead welding safety switch to off position.

## Electric welding process steps

Process steps – Category B areas
The work return lead is to be connected to the work piece by a suitable attachment. e.g. work lead clamp
The work area is to be kept tidy & free from tangled leads, discarded off-cuts & electrode stubs
Welding gloves that are clean, dry and in good condition are to be worn whilst welding activities occur and while changing electrodes.
Insulation rubber mats and / or duck boards to be positioned to insulate the welder from the work piece.
While tacking two pieces together, the arc is to be struck on the piece connected to the work lead. Any material being welded to the work piece should be supported by a system that prevents persons from receiving an electric shock. This may require the use of a jumper lead or fly lead.
The electrode holder or gun is not to be placed on the work piece where it may short circuit, but placed in an area isolated from the work piece.
Before replacing electrodes the power to the electrode should be removed.
The electric power supply to the welding machine is to be switched off and the disused electrode removed from the electrode holder: <ul style="list-style-type: none"> <li>· before the welder leaves the work area, or</li> <li>· when ever the leads have to be moved.</li> </ul>
At completion of work, clean up area and store welding equipment away. Report any defects to supervisor.
If an operator or other person experiences an electric shock the supervisor is to be informed and electric shock protocol is to be enacted.

Additional process steps – Category C areas (includes CAT B hazards)
Welding gloves are to be clean, dry and in good condition to minimise the risk of electric shock.
If the gloves and clothing become damp through perspiration or water, replace the gloves and clothing with dry PPE.
Where required, insulation rubber mats and / or duck boards to be positioned to insulate the welder from the work piece.
For confined space work, use a fan, or similar system, to keep the welder cool and area well ventilated.
Position the observer at Welding Safety Switch and maintain observation vigilance on the welder.

## Electrical hazard awareness pre-use checklist for competent electric arc welder

**Note:** If any answer is No or N, controls are to be put in place for that hazard to provide electrical safety for personnel.

Hazard	Does it comply (Y/N)	If it does not comply ( N ) – what controls have been put in place
Has the person undertaking the welding activity been authorised at the mine?		Review persons competencies and authorisation issued by the mine manager for the electric welding work at the mine.
Is the work area clean and tidy – clear of rags, diesel, oil or other combustible materials?		Consideration should be given to the controls require to prevent a fire to include removal of combustible material, use of protection covering.
Is there a fire extinguisher, with a current test tag, in close proximity and fit for purpose - can it be used on electrical fires and is it in good working order and the person who would use the extinguisher been trained in the use of the extinguisher?		Job should not proceed until suitable and operational fire extinguisher is available at the work site.
Is all PPE to be used for the welding job (gloves, welding shield, safety shoes, clothing that covers arms and legs) in good condition and not damp / wet?		Job should not proceed until suitable PPE is available, worn and remains in a dry state.
Does a visual inspection show the welding machine to be in good condition – are all covers in place and not broken (can live electrical parts to be touched)?		Job should not proceed until the electric welding equipment provides protection against personnel contacting any live electrical circuit.
Is the output of the welding machine DC?		DC is the preferred output of a welding machine as DC has been shown to be a safer energy source.
Are the welding leads safe to use - are there any breaks or bare sections in the insulation (including the attachments) that will allow live conductors to be touched?		Control should include the replacement of any damaged welding lead. Control <b>should not</b> include temporary repairs.
Are the welding leads safe to use - do the leads have a current test tag updated in the last 3 months?		Job should not proceed until the leads have been tested and tagged.
Is the electrode holder safe to use - is the insulation on the handle in place and undamaged so that live parts cannot be touched?		Job should not proceed until the electrode holder is replaced.
Is the work clamp safe to use - is the braiding across the clamp in place, in good condition and in making good electrical connection?		Job should not proceed until the work clamp is replaced.

Hazard	Does it comply (Y/N)	If it does not comply ( N ) – what controls have been put in place
Is the work clamp safe to use - does the work clamp have good clamping force?		Job should not proceed until the work clamp is replaced.
Is the work clamp safe to use - are all connections tight and in good condition - no hot joints on the lead connection point, clamp spring and centre pin?		Job should not proceed until the work clamp is replaced.
<p>Is the <b>Hazard Reduction Device</b> working on the welding machine:</p> <p>For a stick welding machine does the <b>Voltage Reduction Device</b> have indication on the face panel of the welding machine showing it is in good working order (light indicator or voltmeter showing below 30 volts)? or For a MIG welding machine does trigger switch operate correctly?</p>		Job should not proceed until the HRD is repaired or replaced.
If the welding machine supply lead plugs into a socket outlet, does the supply lead have a current test tag?		Job should not proceed until the lead has been tested and tagged.
<p>Does the welding machine have a tag showing that it has been tested to comply to AS1674.2 (i.e. insulation resistance, earthing resistance and HRD tested):</p> <p>In the last 3 months where the welding machine plugs into a socket outlet or In the last 12 months where the welding machine is hard wired to the power supply?</p>		Job should not proceed until the welding machine has been tested and tagged.
<p>Has the work area been made safe for people who may be in the area of work:</p> <p>If you are in the workshop have effective welding screens been put in place If working outside the workshop has warning tape and signage been installed?</p>		Job should not proceed until the area has been prepared to protect personnel in the immediate area.
If the welding is outside the workshop and it looks like starting to rain will the welding job be stopped?		Electric welding should not be performed outdoors in rainy conditions. If rain is eminent, power supply to welding equipment should be removed and actions taken to protect the equipment against the rain.

Hazard	Does it comply (Y/N)	If it does not comply ( N ) – what controls have been put in place
If working outside and it looks like starting to rain and the job has to be completed, is a work procedure available?		Job should not proceed until a procedure is developed which should include the use of Tarpaulins, rubber matting, duck boards and a change of clothing and gloves to maintain dry PPE.
If the welding is in a damp / wet environment is rubber matting and/or duck boards used?		Job should not proceed until effective methods have been implemented to protect the welder from receiving an electric shock.
If the welding is in a confined space do the welder and observer hold current confined space training?		Job should not start where personnel do not hold current confined space competencies.
If the welding is in a confined space is the appropriate equipment available and installed for monitoring the environment of the confined space?		Job should not start until environmental monitoring equipment is set up to monitor the atmosphere during the welding activity.
If the welding is in a damp / wet environment or confined space is an isolation safety switch connected to the electrode lead?		Job should not proceed until an isolation safety switch has been installed.
If the welding is in a damp /wet environment or confined space is there a safety observer to operate the isolation safety switch?		Job should not proceed until a competent observer has is on the job.
If the welding is in a confined space is rubber matting to be used to protect against electric shock?		Job should not proceed until suitable electrical insulation sheeting has been provided and installed.
If the welding is in a confined space do you have an emergency plan and rescue equipment to be able to rescue a person – i.e. victim of an electric shock or overcome by fumes?		Job should not proceed until emergency plan is developed, people are trained and rescue equipment is available at the job.

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