DAWSON COAL MINING PTY LIMITED

ACN 006 746 701
Dawson Highway, Moura, 4718.
Ph: (07) 4990 9700
Fax: (07) 4990 9800
All correspondence to:
PO Box 225, Moura, QLD, 4718.

Electrical Specifications for Welding Machines

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1. GENERAL REQUIREMENTS

1.1 Purpose

The purpose of this specification standard is to provide details of the minimum electrical requirements relating to Welding Machines at AAMC's Dawson Mine operation. This specification applies when approving welding machines for use on site and purchasing equipment.

1.2 Priority of Specifications

In addition to the requirements of this specification, installed equipment shall comply with the latest relevant Australia Standards, applicable Mining Acts and Statutory Regulations and other related AAMC Standard Specifications. In the event that the requirements are not consistent, the following priority of documents shall apply:

1. Appropriate State Acts and Regulations;
2. This Specification (Electrical Specifications for Welding Machines);
3. Applicable Australian Standards.

Queensland State Acts and/or Statutory Regulations that apply:

- Queensland Coal Mining Safety & Health Act – 1999;
- Queensland Coal Mining Safety & Health Regulation – 2001;
- Queensland Electrical Safety Act – 2002;
- Electricity Legislation Amendment and Repeal Act – 2001;
- Work Health and Safety Act – 2011

1.3 Reference to Australia Standards & Dawson procedures

The documents below are referred to in this specification:
- AS 1674.2 Safety in welding and allied processes
- AS 1995 Welding Cables
- AS 3000 Electrical installations
- AS 3010 Electrical installations – Generating sets
- AS 3190 Approval and test specification – Residual current devices (current- operated earth-leakage devices)
- AS 60974.1 Arc welding equipment – Welding power sources
- AS 60974.6 Arc welding equipment – Limited duty portable arc welding and allied process power sources
- AS 60974.11 Arc welding equipment – Electrode holders
-Dawson procedure MOP85 "System for Inspection and Monitoring of Electrical Equipment"
-Dawson procedure SOP32 "Hot Works"

1.4 Definitions

1.4.1 Accessory Equipment

This includes output leads, electrode holders, torches, wire feeders, hoses, etc.

1.4.2 Allied process

An electric arc process that is not used for joining, such as air arc gouging, air arc cutting, metal arcing, arc spraying and plasma spraying.

1.4.3 Authorized person

A person in charge of a premise or a licensed electrical contractor, electrician or other person appointed or selected in charge of a premise, to perform certain duties.

1.4.4 Control lead

A lead that connects the power source to ancillary devices for control or regulating purposes, however it is not part of the welding circuit.

1.4.5 Environment

Category A environment

An environment 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 workpiece, in the event of being in contact with a live part of the welding circuit.

Category B environment

An environment where there is a significant risk of the welder contacting the workpiece or other parts of the welding circuit. An environment where: -

a) where the ambient temperature is less than 32°C;
b) freedom from movement is restricted, so that an operator is forced to perform welding in a cramped position (e.g., kneeling, sitting, lying), with physical contact with conductive parts (e.g., the workpiece); and
c) there is a high risk of accidental or unavoidable contact by the operator with conductive elements, which may or may not be in a confined space as defined in AS/NZS 2865.

Category C environment

An environment where the risk of an electric shock or electrocution by arc welding is greatly increased due to low body impedance of the welder and a significant risk of the welder contacting the workpiece or other parts of the welding circuit. An environment where:-

a) Low body impedance is likely in the presence of water, moisture or heat, particularly where the ambient temperature is above 32°C; and
b) In wet, moist or hot locations, humidity or perspiration considerably reduces the skin resistance of human bodies and the insulating properties of personal protective equipment accessories and clothing.

1.4.5 FCAW

Flux-cored arc welding

1.4.6 GMAW

Gas metal-arc welding, also known as metal inert gas (MIG) welding or metal active gas (MAG) welding

1.4.7 GTAW

Gas tungsten-arc welding, also known as tungsten inert gas (TIG) welding

1.4.8 Hazard-reducing device (HRD)

A device designed to reduce the hazard of electric shocks from a welding circuit.

1.4.9 Licensed electrical worker

A person who holds an appropriate license or approval to carry out electrical work in accordance with AS 3000

1.4.10 MMAW

Manual metal-arc welding which is also known as shielded metal-arc welding (SMAW) or the colloquial term of “stick” welding

1.4.11 Open-circuit voltage (OCV) or no-load voltage

The voltage between output terminals of a power source, while it is switched on, but not delivering any current

1.4.12 Output lead (or cable)

Electrode lead (or cable)
A lead between an electrode holder or torch and an electrode output terminal of an electrode conductor, distribution box, choke or power source.

Work (or return) lead (or cable)
A lead between work and a return or work output terminal of a return conductor, distribution box or power source

1.4.13 Power source (also known as welding machine)

A device that supplies the welding current and output characteristics that are suitable for arc welding or allied processes

1.4.13 Remote Isolation Device (RID)

RID is used to positively isolate the electrical source on welding machines with the use of personal locks and danger tags.

1.4.14 Shall

Indicates that a statement is mandatory

1.4.15 Should

Indicates a recommendation

1.4.16 Terminal

Power source terminal
A terminal of a welding of cutting power source, for the connection of conductors or leads of a welding circuit

Output terminal
A terminal in a welding circuit to which an output lead is connected

1.4.17 Voltage-reducing device (VRD)

A type of hazard-reducing device (either internally or externally fitted to a welding power source) that is designed to automatically reduce the open-circuit voltage to a safer level.

1.4.19 Welding circuit (also known as output circuit)

A circuit that includes the conductive material through which a welding current is intended to flow

1.4.20 Welding current

Current delivered by a power source during welding

1.4.21 Work (or return) conductor

Fixed wiring between a machine work or return terminal and the corresponding output terminal

Figure 1

2. TECHNICAL REQUIREMENTS

2.1 Welding Machines

As seen in Figure 1 the typical general layouts of welding machines. It is important to note that these diagrams do not embrace all the possible combination of circumstances.

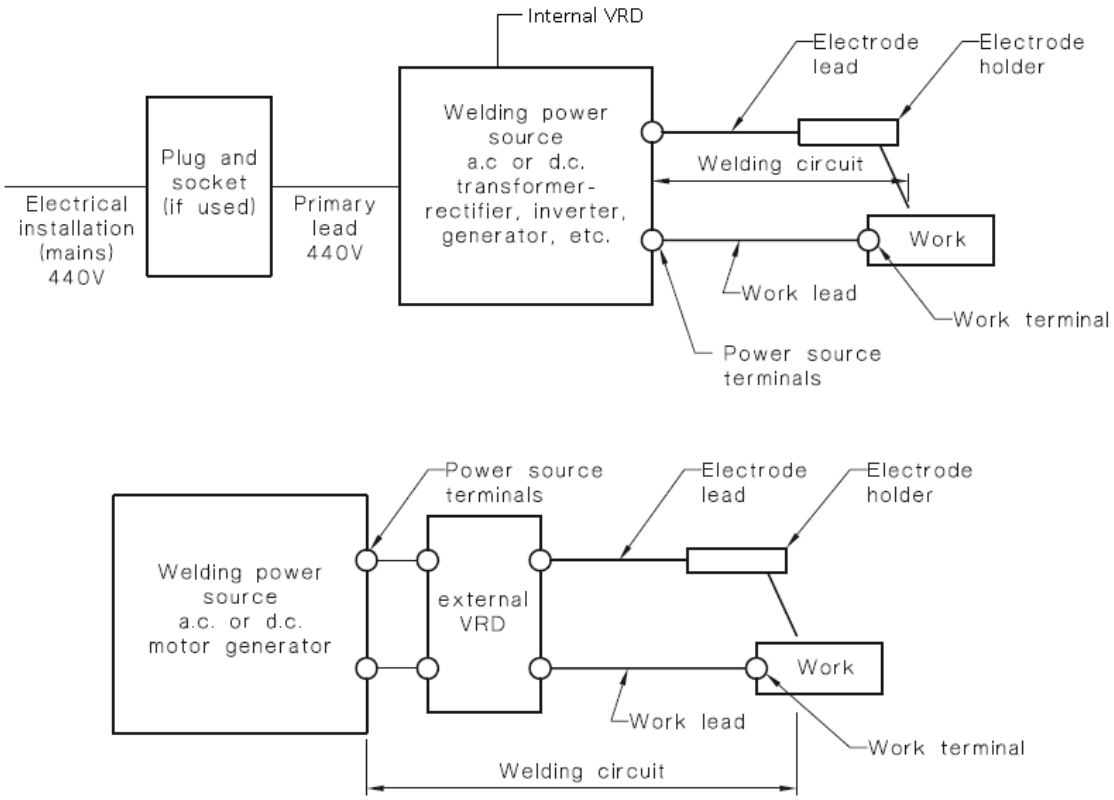

Figure 1: General Layout of different Welding Machines

2.1.1 Electric Welding Machines

Electric welding machines shall be in accordance with the following:

a) All electric welding machines shall have VRDs and RIDs.
b) All welding power sources shall comply with AS 60974.1
c) Welding cables shall comply with AS 1995
d) Electrode holders should be in accordance with AS 60974.11
e) The use of d.c. welding machines is preferable over a.c. welding machines where possible, as d.c. is safer.
f) The use of inverters rather than transformers is preferable
g) Primary circuit protection shall be in accordance with AS 3000. Ensure multiple a.c. welding machines are installed in phase
h) The welding cables should be kept as short as possible. However, should not be extended beyond 9m in length without consideration of voltage drop in accordance with the requirements in AS1674.2.
i) The current carrying capacity of the work lead and work conductor shall be not less than that of the electrode lead and electrode conductor.
j) The duty cycle of the welding equipment should be checked against the duty cycle required before commencement of work.

k) The current carrying capacity of the work return and electrode cable should be determined in accordance with:
   i. Rated output of the welding machine
   ii. Duty cycle of the welding machine
   iii. The distance of the work from the welding machine

2.1.2 Diesel or Petrol Welding Machines

Diesel or petrol machines and/or generators shall be in accordance with the following:

a) All diesel and petrol welders shall have HRDs and RIDs.
b) Welding machines should be in accordance with AS 60974.1
c) it is preferred that no socket outlet is fitted to the welding machine generator. If a socket outlet is installed :
   i. it must comply with AS 3000
   ii. the outlet must operate at 50Hz only.
   iii. Any Idle timers on GPO Outlets must have a system that disconnects the GPO when the machine is not switched to high idle.
d) As outlined in "*Fact Sheet 0027 – Dawson Mine Generator Earth Stake Policy"*;
   i. Portable generators that are used on site to supply tools and appliances are required to have internal wiring that is in accordance with AS 3010.
   ii. Where portable generators are supplying an appliance (i.e. welding machines) onto metal framed equipment, and the generator and the equipment can be touched at the same time. Then **equipotential bonding** shall be required between the equipment and the generator.

2.2. Hazard-Reducing Devices (HRDs)

Hazard-reducing devices **shall** be installed on all welding machines at Dawson Mine.

HRDs shall reduce the electrical-shock hazards originating from no-load voltages that exceed maximum permitted open-circuit voltage (OCV) of: -

a) 35 V d.c. peak;
b) or 35 V peak and 25V a.c. r.m.s.

If the maximum OCV is exceeded the hazard reducing devices shall operate within 300ms.

Wireless HRDs shall not be used without approval from the Dawson Electrical Engineering manager.

The welding machine must be compliant with AS 60974.1 and meet all the requirements for a minimum category B environment. This must be identified on the name plate with IEC/AS60974.1 marking or an “S” in a square.

2.2.1 Hand-piece trigger switches

a) The voltage of its control circuit shall be not more than 35V d.c. peak or a.c. 25V r.m.s; and
b) Its switching mechanism shall –
    i. return to the OFF position, immediately the welder releases pressure on the switch;
    ii. be easy to hold in the closed position, enabling the welder to carry out normal welding operations, without muscle strain; and
    iii. automatically latch in the OFF position, on release of pressure by the welder

2.2.2 Voltage-Reducing Devices (VRDs)

A VRD should automatically reduce the no-load or open circuit voltage (OCV), to a no-load voltage of: -

a) 35 V d.c. peak;
b) or 35 V peak and 25V a.c. r.m.s;
c) or less when the resistance of the output circuit exceeds 200 Ohms.

Conversely the VRD should turn on (switch to a high voltage state) when the circuit resistance is less than the specified value, which is usually significantly less than the turn off resistance.

Selection of a VRD should be based on the expected service performance of the welding machine.

2.2.2.1 Response times

Arc strike time shall be 20 milliseconds or less.

Turn off time shall be less than 300 milliseconds. VRDs that are installed on welding machines for use at Dawson Mine **shall not** have an adjustable turn off time delay.

2.2.2.2 Status Indicators

All VRDs shall have status indicator lights that clearly indicate high voltage or low voltage status. The status indicators lights shall be:

- Red – indicating high voltage state
- Green – indicating low voltage state

2.2.2.3 Test circuits

All VRDs shall have an internal test which applies a low resistance across the output from the welding machine. The status indicators should turn red when the button is depressed and return to green when the test button is released.
A daily check of the VRD shall be performed to ensure that is operating correctly during a welding cycle.

2.2.2.4 Compliance

Compliance of the sensing circuit of a VRD shall be checked with an approved VRD tester prior to introducing the equipment to site and upon every routine inspection of the welding machine.

2.2.3 Types of VRDs

For new welding machine internally fitted VRDs are preferred.

2.3. Isolation Devices

isolation devices **shall** be installed on welding equipment with the ability to utilise personal locks and tags in the isolation of the equipment. Isolation procedures are to be followed as stipulated in *SOP 0024 Control of Energy*.

2.4. Protection and Earthing

Thermal Protection
All type 1 and type 2 VRDs shall have thermal protection installed on the welding machine, as per AS 60974.1.

Earthing
A licensed electrical worker shall ensure the frame of the power source is earthed in accordance with AS/NZS 3000. Under no circumstances shall any earthing conductor of the mains electrical installation be used in place of the work or return conductor or lead.

3. INSPECTION AND TEST PROCEDURES

Inspection and maintenance shall be carried out in accordance with AS 1674.2 and as stipulated in Dawson Mine Procedure MOP0085 and the Dawson standard jobs *OEI010* and *OEI011*.

4. WELDER SPECIFICATION CHECKLIST

Welder Checklist	
Welder machines shall have VRDs (Voltage Reducing Devices) or RIDs (Remote Isolation Devices)	☐ Yes. ☐ No.
Welding machines shall comply with AS 60974.1	☐ Yes. ☐ No.
Plates/Plaques on the machines shall be showing compliance to AS60974.1	☐ Yes. ☐ No.
Welding Cables shall comply with AS 1995	☐ Yes. ☐ No.
Electrode holders shall comply with AS 60974.11	☐ Yes. ☐ No.
Primary circuit protection shall be in accordance with AS 3000	☐ Yes. ☐ No.
Socket Outlet shall be compliant to AS 3000	☐ Yes. ☐ No.
Socket Outlet shall operate at 50Hz	☐ Yes. ☐ No.
Socket Outlet shall have a system that disconnects power at low idle when machine is not switched to high idle	☐ Yes. ☐ No.
Wireless HRDs used. If Yes, shall seek approval from EEM and DWElectrical Team	☐ Yes. ☐ No.
Voltages of the control circuits on hand-piece trigger switches shall not be more than 35V D.C or 25V A.C RMS	☐ Yes. ☐ No.
VRDs shall not have adjustable turn off delay as per section 2.2.2.1 on Electrical Specifications for welding machines	☐ Yes. ☐ No.
VRDs shall have status indicator lights to indicate high voltage or low voltage	☐ Yes. ☐ No.
VRDs shall have an internal test which applies a low resistance across the output from welding machine	☐ Yes. ☐ No.
VRDs shall be internally fitted	☐ Yes. ☐ No.
Type 1 VRDs and Type 2 VRDs shall have thermal protection installed on the welding machine as per AS 60974.1	☐ Yes. ☐ No.
Power Source shall be earthed in accordance with AS/NZS 3000	☐ Yes. ☐ No.