
Guideline for Safe Cutting and Welding at Mines

MDG 25

Produced by
Mine Safety Operations,
New South Wales
Department of Primary Industries

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**NSW DEPARTMENT OF
PRIMARY INDUSTRIES**

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DISCLAIMER

The compilation of information contained in this document relies upon material and data derived from a number of third party sources and is intended as a guide only in devising risk and safety management systems for the working of mines and is not designed to replace or be used instead of an appropriately designed safety management plan for each individual mine. Users should rely on their own advice, skills and experience in applying risk and safety management systems in individual workplaces.

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FOREWORD

This *Guideline for Safe Cutting and Welding at Mines* has been compiled to assist Owners, Operators, Managers and the NSW Department of Primary Industries Mine Safety Operations, to develop, implement and audit management systems for the safe cutting and welding operation in mines. The NSW Department of Primary Industries document MDG 25TR *Technical Reference Material for Safe Cutting and Welding at Mines* provides technical reference material for the Guideline.

This is an Applied Guideline under Coal legislation. The clause of the Coal Mines Regulations relating to MDG 25 *Guideline for Safe Cutting and Welding at Mines* is indicated in the References section of the Guideline. Further information on the status of an Applied Guideline in the range of OHS instruments is available through the NSW Department of Primary Industries Legislation Update Number 2/2001. The range of instruments includes:

- Acts of Parliament
- Regulations made under the Act
- Conditions of Exemption or Approval
- Standards (AS, ISO, IEC)
- Approved Industry Codes of Practice (under the OHS Act)
- Applied Codes, Guidelines or Standards (under clause 14 of the Coal Mines (General) Regulation 1999)
- Published Guidelines
- Guidance Notes
- Technical Reference documents
- Safety Alerts

The principles stated in this document are intended as general guidelines only for the assistance of owners, operators and managers in devising safety standards for the working of mines. Owners, operators and managers should rely upon their own advice, skills and experience in applying safety standards to be observed in individual workplaces.

The State of New South Wales and its officers or agents including individual authors or editors will not be held liable for any loss or damage whatsoever (including liability for negligence and consequential losses) suffered by any person acting in reliance or purported reliance upon this Guideline.

The MDG 25 *Guideline for Safe Cutting and Welding at Mines* was distributed to industry for consultation and comment through the Coal Safety Advisory Committee, Metalliferous Safety Advisory Committee and Extractive Industries Safety Advisory Committee.

The Department of Primary Industries has a review time set for each Guideline that it publishes. This can be brought forward if required. Input and comment from industry representatives will be much appreciated. The Feedback Sheet at the end of this document can be used to provide input and comment.



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Purpose and scope

The purpose of this guideline is to minimise the risks to health and safety of people where cutting and welding activities are being carried out on a mine site or in product processing plants.

It is intended for this guideline to assist mine managers to develop, implement and manage a welding management plan (WMP) for the safe use of cutting and welding equipment at mines and product processing plants.

This guideline describes the processes to be employed, the standards to be referenced, and the issues to be addressed in developing this WMP.

Cutting and welding underground in coal mines is considered a high risk activity. This guideline provides guidance material in providing a safe system of work.

This guideline should be used in all locations where cutting and welding is being carried out.

This may include:

- locations where safe welding areas have been designated including workshops, garages, welding bays, etc
- in product processing plants especially where rubber and polyurethane products are used
- remote locations on the mine site, eg yards
- wet areas
- hazardous areas
- confined spaces
- reclaim tunnels
- underground coal mines
 - designated underground workshop
 - designated underground splicing or vulcanising station
 - non hazardous zones
 - hazardous zones
 - emergency situations underground

Note that this is not an exhaustive list.

Annexed to this guideline is a document MDG 25TR *Technical Reference Material for Safe Cutting and Welding at Mines* providing technical reference material designed to enhance the knowledge of those engaged in, or responsible for, the development and implementation of systems for safe cutting and welding at mines. It can be considered to benchmark Good Industry Practice for mitigating the risk associated with cutting and welding activities in mines at this time.

Note that:

- Adherence to guidelines does not itself assure compliance with the general Duty of Care
- Mine operators deviating from guidelines should document a risk assessment supporting

the alternative arrangements

References

Legislation

- Occupational Health and Safety Act 2000, general duty of care
- Clause 11 of the Coal Mines (Underground) Regulation, 1999

Department of Mineral Resources publications

- MDG 1010 Risk Management Handbook
- MDG 1014 Guide to Reviewing a Risk Assessment of Mine Equipment and Operations
- MDG 25TR, Technical Reference for the Safe Cutting and Welding at Mines; NSW Department of Mineral Resources

Standards

- Australian Standard 1674.1-1997 Safety in welding and allied processes - Fire precautions
- Australian Standard 1674.2-1990 Safety in welding and allied processes - Electrical
- Australian Standard 2865-2001 Safe working in a confined space
- Australian Standard 2430.1-1987 Classification of hazardous areas - Explosive gas atmospheres

Other references

- Welding Technology Institute of Australia – Technical note 7 (TN07). Health and safety in welding.

Safe cutting and welding at mines management system

General

The WMP should be an integral part of the Mines Safety Management Plan (MSMP) and be based on a risk management approach to safety. A risk assessment methodology should be used to identify and quantify likely risks associated with cutting and welding activities and to develop appropriate controls. See MDG 1010 Risk Management Handbook and MDG 1014 Guide to Reviewing a Risk Assessment of Mine Equipment and Operations for more information on this approach.

Conduct of risk assessments and development of systems and procedures should be in consultation with employees and their representatives where appropriate. Guidance on the material to be addressed in the risk assessment is given in MDG 25TR.

Procedures for monitoring/evaluating/reviewing the entire cutting and welding process should be developed as part of the WMP.

The WMP should include all locations where cutting and welding activities are to be carried out on a minesite.

Regard should also be had to any relevant guidelines such as:

- Australian Standard 1674.1 Safety in welding and allied processes - Fire precautions
- Australian Standard 1674.2 Safety in welding and allied processes - Electrical
- Welding Technology Institute of Australia – Technical note 7 (TN07). Health and safety in welding.

Record keeping and documentation

Cutting and welding record keeping should be integrated with the MSMP record system.

Accurate records should be kept of all stages of the cutting and welding process, particularly:

- risk assessment documents
- permits and authorisations issued
- maintenance records, safety inspections and test reports
- audit and review reports
- reports of accidents and safety statistics
- training and competency records
- consultation records

- control procedures
- reports from welding underground in coal mines

Training

The WMP or MSMP should include a training plan, which ensures that all staff are appropriately trained and competent to perform the tasks required of them.

Specific training needs and competencies associated with safe cutting and welding activities should be identified and integrated into the training system. Training and skills should be documented on personnel files.

Where there is a need for a 'competent person' the competencies should be defined and a list of those persons who have those competencies created and kept up to date. For cutting and welding activities this may be necessary for persons:

- carrying out cutting and welding
- supervising cutting and welding
- carrying out inspections

Monitoring, systems audit and review

Cutting and welding should be part of the continuous improvement process under the WMP or MSMP. This includes actions to:

- monitor record keeping
- analyse results, both regularly and after special occurrences or problems
- feed results of the analysis back into future planning and operations
- integrate the monitoring and review of cutting and welding into the mines continuous improvement process

Risk identification and assessment

The following pages list the key system component outcomes, associated risks and main risk considerations. The risk considerations outline some of the industry practice currently in use.

The guidance material annexed to this document (MDG 25TR) tables issues to be considered with examples of Good Industry Practice used to address them.

These lists are not exhaustive. There will always be other hazards, including site specific hazards, which must be identified, assessed and controlled.

For more information on how to conduct a risk assessment refer to MDG 1010 Risk Management Handbook.

Safe cutting and welding at mines - elements and considerations

Hazard identification

Required outcome

Identification and documentation of the hazards associated with cutting and welding activities at each cutting and welding location.

Use of appropriate risk management tools to eliminate and/or control the hazard(s) to an acceptable level of risk.

Main risks

- fire of the surrounding environment
- explosion due to flammable gasses
- radiation and heat burns to the body
- electric shock from both primary and secondary circuits
- environmental risks
- asphyxiation and illness due to inhalation of toxic fumes from gasses created and used
- unforeseen hazards which are not generally apparent

Main risk considerations

- risks to the welding operator, people in the vicinity and to plant and equipment
- flammable materials in the vicinity of cutting and welding
- flammable or explosive gases in the vicinity of cutting and welding
- use of appropriate personal protection equipment (PPE)
- ventilation requirements
- fit for purpose equipment
- compliance with AS 1674.1, AS 1674.2 and WTTA TN07
- welding operators and people in the vicinity of cutting and welding activities
- adequate fire fighting facilities
- safe work procedures
- emergency preparedness
- equipment inspections and examinations
- welding site inspections and checks

Fit for purpose equipment

Required outcome

Equipment used in cutting and welding activities is fit for purpose and appropriately selected for the cutting and welding task at hand.

Selected equipment is installed, operated, maintained, handled, transported, inspected and tested to ensure it is safe to use and without risk to health and safety of people if used properly.

Main risks

- electric shock on primary circuits
- electric shock on secondary circuits
- fire and/or explosion of gas bottles
- radiation and burns to welding operator
- failure of ventilation systems
- grinding injuries to the welding operator

Main risk considerations

- equipment suitably rated for the duty
- assessment against with AS 1674.1, AS 1674.2 and WTTA TN07
- use of a system to remove/reduce the no load voltage or open circuit voltage, eg voltage reduction devices (VRD) or alternative
- use of flashback arrestors
- equipment inspections and tests
- isolated handpieces
- handling, transport and storage of equipment
- use of appropriate PPE
- use of guards and barriers

Fire and explosion

Required outcome

Prepare the welding site to minimise the risk of fire or explosion.

Provide appropriate fire fighting facilities to extinguish a fire.

Main risks

- flammable materials such as rags, oils, greases, chemicals, fuel, etc
- dry grass and scrub
- flammable equipment such as conveyor belts
- flammable dust such as coal dust
- flammable gasses such as methane
- areas beneath the cutting and welding site where slag and spatter may fall
- cutting and welding above equipment where slag and spatter may fall on equipment

Main risk considerations

- location, type and size of fire extinguishers
- location of fire hydrant
- site inspections
- removal and/or coverage of flammable materials
- siting of work in relation to equipment

Hazardous areas, wet areas & confined spaces

Required outcome

Identification of the additional hazards associated with cutting and welding activities in specific areas such as wet areas, hazardous areas, and confined spaces.

Use of appropriate risk management tools to eliminate and/or control the additional hazard(s) that may be present.

Main risks

- changing conditions that may occur while cutting and welding activities are being carried out
- increased risk of electric shock, eg in wet areas
- explosion in hazardous areas and confined spaces
- toxic fumes in confined spaces
- asphyxiation in confined spaces
- engulfment in confined spaces

Main risk considerations

- specific risk assessment for each time cutting and welding is to be carried out
- authorisations and system for work, eg hot work permit system
- water in the vicinity of the cutting and welding activities
- wet or damp clothing due to the environment or preparation
- additional electrical insulation
- ventilation and atmospheric monitoring
- the use of firewatchers and attendants
- emergency preparedness
- disconnection of power supply when welding activities are not being carried out
- assessment against AS 2865 and AS 2430
- energy isolation
- fit for purpose equipment

Emergency preparedness

Required outcome

To develop a risk based emergency response plan for cutting and welding activities.

To outline the procedure to be followed in the event of an emergency.

Main risks

- explosion of gas bottles
- electric shock
- removing an injured person from a confined space
- ventilation failure
- welding underground in coal mines in emergencies

Main risk considerations

- emergency procedures
- communications for emergency services
- egress in an emergency
- removal of injured personnel from confined spaces
- time for emergency services to arrive

Welding Underground in Coal Mines

Required outcome

Identification of the additional hazards associated with cutting and welding underground in coal mines.

Use of appropriate risk management tools to eliminate and/or control the additional hazard(s) that may be present.

Implement a WMP for cutting and welding activities.

Main risks

- methane and explosive atmosphere
- coal dust
- changing conditions including potential for goaf falls, ventilation failures, stopping failures, barometer changes, etc
- flammable materials
- welding in:
 - underground workshops
 - vulcanising/splicing stations
 - non-hazardous zones
 - hazardous zones
 - emergency situations

Main risk considerations

- alternatives to cutting and welding
- ventilation requirements
- transport of equipment to and from the cutting and welding site
- equipment inspections and tests
- site preparation and clearing of flammable materials
- site inspection and explosive gas testing
- earthing of electrical equipment
- continuous monitoring
- competency of welding operators
- fit for purpose equipment

Feedback sheet

Your comment on this Guideline for Safe Cutting and Welding at Mines will be very helpful in reviewing and improving the document.

Please copy and complete the Feedback Sheet and return it to:

*Communication and Education Officer
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Fax: (02) 4391 6790*

How did you use, or intend to use, this Guideline?

What do you find most useful about the Guideline?

What do you find least useful?

Do you have any suggested changes to the Guideline?

Thank you for completing and returning this Feedback Sheet

**Technical Reference Material
For
Safe Cutting
And Welding
At Mines**

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SECTION 1 PURPOSE AND SCOPE

1.1 SCOPE

This Technical Reference '*Safe Cutting and Welding at Mines*' sets out safety requirements to assist management in formulating a management system approach for the safe cutting and welding activities at Mines and Product Processing Plants. The management system for safe cutting and welding (Welding Management Plan) should be an integral part of the Mines Safety Management Plan.

The relevant sections of this Technical Reference should be used for all cutting and welding activities being carried out on mines.

This Technical Reference includes many of those items that require specific attention in order to provide a safe system of work. It by no means covers all possible details that should be reviewed by management. A risk assessment process shall be used in developing the mines Welding Management Plan (WMP). It is intended for this Technical Reference to highlight areas that may have prevented incidents in relation to this type of operation in the past.

This Technical Reference is to be used in conjunction with other standards and associated documentation to address the totality of safety issues relating to cutting and welding activities at mines. Technical References, Guidelines and codes do not generally give quantitative information. Where more detailed information is required relevant standards should be referenced and, if needed, advice sought from recognised authorities on cutting and welding (e.g. Welding Technology Institute of Australia).

1.1.1 Underground Coal Mines

A management system approach must be used if the mine is to comply with Clause 11 of the Coal Mines (Underground) Regulation 1999.

This Technical Reference describes the processes to be employed, the standards to be referenced, and the issues to be addressed in developing a management system for the safe cutting and welding as it applies to underground locations. The intention is to allow underground coal mines to formulate a comprehensive and integrated management system approach for the safe use of cutting and welding equipment underground.

This Technical Reference does not address design and construction requirements for workshops, garages or splicing and vulcanising stations. Refer MDG 34 and MDG 38.

1.2 OBJECTIVE

The objective of this Technical Reference is to minimise the risks to health and safety of people where cutting and welding activities are being carried out on a mine site.

1.3 APPLICATION

This Technical Reference applies to all mines in NSW and should be used in all locations where cutting and welding is being carried out. This may include, but not necessarily be limited to:

- a) Locations where safe welding areas have been designated including workshops, garages, welding bays, etc
- b) In Product Processing Plants
- c) Remote locations on the mine site, e.g. yards
- d) Wet areas
- e) Hazardous areas
- f) Confined spaces
- g) Reclaim tunnels

1.3.1 Underground Coal Mines

This Technical Reference addresses the use of cutting and welding equipment in underground locations under various circumstances. These locations and circumstances include:

- a) Designated underground workshop
- b) Designated underground splicing or vulcanising station
- c) Non hazardous zones
- d) Hazardous zones
- e) Emergency situations underground

1.4 SECTION REQUIREMENTS

Cutting and welding activities at mines should comply with the requirements provided for in each section of this Technical Reference, where applicable.

1.5 REFERENCES

A partial list of associated documents is included in Appendix B for reference.

1.5.1 Abbreviations

a.c.	Alternating Current
AS	Australian Standards
AS/NZS	Australian/New Zealand Standard
d.c.	Direct Current
DIN	German Standard
DMR	Department of Mineral Resources
FCAW	Flux Cored Arc Welding – may be gas shielded or self shielded
GMAW (MIG)	Gas Metal Arc Welding also known as MIG welding
GTAW (TIG)	Gas Tungsten Arc Welding also known as TIG welding
ISO	International Organisation for Standardisation
JSA	Job Safety Analysis
MDG	Mechanical Design Guideline
MMAW	Manual Metal Arc Welding
MSDS	Material Safety Data Sheet
OCV	Open Circuit Voltage
PPE	Personnel Protection Equipment
RCD	Residual Current Device
SAE	Society of Automotive Engineers
SWP	Standard Work Procedure
TN07 & TN22	Technical Note (publication from WTIA)
VRD	Voltage Reduction Device
WMP	Welding Management Plan
WTIA	Welding Technology Institute of Australia

1.6 DEFINITIONS

For the purpose of this document the definitions below apply.

1.6.1 Backfire

A backfire is the return of the flame into the blowpipe with a popping sound, the flame being either extinguished or re-ignited at the nozzle.

1.6.2 Competent Person

A person who has, through a combination of training, education and experience, acquired knowledge and skills enabling that person to perform correctly a specified task.

1.6.3 Confined Spaces

An enclosed or partially enclosed space that is at atmospheric pressure during occupancy and is not intended or designed primarily as a place of work, and-

- a) is liable at any time to-
 - i) have an atmosphere which contains potentially harmful levels of contaminant;
 - ii) have oxygen deficiency or excess; or
 - iii) cause engulfment; and
- b) could have restricted means for entry

(refer AS 2865)

1.6.4 Cutting and Welding Equipment

Includes any blowlamp (blowpipe), flame-torch, grinding and cutting wheel, sander, hand held grinders, electric welding equipment, oxy-acetylene or gas welding apparatus or similar heating and cutting devices and hand held equipment such as dye grinders, pencil grinders and other like equipment etc considered to be cutting and welding equipment if likely to generate sparks that may ignite flammable gases.

1.6.5 Defect Management System

A system that outlines the actions to be taken when a defect is identified.

A defect management system documents instructions to be taken when a defect is identified and how the details of the defect and actions taken are recorded.

1.6.6 Flashback

A flashback is the return of flame through the blowpipe into the hoses and even regulators. It may also reach the cylinder.

If a flashback occurs, immediately close the oxygen valve followed by the fuel valve.

1.6.7 Flammable Gases

Refer, 'A Manual on Mines Rescue, Safety and Gas Detection' J Strang & P MacKenzie-Wood, ISBN 0 9588861 0 5

1.6.8 Fuel Source

Any substance or material that will sustain or propagate a fire or may cause an explosion.

1.6.9 Hazardous Area

An area in which flammable liquids, vapours or gases, combustible liquids, dust or fibres, or other flammable substances may be present. (Refer AS 1674.1 and AS 2430)

1.6.10 Hazardous Zone (Coal Mines)

As defined in Clause 4(1) Coal Mines (Underground) Regulation 1999.

A hazardous zone means:

- a) A return airway in a mine, or
- b) A part of an intake airway of a ventilation district in a mine that is on a return side of such points as are 100m outbye of the most inbye completed line of cut throughs, or 100m from, and on the intake side of, a longwall or shortwall face, or
- c) A part of a mine in which there is methane concentration of 1.25% or greater in the general body of air, or
- d) A part of the mine specified as a hazardous zone.

1.6.11 Hot Work

Work that involves the use of cutting and welding equipment.

1.6.12 Output Circuit Safety Switch

An output circuit safety switch is a device to enable an assistant to cut off the current supply to a welding handpiece quickly. It is located between the welding machine and the electrode holder. Refer AS 1674.2.

1.6.13 Open-Circuit Voltage

The voltage between the output terminals of a welding machine with no current flowing in the welding circuit.

1.6.14 Overall Risk Assessment

A risk assessment to identify the generic hazards at designated welding locations on a mine site.

Note: An overall risk assessment may not adequately cover all hazards for specific tasks.

1.6.15 Reclaim Tunnels

A tunnel under a product stockpile, e.g. coal stockpile.

1.6.16 Shall

Indicates a statement in this Technical Reference that is 'strongly recommended'.

1.6.17 Should

Indicates a statement is 'recommended'.

1.6.18 Splicing or Vulcanising Station (Coal Mines)

A place used for the hot repairs, joints or maintenance of conveyor belts. This may be on a routine basis or a one off occurrence. (Refer MDG 38)

1.6.19 Standards of Engineering Practice (SOEP)

A set of engineering standards that is applied to the mine to ensure equipment is safe to use.

SOEP includes competency of persons, design, installation, commissioning, operation, maintenance and decommissioning.

1.6.20 Task Specific Risk Assessment

A risk assessment which covers specific hazards that lie outside the scope of the overall risk assessment, e.g. welding on hydraulic tanks, hazardous areas, wet areas, confined spaces, non-hazardous zones in underground coal mines and hazardous zones in underground coal mines.

1.6.21 Underground Workshop

Part of a garage or dedicated area designated for the specific purpose of conducting cutting and welding activities, including storage of equipment.

1.6.22 Voltage Reduction Device (VRD)

A device permanently connected into the electrical circuit of the welding machine, which reduces the open (output) circuit voltage when welding is not taking place. Refer WTIA TN22 for more information on VRDs.

1.6.23 Welding Management Plan (WMP)

A WMP is a systematic approach for the use of cutting and welding activities. The extent of the plan will depend on the hazards at the mine site.

A WMP is an integral part of the mines overall safety management plan and need not be a stand alone document.

SECTION 2 OPERATING SYSTEMS (GENERAL REQUIREMENTS)

2.1 RECOGNISED PUBLISHED STANDARDS - GENERAL

Unless otherwise specified the appropriate Australian Standards shall apply as a minimum. Where Australian Standards have not been published the appropriate ISO, DIN or SAE Standards shall apply.

2.2 MANAGEMENT SYSTEMS

The WMP should be based on the principles associated with a quality OHS Management System as defined in AS 4801 and AS 4804. The mine's WMP should address each of the following:

- a) Hazard identification
- b) Consultation
- c) Risk assessment
- d) Risk management procedures (e.g. JSA, SWP)
- e) Information to be collated (e.g. manufacturers instructions, MSDS)
- f) Instruction and training
- g) Supervision
- h) Monitoring
- i) Review
- j) Revision

2.2.1 Hazard Identification

All hazards must be identified and dealt with so that they are eliminated, or controls established to minimise the risk prior to the cutting, welding or grinding activity commencing.

Specific hazards associated with cutting and welding may include but be not limited to:

- a) Explosion and fire hazards
 - i) Body burns – due to heating of the work piece, weld spatter, hot molten material or ignition of clothing
 - ii) Explosion – flammable gases
 - iii) Fire of the surrounding environment – combustible material near welding activity or the current path
- b) Radiation and heat
 - i) Radiation burns – to eye or body from welding arcs
- c) Potential hazards due to the environment
 - i) Eye injury – flying materials
 - ii) Excessive noise - due to grinding activities
- d) Potential for electric shock on both primary and secondary circuits
- e) Ventilation to control toxic fumes and explosive atmospheres
 - i) Asphyxiation and illness – due to inhalation of gases created and used

Note:

- (i) This is not an exhaustive list and there may be other hazards present.
- (ii) There may also be hazards present to both the welding operator as well as a bystander.

2.2.1.1 Unforeseen Hazards

Unforeseen hazards may include:

- a) Falling down shafts
- b) Contacting flammable material
- c) Flammable dust and gases
- d) Falling through mesh floors where others may be present
- e) Contacting chemical storage areas
- f) Contacting natural rubber, e.g. 'linatex'
- g) Contacting conveyor belts
- h) Contacting polyurethane screens
- i) Roof falls while welding (underground coal)
- j) Molten metal, slag and sparks

2.2.2 Consultation

The mine's WMP should be prepared in consultation with the workforce.

Employees should be consulted:

- a) In the development, implementation and review of the WMP
- b) In the identification of hazards, assessment and control of risks
- c) Whenever changes, defects or incidents occur
- d) After an audit has been carried out

2.2.3 Overall Risk Assessment

An overall risk assessment shall be conducted prior to the use of cutting and welding equipment at a mine. The risk assessments should be in accordance with AS 3931, AS 4360, MDG 1010, or equivalent, and address the following items as a minimum:

- a) Identify the risk to health and safety of people associated with the operation of cutting and welding equipment
- b) Identify the risk to health and safety of people in the vicinity or that may be affected by the use of cutting and welding equipment
- c) Identify the risk to plant and equipment
- d) Include each location where cutting and welding activities are being carried out
- e) Eliminate or, where this is not practicable, reduce risk to an acceptable level
- f) Determine if the recommendations in this Technical Reference be adopted or rejected
- g) Determine any additional criteria that may be required for a particular mine
- h) Determine any additional criteria that may be required for a specific task that is considered to be hazardous
- i) Develop safe work procedures
- j) Ensure the equipment is fit for purpose
- k) Ensure the equipment is in a safe condition to use

The controls recommended from the risk assessment should be used to formulate the basis of the mines WMP.

The risk assessment should be assessed for completeness against MDG 1014 or an equivalent document.

2.2.4 Instruction, Training and Competencies

All persons involved with cutting and welding activities should be trained and assessed for their competencies.

Records of training and assessments should be maintained and available for audit. The training and assessment of competencies extends to all levels including senior management and contractors.

Persons with appropriate knowledge, skills and experience should carry out training.

2.2.4.1 Competencies

The mine management system shall address the minimum acceptable competencies for particular types of work. For example,

- a) Heating, cutting and grinding
- b) General welding
- c) Structural welding
- d) Welding in confined spaces, hazardous areas or other specialised work

2.2.4.2 Training

Training and assessment of competencies for personnel who use cutting and welding equipment should as a minimum include:

- a) Safe operation, inspection and checking of the equipment
- b) Maintenance and repairing of the equipment

2.2.4.3 Authorisations

Persons should be authorised by the manager to use cutting and welding equipment.

2.2.5 Supervision

All employees should be adequately supervised according to their skills and competencies.

All cutting and welding activities shall be carried out under the supervision and/or direction of a suitably qualified and competent person.

This person must have sufficient control to ensure that before cutting and welding is commenced the following items have been taken into consideration:

- a) The hazards of the location have been identified and the risks assessed
- b) Controls are in place to eliminate or reduce risk
- c) The equipment being used has been inspected, is fit for purpose and safe to operate
- d) The welding operator is aware of potential hazards

2.2.6 Audit, Monitor & Review

The potential risks to health and safety should be continually assessed and actions taken to reduce the risk before an incident occurs.

Cutting and welding activities should be audited at regular intervals for compliance with the mines WMP.

All defects associated with cutting and welding should be recorded and actions taken to prevent recurrence of the defect.

The mines WMP should be audited, monitored and reviewed at regular intervals not exceeding two years. This should include assessment against:

- a) This document
- b) The mines WMP
- c) Industry benchmarks

2.2.7 Revision

The mines WMP should be revised after an audit or review has taken place. The procedures for revision should be documented.

2.2.8 Responsibility and Accountabilities

There should be single person accountability for the mines WMP.

All personnel associated with cutting and welding activities should understand their areas of accountability and responsibility. This includes contractors.

2.3 DOCUMENTATION

The following records should be kept for a minimum period of six years:

- a) Risk assessment documents
- b) Permits and authorisations issued
- c) Maintenance records, safety inspections and test reports
- d) Audit and review reports
- e) Reports of accidents and safety statistics
- f) Training and competency records
- g) Consultation records
- h) Control procedures
- i) Reports from welding underground in coal mines

The records shall be stored and maintained in such a way that they are readily retrievable and protected against damage, deterioration or loss.

2.4 MAINTENANCE AND INSPECTION

An appropriate examination, inspection, testing and maintenance system shall be developed and implemented to ensure all cutting and welding equipment is fit for purpose, safe and without risks to health when properly used.

For guidance on maintenance and inspections refer Appendix C4 'Inspections'.

2.5 EMERGENCY PREPAREDNESS

The WMP should consider actions to be taken in the event of an emergency, such as:

- a) Fire over and around cylinders
- b) Flashback or backfires
- c) Leaking cylinders
- d) Electric Shock
- e) Explosions

SECTION 3 GENERAL WELDING SAFETY

3.1 GENERAL

All cutting, welding and grinding activities shall be carried out in accordance with the following:

- a) AS 1674.1
- b) AS 1674.2
- c) Safety instructions or recommendations given by the manufacturer of the equipment being used.

The applicable safety requirements of WTIA TN07 and WTIA TN22 should be used and considered for all cutting, welding and grinding activities. These documents provide a greater level of detail than this Technical Reference.

Suitable lighting shall be provided to all work areas.

3.1.1 Equipment - General

All equipment should be installed, operated and maintained in accordance with manufacturers' recommendations and the appropriate Australian Standards.

An earth leakage device complying with AS 3190 shall protect all electrical equipment that is operating at more than 32V a.c.

Portable electrical equipment shall comply with AS 3012.

3.1.2 Asphyxiation & Fume Management

- a) The WMP should include fume management practices
- b) Asphyxiation can occur when there is a build up of gases in the workplace. Precautions may include:
 - i) Ensure the area is adequately ventilated. Mechanical ventilation may be required
 - ii) Testing of the atmosphere
- c) There should be adequate ventilation for toxic fumes to escape from the vicinity of the operator and other persons at the mine
- d) Where natural ventilation is not adequate, then mechanical ventilation should be used

Note: Refer WTIA Fume Management Technical References for further advice.

3.1.3 Safe Areas

Each mine should have a safe area where cutting and welding can take place at any time (e.g. workshops).

Safe areas should be inspected on a regular basis and prior to cutting and welding to ensure the equipment is in a good condition, fit for purpose and that there are no fire hazards present.

3.2 PEOPLE PROTECTION

Protective guards (screens) to barricade the work area off shall be used to protect people in the vicinity. These guards should be fire resistant.

Adequate warning signs should be provided where there is a risk of exposure of persons to hazards associated with cutting and welding.

3.2.1 Personal Protective Equipment

Appropriate personal protective equipment (PPE) shall be worn at all times to protect the health and safety of all employees.

Examples of PPE include but are not limited to:

- a) Helmets, hand shields, goggles or face masks (shield) with the correct shade of filter that shall be used (refer AS 1336, AS 1337, AS 1338)
- b) Suitable protective equipment that shall be worn, ie gloves, spats, aprons and shoes (boots) (refer AS 2161, AS 2210)
Note: Nylon vests are a fire hazard due to their flammability.
- c) Suitable protective clothing that shall be worn, e.g. overalls, industrial clothes.
Note:
 - (i) It is important that the welding operator's clothes remain dry.
 - (ii) Take caution with hot and humid environments especially in confined spaces.
- d) An appropriate respirator that shall be worn when working on lead, lead bearing materials, steel coated with lead paints, cadmium-coated materials, zinc-coated materials or any objects containing material which may give off toxic fumes (refer AS 1715, 1716).

An example of the minimum PPE for different welding processes is shown in the Table below:

Process	Hazard	Minimum Personal Protection Required
Gas cutting and welding	Radiation Burns	i) Goggles or shields with appropriate filters ii) Adequate clothing, gloves footwear iii) Suitable head wear for overhead cutting
Arc Welding (manual)	Burns Radiation Electric Shock	i) Full face shields and filters ii) Adequate dry clothes, gloves and footwear
Grinding and chipping	Hard particles	i) Goggles ii) Adequate clothing iii) Hearing protection
Plasma cutting	Fumes Radiation Electric Shock	i) Goggles with appropriate filters ii) Adequate clothing, gloves, footwear iii) Suitable head wear for overhead cutting
Cutting & Welding (zinc or cadmium coated plate, fasteners etc)	Toxic Fumes	i) Suitable respirators ii) Ventilation

3.3 FIRE PROTECTION

3.3.1 Fire Hazard Controls

The risk of fire is always present in welding operations. For a fire to survive there must be Oxygen, Fuel and Heat present. If any of these is removed the fire will extinguish.

Fire precaution should include:

- a) Inspect every location before cutting and welding commences to ensure the potential for a fire to occur is eliminated
- b) Suitable fire fighting facilities are available near the work area and operators know where they are located. Are the fire fighting facilities adequate for the potential hazard?
- c) Work areas being clear of all rubbish and flammable material such as rags, oil etc. These materials should be removed to a safe distance before cutting and welding
- d) Removal and/or protection of flammable material. For example deluged the area with water or stone dust (Underground Coal Mines)
- e) Clear, or soak with water, dry grass and scrub in surrounding area
- f) Operators should check their clothing is not impregnated with oil or grease
- g) Conveyor belting or other combustible materials should be suitably protected from cutting and welding and its sparks
- h) Inspecting the site after cutting and welding has been performed to ensure that the potential for a fire to occur is eliminated
- i) Isolate electricity

Note:

- (i) Oil or grease in the presence of oxygen may ignite spontaneously and burn violently or explosively.
- (ii) When using water care should be taken not to impair the safe operation of electrical equipment including the welding equipment.

3.3.2 Fire Extinguishers

As a minimum fire extinguisher(s) should be:

- a) Located in the vicinity of the work area (within 10m) and ready for immediate use
- b) Of a suitable type and capacity as appropriate to the fire risk
- c) Maintained in accordance with AS 1851
- d) Selected in accordance with AS 2444

3.4 EQUIPMENT INSPECTIONS

Examination and inspection of equipment should be made at regular intervals in accordance with the appropriate Australian Standards and manufacturer recommendations.

The frequency of these inspections should be such that the equipment is kept in a safe condition for use, and faulty items reported and replaced immediately.

Items of equipment to inspect should include as a minimum:

- a) Cylinder regulators
- b) Flashback arresters
- c) Hoses and couplings
- d) Torches and tips
- e) Work return leads and connections for cuts, areas of wear, exposed metal, being clean and securely connected
- f) Welding leads and connections for cuts, areas of wear, exposed metal, being clean and securely connected
- g) Electrode holders for cracks and broken pieces, gloves, etc for moisture
- h) Voltage Reduction Device (VRD)
- i) Output Circuit Safety Switch

- j) Cracked or missing insulators on electrode holders

Note: Further guidance on equipment inspections is provided in Appendix C4

3.5 GAS CUTTING, HEATING AND WELDING EQUIPMENT

3.5.1 General

Flashback arrestors and non-return valves complying with AS 4603 should be used on all handpieces and cylinders. They should not restrict gas flow.

Flashback arrestors that incorporate a pressure sensitive flow cut-off valve and pressure relief safety valve should be considered.

Oxygen or fuel gas should not be used to remove dust from clothes or work.

Inspection should include a suitable means for detecting leaks as recommended by the manufacturer.

3.5.2 Cylinders

3.5.2.1 General

Cylinders should generally comply with the following:

- a) Filled, inspected and maintained in accordance with AS 2030
- b) Gas safety data sheets to be kept at all sites
- c) Cylinder valves should be tightly closed when not in use or where cutting activities are stopped for a period of time, e.g. lunch
- d) Never leave an empty cylinder connected to a process
- e) Never sling or lift a cylinder by the valve cap
- f) Do not subject cylinder to abnormal mechanical shocks
- g) Cylinders shall be located so that sparks, slag and molten material cannot fall on hoses or on the cylinders or attachments

3.5.2.2 Storage

All cylinders should be stored in accordance with AS 4332, AS 1940 and AS 1596.

All cylinders should be kept upright, away from any sources of heat, electrical circuits and oil or grease during use.

Cylinders should be stored at least 15m away from fuel bays, fuel outlets and mobile equipment under repair.

All oxygen and acetylene cylinders should be placed on a stable footing and be secured to prevent falling.

Storage areas should be fitted with lockable doors, level floors and should be raised at least 150mm above the surrounding floor.

Dry powder extinguisher should not be positioned less than 8m or more than 10m from the storage area.

Cylinders should be returned to a safe storage area when cutting operations are completed and kept isolated.

Grease, oils or other combustible substances should not be in contact with the valves of cylinders containing oxygen, nitrous oxides or other oxidants. Oils and any fuels in the presence of oxygen may ignite spontaneously.

Oxygen cylinders should be stored more than 3m away from fuel cylinders.

Note: A segregation panel between fuel and oxygen gas bottles may achieve this.

3.5.2.3 Transport

Cylinders should be made secure when being transported and retained to a rigid support.

Acetylene and LP Gas cylinders should be transported in an upright position.

Cylinders should not be rolled on the ground.

Where possible use an appropriate trolley for transporting cylinders, even over short distances.

All cylinders must be labelled, colour coded and accounted for and removed from the mine after use.

Cylinder valve guards should be used during transport.

Cylinders should be lifted in a manner as recommended by the manufacturer.

3.5.3 Ignition Safety Devices

An ignition safety device (Flint Gun) for flame cutting and burning activities should be used at all times.

Matches, cigarette lighters, wicks, smouldering material and other similar devices should not be used to ignite a gas.

3.5.4 Hoses

Hoses should comply with AS 1335 and AS 1869.

Hoses should be protected from sparks, hot slag, hot objects, sharp edges and open flames.

An automatic hose reeling system should be used when cutting and welding from heights or in a mine shaft.

If hoses are burnt in a flashback or damaged they should be replaced.

Do not use hoses longer than necessary.

Hoses should be checked for leaks daily.

3.6 ELECTRIC WELDING

3.6.1 General

All welding power sources shall comply with AS 1966 or AS 3195.

All welding equipment should be appropriately labelled.

Welding cables shall comply with AS 1995.

Electrode holders should be in accordance with AS 2826 Class 'A' but as a minimum shall be Class 'B'.

The use of d.c. welding equipment is preferable over a.c. welding equipment, d.c. is safer.

The use of inverters rather than transformers is preferable.

The duty cycle of the welding equipment should be checked against the duty cycle required.

3.6.2 Welding flash

Welding flash is the observation of welding arc by the naked eye.

Suitable screens shall be used to protect other personnel in the vicinity of the welding activities.

An appropriately rated welding face shield must be used to protect the welding operator.

3.6.3 Primary Circuit

Primary circuit protection shall be in accordance with AS 3000.

Note: Additional primary circuit protection needs to be considered when welding underground in coal mines.

Where mains fed welding machines are to be used adjacent to each other, the mains connection shall be phased out to ensure that the open circuit voltage between adjacent electrodes does not exceed Extra Low Voltage (phase out as per AS 1674.2 and Appendix C). If this is not possible fixed barriers should be installed so a person cannot gain access to both electrode holders at the same time.

Ensure multiple a.c. welding machines are installed in phase.

3.6.4 Output Circuit

Electric shock in welding occurs when a person's body is in simultaneous contact with any exposed part of the secondary circuit electrode conductor and any metal or conducting material connected to the work terminal.

All parts of the welding circuit including the return path is 'live', therefore the welding operator must ensure that no part of the body is placed in a position such that it completes a path through the body for the passage of the electric current.

To prevent electric shock from the secondary circuit, it is important that:

- a) Welding cable is in good condition and suitably rated, located, protected and insulated, to contain all welding currents within the cable, and not allow any stray currents to occur
- b) The work return lead (cable) is fastened as close as practicable to the welding location to avoid stray currents

Note:

- (i) Gears, bearings, brushings, pipes, etc should not be used to form part of the return circuit. This is to prevent damage to the equipment and arcing or sparking within the gearcases.
 - (ii) Particular care should be taken when using two or more welding machines in close proximity.
 - (iii) The lead (cable) connecting the welding machine to the work is called the "work return lead (cable)". The work return lead (cable) is commonly (incorrectly) called the earth lead (cable). Deliberate or accidental connection of the work return lead (cable) to earth creates hazardous situations and allows stray currents of significant magnitude to be generated by welding circuits.
- c) The electrical connection between the work return lead (cable) clamp and cable is secure
 - d) Welding operators should ensure that no part of their body is placed in a position to effect a return path for the circuit
 - e) Electrode holders are not defective
 - f) Welding machines must be switched off and isolated from supply before connecting and disconnecting leads
 - g) When welding has stopped for a period of time, power should be turned off and the electrode removed from the holder in order to prevent inadvertent operation
 - h) Prevent bare skin contact with the workpiece and always use dry insulating gloves. Gloves should always be used to handle electrodes
 - i) An output circuit safety switch, between the welding machine and the hand piece, is recommended
 - j) Two electrode leads are not along side each other
 - k) For a.c. welding machines the electrode terminal is connected to the electrode lead and the work terminal is connected to the work return lead not vice versa
 - l) Consideration should be given to the risk of electromagnetic induction with other circuits

3.6.4.1 Welding Cables

The welding cables should not be extended beyond 9m in length without consideration of voltage drop in accordance with the requirements of AS 1674.2.

The current carrying capacity of the work return and electrode cable should be determined in accordance with:

- a) Rated output of the welding machine
- b) Duty cycle of the welding machine
- c) The distance of the work from the welding machine

3.6.5 Voltage Reduction Devices (VRD)

VRDs are a safety enhancement that greatly reduces the risk to welding personnel of exposure to potentially hazardous voltages produced by a welding power source. The VRD function is to reduce the voltage from the electrode to a safe value when the welding machine is not being used.

A system (VRD or alternative) shall be provided to reduce the no-load voltage or open circuit voltage (OCV), to a no load voltage of:

- a) 35V for d.c., or
- b) 35V peak, 25V rms for a.c. circuits, or
- c) less when the resistance of the output circuit exceeds 200 Ohms.

Note:

- (i) For additional information about VRDs refer Appendix C3 or WTIA TN22.
- (ii) Alternative systems may include triggers, switches and open circuit safety switch being operated when changing electrodes.
- (iii) MIG's and TIG machines reduce the voltage to zero when the trigger is not operated.

3.6.6 Response Time for VRD

The turn off time (reaction time) for the VRD to reduce the voltage to the low voltage state after the circuit resistance reaches or exceeds 200 Ohms shall be less than 300 ms.

3.6.7 Diesel or Petrol Welding Machines

Diesel or petrol driven welding machines and/or generators should be in accordance with the following:

- a) Welding machines should be in accordance with AS 1966.2
- b) If a socket outlet is installed it must comply with AS3000 – Portable Generators
Note: The preferred arrangement is no socket outlet fitted to the welding machine generator
- c) Only a single class 2 (double insulated appliance) can be used if no earth stake is installed
- d) An earth stake and RCD must be used if more than one appliance is being operated off the socket outlet

3.6.8 Output Circuit Safety Switches

An output circuit safety switch shall be used when welding in confined spaces or electrically hazardous environments, e.g. damp environments.

3.6.9 Electrically Hazardous Environment

An environment is considered electrically hazardous whenever the welding operator has to work in physical contact with the workpiece, particularly in a cramped (kneeling, sitting or lying) position. The hazard is compounded in wet, damp or hot locations where moisture or perspiration considerably

reduces the electrical resistance of the human body and the insulating properties of clothing. Critical open circuit voltages can be as low as 25V in wet conditions, refer table below.

Table: Critical Open Circuit Voltages

Environment	Maximum OCV d.c. welding machine	Maximum OCV a.c. welding machine
Non electrically hazardous	113 volts	113 volts peak or 80 volts rms
Electrically hazardous but dry conditions	113 volts	68 volts peak or 48 volts rms
Electrically hazardous and wet conditions	35 volts	35 volts peak or 25 volts rms

Examples of such environments include:

- i) Underwater
- ii) In the splash zone close to the water's edge
- iii) While standing in water
- iv) In rain
- v) Welding in hot or humid areas, when it is impossible to avoid accumulation of perspiration or condensation
- vi) In mines, trenches, coffer dams, etc, which are difficult to keep dry
- vii) In treatment works which may have accumulations of water and while performing work which might result in metal pieces falling onto welding cables

Note:

- (i) Power sources that comply with this requirement are often marked with an 'S' in a square box on the compliance plate.
- (ii) d.c. only welding machines may comply, but most a.c. welding machines will not.
- (iii) Management of the increased hazard of a.c. power sources is essential.

3.7 GRINDING & ABRASIVE WHEELS

Work that incorporates grinding activities either driven by electricity or by fluid power shall be regarded as hot work and the appropriate controls taken.

The correct type of grinding/cutting wheels or discs shall be used for the application. Grinding/cutting activities shall be carried out in accordance with equipment and disc manufacturers instructions. Maximum rotation speed should not be exceeded.

Wheels should have no visible cracks, or damage and be fitted correctly.

Guards should be checked on a regular basis.

SECTION 4 ADDITIONAL REQUIREMENTS FOR SPECIFIC AREAS

4.1 GENERAL REQUIREMENTS FOR ALL SPECIFIC AREAS

The risk of fire or electric shock may be significantly increased because of the nature of the environment. In particular the risk of electric shock will increase significantly when the environment is damp, humid or wet.

Therefore additional precautions need to be taken when working in particular hazardous environments such as where there is a higher risk of fire and explosion or where there is a high risk of electric shock.

Electrode holders should be fully insulated to AS 2826 Class 'A'.

Also care needs to be taken to ensure that the current only flows in the work return lead and not through structural members away from the point of work.

4.1.1 Task Specific Risk Assessment

A task specific risk assessment must be conducted to identify all hazards that were not covered in the overall risk assessment (refer 2.2.3).

This risk assessment should also address:

- a) Consider all changing circumstance that may occur while welding is being undertaken, e.g. weather, ventilation, power failures, etc
- b) Emergency procedures

4.1.2 Hot Work Permit System

A hot work permit system should be used when welding in areas with specific hazards. The hot work permit system should be in accordance with AS 1674.1 and AS 2865. A hot work permit system should ensure adequate safeguards are in place prior to, during and after all hot work.

A hot work permit system should incorporate the following as a minimum:

- a) Ensure a task specific risk assessment has been undertaken
- b) Identify appropriate controls for access, ventilation, electrocution, and fire hazards
- c) Ensure each person to be conversant with the risk assessment hazards and controls
- d) The mine owner or mines representatives have given authorisations
- e) The required inspection and their frequency

4.1.3 Preparation of Work sites

Prior to issuing a hot work permit the area should be inspected by a competent person. The inspection should cover the area within a 15m radius including above and below the work area.

This inspection should include:

- a) All flammable materials are removed from the area
- b) Ventilation is adequate to ensure atmosphere does not contain flammable vapours
- c) Combustibles are removed from the opposite side of walls
- d) Wall and floor openings are covered
- e) Fire equipment is available within 10m of the work area
- f) Sweep floors and wet them down, check walls and horizontal surfaces for dusts and lint's. If outdoors, clear away combustible materials such as vegetation, sawdust, wooden pallets and soak area concerned

- g) Disconnect (isolate) electrical sources
- h) Communications and emergency preparedness is in place
- i) Access and emergency egress is available

4.1.4 Working in a Shaft

When working in a shaft, rise, lift, pit, closed vessel etc, then:

- a) Cylinders should be located above the cutting point so that sparks, slag and molten material cannot fall on hoses or on fusible plugs
- b) The area should be deluged with water, if flammable material which cannot be easily removed or covered is present, e.g. timber structures
Note: Particular care should be taken when using electrical equipment.
- c) Molten metal, slag and sparks must be prevented from falling down shafts onto flammable material, e.g. chemical storage areas, belting, 'Linatex', polyurethane screens, etc
- d) When oxygen and acetylene is used in a mineshaft an automatic hose reel is preferable

4.1.5 Emergency Response Plan

Whenever work is carried out in an area with increased hazards then there should be:

- a) An emergency response plan developed and implemented
- b) The emergency response plan should include recovering a welding operator from an electric shock or any other risk
- c) An attendant who is outside the danger area and readily accessible to the welding operator. This person should be trained in first aid, emergency procedures and disconnecting the power
- d) The attendant who has communications with the welding operator
- e) A whole current isolator (output circuit safety switch), within the reach of the attendant, that will cut off the supply to the welding machine if the welding machine is located in the confined space
- f) Output circuit safety switch, within the reach of the attendant, to remove power between the handpiece and the welding operator if the welding machine is located outside the confined space

4.1.6 Disconnection of Power Supply

The welding machine current should be disconnected:

- a) Whenever gas testing is being undertaken
- b) Until the welding operator is ready to commence welding activities
- c) While electrodes are being changed
- d) Whenever the operator is not welding
- e) If an attendant is not present

4.1.7 Specialised Work

The following work is considered to be specialised work. It should not be carried out at a mine unless under direct control of a suitable competent person in the type of work being performed.

- a) Welding on vehicles with pneumatic tyres
- b) Rims of tyres
- c) Pressure vessels
- d) Pressure equipment and pipelines
- e) Structural Purpose welding SP (refer AS 1554.1) or greater (e.g. cranes or lifting requirements)
- f) Hot work on or near petrol, fuel or bulk oil tanks where explosive vapours are likely to be present

4.2 WET AREAS

The presence of water in the work area increases the risk of electric shock (refer Appendix C1). Therefore it is important that welding activities in wet, damp or areas which are likely to be humid, should be carried out in accordance with AS 1674.2 and the following, in order, to reduce the risk of electric shock:

- a) The person is kept dry to ensure the person is effectively insulated from earth, e.g. the use of covers to protect from rain, air conditioning in a hot confined space, or frequent changes of damp clothing (particularly gloves)
- b) Additional insulating materials should be used (Secondary insulation), e.g. insulating mats, duck board, etc
- c) Ensure water is drained away from the welding operator
- d) Refer Section 3.6.9 Electrically Hazardous Environment

4.3 HAZARDOUS AREAS

4.3.1 General Requirements

In addition to the above requirements, work carried out in hazardous areas should be in accordance with the following:

- a) Defined, prepared and controlled in accordance with AS 1674.2, AS 2430 and AS 3000 Clause 7.9
- b) Welding shall not be carried out in Zone 0 and Zone 1, as defined in AS 2430
- c) The hazardous area should be effectively eliminated if practicable. Removal of the equipment from the hazardous area is preferable
- d) There shall be an assigned firewatcher and hot work permit system implemented
- e) Electrical equipment shall be suitably rated
- f) Proper ventilation shall be provided
- g) The area where cutting and welding is being performed should be isolated
- h) The welding equipment should be located outside the hazardous area
- i) AS 1940 and AS 1596 specify minimum distances from sources of flammable and combustible liquids and gases to ignition points

4.3.2 Types of Hazardous Areas

Hazardous areas may be found in the following locations (the list is not exhaustive):

- a) A place where explosives are stored
- b) A place where batteries are charged
- c) Near a refuelling station, fuel spillage or any exposed combustible material
- d) Hot work associated with fuels, oil, bulk storage tanks, pipelines and their surrounds
- e) Near any drum or opening, which have held or are suspected to have held chemicals
- f) Conveyor belts and/or associated structures, where coal, or other combustible materials are handled. For example:
 - i) Conveyor transfer chutes
 - ii) Coal reclaim tunnels
 - iii) Coal and refuse storage bins
- g) Inside any confined space
- h) An area in which an explosive gas atmosphere is present continuously, Zone 0, AS 2430
- i) An area in which an explosive gas atmosphere is likely to occur in normal operation, Zone 1, AS 2430

4.3.3 Firewatchers

A firewatcher should be working with the welding operator at all times. The firewatcher should:

- a) Be alert for fire outbreak or hazard
- b) Stop work if conditions change to a hazardous environment
- c) Not leave the job until replaced
- d) Be trained in the emergency response plan
- e) Be trained in first aid

Note: A firewatcher and an attendant could be the one person.

4.4 CONFINED SPACES

In addition to the above requirements, work carried out in a confined space should be in accordance with the following:

- a) Defined and carried out in accordance with AS 2865
Note:
 - (i) A confined space may also be a hazardous or wet area and additional controls as outlined above may be required.
 - (ii) Further information can be found in WTIA TN07.
- b) Personnel involved in confined space work shall be formally trained
- c) An attendant outside the area with knowledge of the emergency response plan
- d) Ventilation is purged of flammable liquids and vapours
- e) Gas cylinders and welding machines to be left outside the confined space if possible
- f) Heavy portable equipment mounted on wheels should be securely blocked
- g) If electric welding is suspended for any period of time all electrodes should be removed from holders and the welding machine disconnected from the power source
- h) The emergency plan should include means for the welding operator to be removed quickly in the event of an emergency and/or injury
Note: Safety belts and lifelines could be used for this purpose

- i) To prevent accidental gas leakage, cylinder valves should be closed whenever the torch is not to be used for a sustained period. Where practicable the torch and hoses should be removed from the confined space

SECTION 5 ADDITIONAL REQUIREMENTS FOR UNDERGROUND COAL MINES

5.1 GENERAL REQUIREMENTS

The requirements listed in this section shall apply to all welding carried out underground in a Coal Mine. In addition to Section 1,2 & 3 the requirements of Section 4 should also be considered.

5.1.1 Clause 11 Coal Mines (Underground) Regulation 1999

Clause 11 of the Coal Mines (Underground) regulation 1999 states:

'Cutting or welding underground

Cutting or welding must not be carried out underground at a mine unless it is carried having regard to a code, relating to cutting and welding, applied to the mine.'

5.1.2 Compliance with this Technical Reference

To meet the requirements of Clause 11, Coal Mines (Underground) Regulation 1999, a mine must:

- a) Develop and implement a WMP in accordance with this Technical Reference
- b) Provide a copy of the WMP to the Department of Mineral Resources Inspectorate
- c) Provide a copy of the self-assessment checklist, as detailed in Appendix A1 and A2, to the Department of Mineral Resources Inspectorate
- d) Notify the Department of Mineral Resources Inspectorate and the District Check Inspector four weeks prior to commencing cutting and welding activities on the first occasion

5.1.3 Locations for Cutting and Welding Underground

The use of cutting and welding equipment underground in a Coal Mine shall be considered in relation to the following areas:

- a) Underground splicing stations
- b) Underground workshops
- c) Non-hazardous zones underground
- d) Hazardous zones underground
- e) Emergency situation

Welding in 'Underground splicing stations, underground workshops, and non-hazardous zones' represents an increase in potentially hazardous, but manageable, situations.

It is preferable for all welding underground to be carried out in designated underground workshops. When welding in an underground workshop controls are in place and engineered before cutting and welding activities commence and therefore there should be no greater risk to underground employees.

When welding in non-hazardous zones, outside dedicated workshops, the environment is likely to present greater risk.

Welding in a 'hazardous zone' is associated with a high level of risk and is not considered acceptable unless there is no practicable alternative.

When **Welding in 'emergencies'** it is likely that little time will be available to plan the activities in detail. However the general situation should be considered beforehand and the fundamental practices and standards that apply should be determined in advance. The basic principle that underpins the use

of cutting and welding equipment in an emergency is that persons are not to be exposed to an unacceptable level of risk to themselves that might exacerbate the overall situation.

5.1.4 Overall Risk Assessment

An overall risk assessment must be conducted to assess the risk associated with the task of using cutting and welding in each location underground. In addition to the general requirements this risk assessment shall include, but not necessarily be limited to:

- a) Frequency and nature of inspections (before, during and after)
- b) Competencies of site personnel relating to reading, recording and the interpretation of real time monitoring
- c) Minimum gas and ventilation standards to be applied
- d) Site preparation and housekeeping standards (before, during and after)
- e) Actions to be included in the emergency response plan
- f) The fire fighting provisions to be provided
- g) Communication requirements
- h) Equipment and Standards
- n) The transport and storage requirements
- o) Earthing of the electrical welding equipment

Senior Mining and Engineering personnel must participate in this risk assessment.

5.1.5 Task Specific Risk Assessment

A task specific risk assessment shall be conducted on each occasion where cutting and welding is being carried out in:

- a) A workshop or splicing station, if they were not covered by the overall risk assessment
- b) A workshop or splicing station, where hazards are present other than those covered in the overall risk assessment
- c) A non-hazardous zone
- d) A hazardous zone

Senior Mining and Engineering personnel must participate in this risk assessment.

5.1.6 Appointment of Welding Operators

All persons carrying out cutting and welding must be authorised by the mine manager in writing and a hot work permit system implemented.

The person carrying out the cutting and welding shall be provided with a copy of this authorisation.

The authorisation shall consider the following:

- a) Types of work permitted by the person being authorised
- b) Duration of the authorisation
- c) The locations of the permitted work area
- d) Any other management controls

All persons carrying out cutting and welding activities shall be given appropriate training in the outcomes of any risk assessment and the mine WMP.

For cutting and welding in a non-hazardous zone, authorisation should be for each separate occasion.

Contractors

Contractors shall be competent and authorised to carry out cutting and welding activities. Training should extend to the additional hazards associated with the underground coal mining environment.

5.1.7 Inspections Recording

All inspections must be recorded and kept as part of the WMP.

5.1.8 Transport of Equipment to the Work Site

All welding and cutting equipment should be transported to site in accordance with the following:

- a) Transported directly between the surface of the mine and the location where cutting and welding is to take place
- b) Cylinders to be secure so they cannot move about and do not protrude outside the vehicle
- c) Before transporting close all shut-off valves and check for leakage on cylinders
- d) Disconnect all ancillary equipment such as regulators, gauges etc.
- e) Unloaded all cylinders as soon as possible
- f) Inspect equipment prior to use

5.1.9 Ventilation and Gas

Ventilation and gas control is to include the following:

- a) The provisions of other Ventilation Guidelines should be considered, e.g. draft MDG 1023
- b) A positive airflow of intake air shall be directed and maintained over the cutting and welding site at all times
- c) If the percentage of flammable gas anywhere within 20m of the cutting and welding area exceed 0.25% then:
 - i) Work shall not commence operation
 - ii) Work shall be stopped until such time as the percentage of flammable gas is reduced to below 0.25%
 - iii) Special attention shall be paid to examination and history of flammable gas at roof level, crevices and floor breaks

Note: These can be issuing gas that gets mixed with ventilation. However if hot slag or dross enters the floor break it will pass through an explosive mixture.
- d) Real time (continuous) gas monitoring should be operational in an underground workshop. This continuous gas monitoring should be transmitted to a central location. It should monitor the return air from the workshop
- e) Adequate ventilation shall be provided in order to dilute any gases to render them harmless

5.1.10 Flammable Materials

The work job shall be thoroughly cleaned down to remove all dirt, grease, loose coal etc prior to starting cutting and welding. Special precautions should be taken when access is not possible to the back of the plate, or material being welded on.

There shall be no flammable materials such as spilt oil, grease, and coal dust or rags within a 10m radius of the cutting and welding activity.

All movable flammable material such as oil, diesel fuel, chemicals within a 10m radius of the welding activity shall be removed.

The machinery, floor or material immediately beneath the area of the cutting and welding operations shall, where practicable, be protected by sheet metal covered with wet sand to prevent sparks and hot dross being scattered.

5.1.11 Fire Fighting Facilities

The following fire fighting and fire prevention facilities shall be provided as a minimum:

- a) Two extinguishers of an approved type and suitable capacity (80BE)
- b) A fire hydrant located within 25m on the intake side of the cutting and welding area
- c) A fire depot located beside the fire hydrant with sufficient hose to reach all extremities of the area where cutting and welding activities are being undertaken (splicing station, workshop)
- d) Suitable water supplies in the area (Refer clause 116, Coal Mines (Underground) Regulation 1999)
- e) A suitable hose, minimum 25mm and pressurised in readiness for use
- f) Adequate supplies of stone dust (five bags minimum)

5.1.12 Emergency Egress

There shall be a second means of egress provided.

5.1.13 Lighting

Adequate lighting shall be provided in order to allow welding activities to be carried out safely.

5.1.14 Inspections

5.1.14.1 Prior to the Commencement of Cutting and Welding

A competent person shall carry out and record the following inspections before any cutting and welding activities are commenced:

- a) A thorough examination of the area within a radius of 20m of the welding site for the presence of:
 - i) Adequate ventilation and positive air flow over the cutting and welding site
 - ii) Flammable gas (0.25% CH₄)
 - iii) Combustible materials
 - iv) Adequate stone dust
 - v) Strata conditions
 - vi) Fire fighting facilities are operational
- b) An examination of the cutting and welding equipment to ensure it is fit for purpose and safe for use
- c) A examination of the area within a radius of 10m of the welding site for confirmation that:
 - i) The walls, floor and roof are covered with a non-flammable material (heavily stone dusted)
 - ii) Grease, coal dust and all movable flammable material are not in the vicinity of the area

5.1.14.2 During and After Completion of Welding and Cutting

A competent person shall inspect the site regularly and at intervals:

- a) Not exceeding two hours while the equipment is in use
- b) Continuously for at least 1 hour after completion of the welding and cutting to ensure that the place is free from any fire or smouldering material and the site is in a safe condition
- c) After completion of cutting and welding activities deluge the area with water

5.1.15 Emergency Response Plan

An emergency response plan shall be developed as an integral part of the mines WMP. The emergency response plan should be implemented if ventilation quantity and/or gas levels deteriorate, or any other abnormal circumstance eventuates.

In this regard MDG 1022 and the provisions of Part 5 of the Coal Mines (Underground) Regulation 1999 are considered relevant.

5.2 UNDERGROUND WORKSHOPS

5.2.1 General

All underground workshops should be constructed, operated and maintained in accordance with MDG 34 (Draft).

All welding and cutting activities in a workshop must not be carried out:

- a) In a workshop that has battery charging facilities available
- b) In an area used for refuelling

5.2.2 Materials of Construction

Workshop floor, roof and walls shall be constructed from a suitable fit for purpose non-flammable material. It is preferable to have concrete floors and sprayed roof and walls.

5.2.3 Storage of Equipment

All welding and cutting equipment should be stored and maintained in accordance with the following:

- a) In a designated area which shall be set aside and marked for the storage of cutting and welding apparatus
- b) The storage area should be a secure lockable area with limited access. This lockable area should be a fireproof cabinet
- c) Access to the storage area to be by appointed persons only
- d) A register should be kept of the equipment stored. This register should record all quantities, and movements, of the equipment
- e) Fuel and oxygen cylinders shall be segregated and stored separately

5.2.4 Garages

Cutting and welding shall not be conducted in the same part of a workshop as that used for refuelling.

Where refuelling facilities (garage) are provided near a workshop then the following shall apply as a minimum, but be not limited to:

- a) The risk assessment shall address the additional hazards
- b) Hot work and refuelling shall not be carried out simultaneously
- c) There shall be an effective segregation method of the fuel source and fire source. This segregation shall be based on:
 - i) The quantity and type of fuel source
 - ii) Ventilation
 - iii) The environment, e.g. type of flooring, roof, walls, etc
 - iv) Other potential fuel sources such as oils, greases, etc
- d) The floor shall be graded such that spillage cannot accumulate
- e) There shall be a positive mechanism to prevent any vehicle entering the workshop space when welding activities are being carried out

5.3 VULCANISING / SPLICING STATIONS

Splicing stations should be constructed, operated and maintained in accordance with MDG 38 (Draft).

Welding activities other than grinding must not be carried out in a vulcanisation station unless the requirements of workshops or non-hazardous area are complied with.

It is intended to only use buffing, cutting discs and grinding discs to prepare the conveyor belt ready for splicing. It is recognised that sparks may be created due to the buffing, cutting and grinding process.

Vulcanising or splicing stations underground:

- a) Shall not be installed in a hazardous zone or area
- b) Equipment and hand tools shall comply with the mines Standard of Engineering Practice and Portable Apparatus Management Plan
- c) There shall be positive adequate ventilation and the splicing station shall be in an intake airway
- d) Shall be inspected at appropriate intervals (before, during and after). Inspections to include:
 - i) Ventilation and gas
 - ii) Lighting
 - iii) Isolation
 - iv) Fire fighting, water and fire extinguisher

5.4 NON – HAZARDOUS ZONES

5.4.1 General

The provisions of this section include those additional requirements, to Section 5.1, when cutting and welding in a non-hazardous zone.

All cutting and welding equipment shall be transported directly to the surface after completion of cutting and welding, or to an underground workshop, for safe storage. There shall be no storage facilities for cutting and welding equipment in the non-hazardous zone outside an underground workshop.

5.4.2 Task Specific Risk Assessment

In addition to the overall risk assessment a task specific risk assessment must be conducted on each occasion where cutting and welding is being carried out in a non-hazardous zone.

This risk assessment shall also include the following:

- a) A site inspection on each specific occasion to assess and address site-specific hazards
- b) Applied to a specific location that has clear defined boundaries
- c) The inspections to be performed before, during and after cutting and welding activities
- d) The removal and/or protection of flammable materials including coal dust from accidental ignition
- e) Stone dusting standards
- f) Strata Control requirements
- g) The potential for sudden fluctuations in ventilation quantity and/or gas emission and controls designed to protect against such events

5.4.3 Site Preparation

The area shall be thoroughly stone dusted for at least a radius of 20 metres from the cutting and welding site.

Fire fighting facilities, as stated above, shall be provided.

5.4.4 Inspections

5.4.4.1 Before, During and After Completion of Welding and Cutting

A competent person must see that these conditions have been carried out before welding or cutting is commenced.

Inspections must be carried out as detailed in 5.1.15 as a minimum.

There shall be no flame lit to ignite the equipment and no arc struck with an electric welding apparatus except by or in the presence of a competent person.

A competent person shall:

- a) Inspect the site regularly at appropriate intervals (maximum of one hour) while the equipment is in operation
- b) Check the area is thoroughly stone dusted and fire fighting facilities are available
- c) Remain at the site or in close proximity to the site whilst cutting, welding or heating operations are in progress
- d) Remain at the site for a period of at least four hours after the completion of cutting and welding activities and inspect for fire, smouldering material or dangerous Methane concentrations

5.5 HAZARDOUS ZONES UNDERGROUND

5.5.1 General

When cutting and welding is being proposed in a hazardous area then:

- a) The requirements of all sections of this Technical Reference must be considered and demonstrated
- b) The Department of Mineral Resources Inspectorate must be notified on each occasion
- c) The District Check Inspector must be notified on each occasion

5.5.2 Notification Procedure

This notification shall contain the following information as a minimum:

- a) A list of all alternative options to cutting and welding in the hazardous zone which have been considered. Examples may include:
 - i) Repair of equipment by other means
 - ii) Relocating the equipment to a non-hazardous zone such that the component can be welded on
 - iii) Dismantle and remove the components to the surface
 - iv) Change ventilation such that the area is no longer a hazardous zone, e.g. ventilation fans
- b) The mine must demonstrate by risk assessment techniques that the welding option has an acceptable level of risk
- c) A copy of the task specific risk assessment which:
 - i) Identifies the hazards
 - ii) Establish controls to eliminate or minimise the risk to an acceptable level

Note: It would be expected that the Mine Mechanical Engineer, Mine Electrical Engineer and Mine Manager or Undermanager In Charge are participants on this risk assessment, also including the employees representatives, welding operator/ boilermaker, deputy, fitter etc.

- d) A copy of a self assessment of the risk assessment to MDG 1014

- e) Plan of the area showing relevant information, equipment, power supply, ventilation and areas of potential gas
- f) Work procedure (SWP, JSA, etc) for the specific task
- g) Clearly identify the authorised person (Manager, Deputy Manager or Undermanager) that shall be present on the cutting and welding site at all times when the welding or cutting activities are being carried out
- h) State the date and time, and which cutting and welding activities are to be carried out. A minimum of seven days notice shall be given
- i) Provide details of inspections before, during and after cutting and welding activities are carried out. Refer Clause 5.4.4 as a minimum
- j) Provide details of all electrical equipment
- c) Application for an exemption Under Section 174(5) of the Coal Mines Regulation Act for an exemption from Clause 139.1 of the Coal Mines (Underground) Regulation 1999 (Electrical Apparatus)
- k) The application shall be in accordance with the applicant's guide for exemption (under development by the DMR)

5.5.3 Notification Assessment

The Department of Mineral Resources and the District Check Inspector must be given adequate time to inspect the site and review the notification. There should be a minimum 7 days period for this.

A Mining Officer, an Engineering Officer and the District Check Inspector shall inspect the site.

The Inspectorate may:

- a) Request additional controls to be in place
- b) Request additional information
- c) Issue a notice, under Section 63 of the Coal Mines Regulation Act, that the DMR Officer is of the opinion the proposed cutting and welding activities are liable to shortly become dangerous to the occupational health and safety of any persons employed at the mine
- d) Approve the exemption application under the provisions of Section 175 (5) of the Coal Mine Regulation Act to exempt the mine from Clause 139.1 '*Electrical Apparatus*' of the Underground Regulations

5.6 EMERGENCY SITUATION

An emergency welding procedure shall be developed and maintained in the mines WMP.

Note: An emergency is where there is a safety risk if cutting and welding is not done. It does not include production loss as a reason.

This emergency plan shall take into consideration the outcomes of the overall risk assessments previously carried out.

In addition the likely hazards associated with welding in an emergency shall be clearly identified in the WMP.

A risk assessment shall be carried out to address additional controls that may be used to minimise the hazard in the event of an emergency.

The application of these controls in an emergency situation may need to be carried out without the time to conduct a formal site inspection.

The mines welding management plan shall include but not necessarily be limited to:

- a) Any corporate permission/authorisation to be obtained, or notification to be given, before the emergency use of cutting and welding equipment can be activated

- b) The status and/or qualifications of the person (on any shift) who is responsible to inspect the site and determine that persons performing emergency cutting and welding operations are not being put at unacceptable risk or undertaking any activity that may compound the problem
- c) The means by which this person can ensure that the appropriate controls in relation to cutting and welding are put in place to the maximum extent possible in the limited time available

Note: This may be in the form of a checklist that specifies a hierarchy of controls to be in place before emergency cutting and welding is activated. This list may be separated into:

- (i) Those that shall be put in place, but may be enacted during the emergency cutting and welding operation, and
- (ii) Those that are desirable if time allows but are not essential to an acceptable level of safety of personnel operating in an emergency situation.
- (iii) The location of any equipment that will be required to ensure the safety of persons performing emergency cutting and welding operations.

The Manager or, in the absence of the manager, the Undermanager shall be in attendance to determine if the situation is an emergency, and ensure all safety precautions are in place and not affect the safety of the rest of the workforce.

The District Inspector of Coal Mines shall be notified if cutting or welding activities are to be carried out in an emergency.

SECTION 6 APPENDICES

6.1 APPENDIX A – ASSESSMENTS

The following checklists are to be used as guidance material for review of a WMP. It is not intended to be a comprehensive list. Therefore compliance with these assessments may not necessarily mean statutory compliance.

6.1.1 Appendix A1 – Assessment for Welding Management Plans

- Does a WMP exist?

Is the WMP:

- An easily understood document
- Accessible to all employee and contractors
- Actively maintained and up to date
- Define the locations that the WMP applies to

Risk Assessment

- Has a risk assessment been carried out (view the documents)
- Has the risk assessment been carried out in accordance with a recognised standard
- Is this standard stated
- Has a self-assessment to this standard or MDG 1014 been carried out
- Does the risk assessment include:
 - Identification of risks to people
 - Identification of risks to plant
- Have all hazards associated with cutting and welding been identified for each location where cutting and welding is to take place
- Have controls been put in place to adequately address the hazards stated
- Is the risk assessment team appropriately selected

Does the Overall Risk Assessment consider cutting and welding areas on site such as:

- Surface general and workshops
- Surface specific areas
- Product processing plant
- Confined spaces
- Diesel Tanks etc

Consultation

- Is there evidence that consultation has taken place

Instruction, Training and Competencies

- Have competencies been defined for people carrying out cutting and welding activities
- Is there an authorisation process in place for these people
- Do these competencies cover particular types of work
- Does training include safe operation, inspection, and maintenance of the equipment
- Have competencies been defined for supervisors of the work

Audit, Monitor and Review

- Is there a process to audit cutting and welding activities against the mines WMP
- Is there a process to audit the WMP
- Is a frequency stated for these audits
- Is there a system for monitoring and recording defects and hazards identified
- Is the WMP revised after audit or reviews taken place

Responsibilities and Accountabilities.

- Is there a single person accountable for the WMP
- Are accountabilities and responsibilities defined for all personnel associated with the cutting and welding activities

Documentation

- Are relevant documents to be kept for six years (refer 2.3 items a) to j))

Maintenance and Inspection

- Is there a system to examine, inspect and test all cutting and welding equipment to ensure it is safe to use
- Does this system cover mechanical and electrical safety inspections

Emergency Preparedness

- Does the WMP consider emergency response

General

- Is cutting and welding activity being carried out in accordance with AS 1674.1 & AS 1674.2
- Does the WMP identify appropriate PPE to be worn
- Is there a safe area identified for cutting and welding activities
- Have fire controls been addressed
- Have ventilation requirements been addressed

Specific Areas

- Does the WMP include additional requirements for specific areas
- Controls for electronically hazardous environments
- Does this include:
 - Hot work permits
 - Task specific risk assessments
 - Site preparation
 - Emergency response
 - Particular requirements for types of areas, e.g. wet areas, hazardous areas and confined spaces

6.1.2 Appendix A2 –Assessment for WMP for welding Underground in Coal Mines

In addition to the above assessment for WMP in mines the following assessment can be used when cutting and welding activities are being undertaken underground in a coal mine.

- Does the WMP meet the general requirements of Sections 1 to 4
- Has a copy of the WMP been issued to the DMR for review

Risk Assessment

- Is there an overall risk assessment to identify the hazards associated with each location that cutting and welding activities will be carried out at underground.

Does risk assessment include welding in the following locations:

- Splicing station
- U/G workshop
- Non-hazardous zone
- Hazardous zone
- Welding in emergency situations
- Does this risk assessment identify the controls that are required to reduce the risk to an acceptable level
- Does this risk assessment address item a) to o) of 5.1.4
- Is there a process to identify when a task specific risk assessment is required in a workshop and splicing station
- Is there a system for the appointment of welding operators
- Is there a system to record all inspections
- Is there a system to transport equipment to the work site
- Is there a ventilation and gas management procedure
- Is there a system for the preparation of the site
- Is there a system of fire fighting facilities and procedures
- Is there a system for inspections, before, during and after cutting and welding
- Is there an emergency response plan

Hazardous Zones

- Is there a system to cut and weld in a hazardous zone:
 - Have alternatives to cutting and welding been considered
 - Have all hazards be identified
 - Is there a process to notify the DMR

6.2 APPENDIX B - ASSOCIATED DOCUMENTS

The following partial list of documents is related for cutting and welding activities. This list is provided for information only and it is not a full and comprehensive list of all documents that may be applicable.

6.2.1 Australian Standards.

1223	Safety requirements for industrial hand cleaners (petroleum solvent type)
1259	Acoustics-Sound level meters
1269	Occupational Noise Management
1270	Acoustics-Hearing protectors
1335	Hose and hose assemblies for welding, cutting and allied processes
1336	Recommended practices for occupational eye protection
1337	Eye protectors for industrial applications
1338.1	Filters for eye protectors – Filters for protection against radiation generated in welding and allied operations
1338.2	Filters for eye protectors – Filters for protection against ultraviolet radiation
1338.3	Filters for eye protectors – Filters for protection against infrared radiation
1345	Identification of the contents of piping, conduits and ducts
1470	Health and safety at work – Principles and practices
1627.1	Metal finishing – preparation and pre-treatment of surfaces. Part 1: Cleaning using liquid solvents and alkaline solutions
1627.3	Metal finishing – preparation and pre-treatment of surfaces. Part 3: Flame cleaning
1627.4	Metal finishing – preparation and pre-treatment of surfaces. Part 4: Abrasive blast cleaning
1674.1	Safety in welding and allied processes - Fire precautions
1674.2	Safety in welding and allied processes - Electrical
1680	Interior lighting–Safe environment
1715	Selection, use and maintenance of respiratory protective devices
1716	Respiratory protective devices
1837	Code of practice for application of ergonomics to factory and office work
1851	Maintenance of fire protection equipment
1869	Hose and hose assemblies for liquified petroleum gases (LPG), natural gas and town gas
1885	Measurement of occupational health and safety performance
1891	Industrial fall-arrest systems and devices (safety belts and harnesses)
1940	The storage and handling of LP Gas
1966.1	Electric arc welding power sources - Transformer type
1966.2	Electric arc welding power sources - Rotary type
1995	Welding cables
2030.1	The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases - Cylinders for compressed gases other than acetylene
2030.2	The verification, filling, inspection, testing and maintenance of cylinders for the

	storage and transport of compressed gases - Cylinders for dissolved acetylene
2161	Occupational protective gloves (excluding electrical and medical gloves)
2161.1	Occupational protective gloves - Selection, use and maintenance
2161.2	Occupational protective gloves - General requirements
2161.3	Occupational protective gloves - Protection against mechanical risks
2161.4	Occupational protective gloves - Protection against thermal risks (heat and fire)
2161.5	Occupational protective gloves - Protection against cold
2161.7	Occupational protective gloves - Protection against cuts and stabs by hand knives – Chain mail gloves and arm guards
2161.8	Occupational protective gloves - Protection against ionizing radiation and radioactive contamination
2210	Occupational protective footwear Safety footwear
2210.1	Occupational protective footwear - Guide to selection, care and use
2374	Power transformers
2430.1	Classification of hazardous areas - Explosive gas atmospheres
2444	Portable fire extinguisher and fire blankets-Selection and location
2480	Electrical equipment for explosive atmospheres – Flame proof enclosure
2799	Resistance welding equipment - Single-phase a.c. transformer type
2812	Welding, brazing and cutting of metals – Glossary of terms
2826	Manual metal-arc welding electrode holders
2865	Safe working in a confined space
3000	Electrical Installations (known as the Australian/New Zealand Wiring Rules)
3012	Electrical installations-Construction and demolition sites
3100	Approval and test specification – General requirements for electrical equipment
3108	Approval and test specification-Particular requirements for isolating transformers and safety isolating transformers
3109.1	Approval and test specification - Appliance couplers for household and similar general purposes - General requirements
3123	Approval and test specification – Plugs, socket-outlets and couplers for general industrial application
3190	Approval and test specification – Residual current devices
3191	Approval and test specification – Electric flexible cords
3195	Approval and test specification – Portable machines for electric arc welding and allied processes
3760	In-service safety inspection and testing of electrical equipment
3859	Effects of current passing through the human body
3931	Risk analysis of technology systems - Application guide
4289	Oxygen and acetylene gas reticulation systems
4332	The storage and handling of gases in cylinders
4360	Risk management
4603	Flashback arrestors – Safety devices for use with fuel gases and oxygen or compressed air

4801	Occupational health and safety management systems-Specification with guidance for use
4804	Occupational health and safety management systems – General guidelines on principles, systems and supporting techniques
4839	The safe use of portable and mobile oxy-fuel gas systems for welding, cutting, heating and allied processes

6.2.2 NSW Department of Mineral Resources Guidelines

MDG 25	Guideline for Safe Cutting and Welding at Mines
MDG 34	Guidelines for the Design, Construction and Operation of Underground Workshops, Garages and Parking Areas.
MDG 38	Design Guidelines for Splicing and Vulcanising Stations for Underground Coal Mines.
MDG 1010	Risk Management Handbook for the Mining Industry
MDG 1014	Guide to Reviewing a Risk Assessment of Mine Equipment & Operations.
MDG 1022	Guidelines for Determining Withdrawal Conditions from Underground Coal Mines
MDG 1023	Ventilation Control System

6.2.3 Other Standards and Documents

DIN 8521	Flashback Arresters
TN07	Health and Safety in Welding. -. Welding Technology Institute of Australia - Technical Note 7 (TN07)
TN22	Welding Electrical Safety - Welding Technology Institute of Australia - Technical Note 22 (TN22)
WTIA Guidance Note	Fume Minimisation Guidelines

Note: WTIA documents can be purchased from the Welding Technology Institute of Australia at www.wtia.com.au

A Manual on Mines Rescue, Safety and Gas Detection. J Strang and P MacKenzie-Wood, ISBN 0 9588861 0 5

6.3 APPENDIX C – ADDITIONAL INFORMATION – WELDING TECHNOLOGY INSTITUTE OF AUSTRALIA

(Informative from WTIA)

6.3.1 Appendix C1 - Assessing the Risk of Electric Shock

ENVIRONMENTS

There are three types of environments.

- a) Normal.
- b) Increased risk of Electric Shock.
- c) High Risk of Electric Shock.

6.3.1.1 Normal Environment

A normal environment is one where there is a low risk of becoming part of the welding circuit. The risk of simultaneously touching the workpiece and the electrode is low. It is typically where the welding operator is working at a bench, welding small components, such as test pieces. The welding operator must be standing, laying or sitting on non-conducting material. When changing electrodes, the welding operator is not touching either the bench or the workpiece. The bench is often part of the circuit and is live, and covering parts of it with a leather coat or blanket where the welding operator may touch it is essential.

In this situation, only the general precautions apply.

6.3.1.2 Environment With an Increased Risk of Electric Shock

This environment is where the welding operator is forced to work while in contact with the workpiece or conducting materials connected to the workpiece. It includes large steel building structures, storage tanks, conductive confined spaces, and onboard ships. The ambient temperature is less than 32C and the area is dry. In this case, the welding operator only has to touch the electrode accidentally to get a shock. This can occur by stroking the face with a live electrode, dropping it, or placing it under the armpit.

Much work in a workshop can be conducted in a non-hazardous workspace, but if the workpiece is large, or is sitting on a steel plate on the floor, the workspace should be regarded as potentially electrically hazardous. The workspace is not hazardous if insulating material can be used to prevent contact with the workpiece. Standing in rubber soled shoes is not hazardous, but if work is performed while sitting, kneeling or laying on the workpiece it may become hazardous. The hazard can be minimised by laying on leather-covered cushions, wooden duckboards, or similar insulation. It is not sound practice to rely on normal work clothing for insulation, because it is easily holed or moistened with sweat, and may have metal button or zip closures.

If the workspace is a small space closely confined by conducting elements, then insulation from contact is almost impossible. Such a workplace could be inside a pipe or small vessel.

The hazardous environment may or may not be a confined space as defined by AS 2865. A confined space, without an electrically conducting boundary is not electrically hazardous. A room with electrically conducted walls, such as ship's engine room is not a confined space (it is a normal place of work), but it may be electrically hazardous. If it is a confined space then the precautions specified in AS 2865 are mandatory, to prevent asphyxiation, entanglement with machinery, entrapment or engulfment.

6.3.1.3 Environment with a High Risk of Electric Shock

Where an electrically hazardous or normal environment is also hot, humid, damp or wet there becomes a high risk of electrocution. This typically occurs if the temperature exceeds 32 degrees C, so that the welding operator's clothing, particularly gloves become dampened with perspiration. It also occurs if welding is performed in rain, partially submerged, in damp mines, where waves can splash the welding operator or underwater. Typical areas where an extreme hazard may exist are mines, cofferdams, floating platforms, damp earth particularly trenches, tropical or inland work sites, inside

vessels exposed to hot sun. If high preheat has to be used a hazardous environment may become extremely hazardous.

In these situations, the water or perspiration makes insulation of the welding operator from the workpiece extremely difficult. There are often large contact areas between the welding operator's skin and the workpiece and the skin resistance is low. In addition perspiration, dampened gloves make the risk of contact with the electrode high. The risk of a shock is high and the consequences of one are likely to be serious.

Plasma processes should not be used in this environment. To comply with the low OCV, some hazard protection device is required for the MMAW, air-arc gouging and GTAW processes. This can be a trigger switch operated by the welding operator. Most GTAW is conducted with such a switch, and it is possible to use a switch on MMAW or arc gouging torches. A better solution for MMAW and air-arc gouging is to use a voltage reduction device.

GMAW, FCAW machines comply with the restriction on maximum OCV, because they are switched, and they operate with low OCV d.c. There is no benefit in fitting VRDs to these machines. The OCV is usually too low to trigger the device.

Important Note

These are new requirements intended to eliminate the risk of electrocution of welding operators. They represent a change from what was previously regarded as acceptable practice.

6.3.2 Appendix C2 - Effects of current passing through the human body - PHYSIOLOGY OF ELECTROCUTION

(Informative Excerpts from AS 3859-1991)

ELECTROCUTION—DESCRIPTION The term electrocution implies death due to the action of electric current. The current may produce functional derangements incompatible with life in certain vital organs. The most common disorders of this sort relate to heart function and respiratory action. If the heart ceases its function of pumping blood, the oxygen carried by the blood does not reach vital centres and death ensues. If breathing ceases, then insufficient oxygen enters the blood stream (hypoxia) and this causes cell and tissue death. Some tissues are more sensitive than others to hypoxic damage, the most sensitive being the brain which can only be without oxygen for about 4 minutes before onset of irreversible damage. In electrocution, cessation of circulation (circulatory arrest) occurs because the natural rhythm of the heart is disrupted, making coordinated pumping impossible. The disordered rhythm may take one of several forms, the most common being ventricular fibrillation, where heart muscle cells contract in a random disordered fashion.

6.3.2.1 ELECTRICAL ACTIVITY OF EXCITABLE CELLS

All cell membranes are electrically polarised, the inside of the membrane surface negative with respect to the outside. The membrane has a polarisation voltage of 70 mV to 90 mV, maintained by active cellular processes that create ionic concentration differences across the membrane. When a cell membrane is stimulated, it becomes locally depolarised with the inner surface losing its charge. When this process reaches a certain electrical threshold, a regenerative process occurs which leads to depolarisation of the whole membrane. This depolarisation is propagated by local currents along the cell producing a measurable voltage known as an action potential. The membrane must repolarise before another action potential can be conducted and during this period is said to be refractory.

6.3.2.2 EFFECT OF FREQUENCY

Because of membrane capacitance, the response of excitable cells is frequency dependent. The membrane is effectively a low-pass filter. If the frequency of the applied current is high, the time constant of the cell membrane may be sufficiently long to prevent the depolarisation threshold being reached. Thus such a current would be an ineffective stimulus.

6.3.2.3 EFFECT OF ELECTRICITY ON HEART MUSCLE CELLS

Heart muscle cells are particularly susceptible to low-frequency alternating current in the range 40 Hz to 100 Hz. An appreciation of how such currents can disrupt cardiac rhythm requires an understanding of the electrical and mechanical events in the cardiac cycle. The heart is a sophisticated four-chambered pump controlled by an intricate electrical system. The upper chambers of the heart are known as the right and left atria. The lower chambers are known as the right and left ventricles. Blood entering the right ventricle must be pressurised sufficiently to be forced through the pulmonary circulation to the left atrium and left ventricle. The left ventricle is then responsible for generating enough pressure to force the now oxygenated blood through the body. The heart rate is governed by both intrinsic and extrinsic factors. Electrical impulses originate in the sino atrial (SA) node in the right atrium, which initiates the contraction process. The wave of depolarisation initiated in the SA node is carried to the remaining cardiac muscle through a specially adapted network of fast-conducting muscle fibres as shown in AS 3858 Figure B1. The SA node (the heart's natural pacemaker) discharges at an intrinsic rate of about 1 Hz. However this may be modulated up or down by sympathetic and parasympathetic nerves impinging on the SA node or by circulating hormones or both. Physiologically the atria are electrically insulated from the ventricles except at the AV node. The wave of depolarisation originating in the SA node moves over the atria (causing contraction) and eventually reaches the atrio-ventricular (AV) node. Functionally the AV node is similar to the SA node. It acts to coordinate the atrial impulse so that it is transferred to the ventricles as a single impulse and from where it is distributed throughout the ventricles via a further network of specialised conductive tissue. Thus the ventricles contract a short time after the atria. An electric current that impinges on the orderly contraction process may disrupt it, the requirements being sufficient magnitude and appropriate frequency. Heart muscle is particularly vulnerable during its electrical repolarisation phase and ventricular fibrillation may result, (see Figures 6 and 7 on page 1616 of AS 3859). Ventricular fibrillation will often continue even though the source of current may be switched off or removed.

6.3.3 Appendix C3 - Guidance Notes on Voltage Reduction Devices for Manual Metal Arc Welding and Air-Arc Gouging Power Sources

(Informative from WTIA)

There are a number of VRDs on the market and they must be selected on the basis of compatibility with welding equipment. A recommendation when purchasing new equipment is to have a VRD internally fitted or "hard wired". Regular verification of the correct functioning of a VRD must be carried out. Guidance on selection, performance and testing of VRDs is given below.

6.3.3.1 General description

Voltage Reducing Devices (VRDs) are safety enhancements that greatly reduce the risk of exposure of welding personnel to potentially hazardous voltages produced by a welding power source. A voltage-reducing device or system should automatically reduce the no-load or open circuit voltage (OCV), to a no-load voltage of: -

- a) 35 V for d.c. and
- b) 35 V peak, 25 V rms for a.c.

or less when the resistance of the output circuit exceeds 200 Ohms.

There are three types of VRD commonly used.

6.3.3.2 Type 1 – Externally fitted to secondary circuit

This type of VRD is connected in series with the output of the secondary circuit on a welding machine and has four connections as follows:

- a) Electrode lead from the welding machine to the VRD.
- b) Work return lead from the welding machine to the VRD.
- c) Electrode lead from the VRD to the welding hand-piece.
- d) Work return lead from the VRD to the work clamp.

The leads connecting the output terminals of the welding machine secondary circuit to the VRD (1 and 2 above) are at unreduced open circuit voltage or welding voltage during operation of the equipment. The leads connecting to the welding hand piece and the work clamp are at a reduced voltage of 35 V d.c., 25 V a.c. or less when the circuit resistance is greater than or equal to 200 Ohms. When the resistance drops below 200 Ohms, the voltage rises to the unreduced output voltage of the equipment.

This type of VRD is suitable for all a.c. and d.c. welding machines for MMAW and can be attached to whichever welding machine is to be used. These VRDs are usually housed in a rugged metal enclosure and weigh a few kilograms.

6.3.3.3 Type 2 – Internally fitted to secondary circuit

This type of VRD is identical in operation to the externally fitted VRD except that the VRD and all connections are located within the enclosure of the welding machine. There are added safety benefits in this arrangement because connection of wiring to the VRD is permanent.

This type of VRD is commonly used for engine drives and larger welding machines where there is enough internal space to fit the device. One disadvantage of this type is that the VRD is a permanent part of that particular machine and cannot be transferred if the power source fails.

6.3.3.4 Type 3 – Fitted to primary circuit

6.3.3.4.1 Type 3a

This type of VRD is suitable for the inverter type welding machines and consists of a small package of electronics connected into the voltage control electronics. It is fitted within the enclosure of the welding machine as a permanent installation and does not impact on the portability of the inverter welding machines.

6.3.3.4.2 Type 3b

This type of VRD is suitable for the a.c. to a.c. transformer type welding machines and electronically controls the voltage applied to the primary circuit winding which in turn reduces the output voltage.

The package of electronics for these inverters is smaller than Types 1 and 2, and in some instances may be fitted internally. Alternatively the package may be attached to the outside of the welding machine enclosure.

- a) Type 1 and Type 2 VRDs are substantially larger and heavier than Type 3 VRDs.
- b) Type 2, Type 3a and Type 3b VRDs are permanently wired into the welding machine.

6.3.3.5 Response Times

Response times for “turn on” (full voltage) and “turn off” (reduced voltage) operations of a VRD affect the operator appeal and more importantly, the degree of hazard reduction afforded to the welding operator by a VRD. Turn off time is of particular significance because this directly influences the time a welding operator could be exposed to the unreduced no-load voltage after the welding arc is broken as the electrode is lifted from the weld pool. Turn on time or arc strike time is also very important for ease of use of the welding machine when a VRD has been fitted.

6.3.3.6 Arc strike time

Arc strike time should be as fast as practical. Typical values are 20 milliseconds or less.

6.3.3.7 Turn off time

This is the time taken for the VRD to reduce the secondary circuit voltage to the low voltage state after the circuit resistance reaches or exceeds 200 Ohms. Maximum turn off time should be less than 300 milliseconds. Some VRDs have an adjustable turn off time delay, enabling the turn off time to be adjusted to 5 seconds or more. The risk of fatal electric shock (electrocution) multiplies with increasing exposure time. Longer turn off times lead to potentially fatal exposures to electric current under conditions of minimal welding operator body resistance.

When VRD equipment with a turn off time greater than 300 milliseconds is used, welding operators must be made aware of the increased period of vulnerability to exposure to hazardous voltage before the VRD “turns off”. With slower response times there is a greatly increased risk period where accidental contact with live parts of the circuit will expose the welding operator to high voltages.

6.3.3.8 Operational Parameters

6.3.3.8.1 Operational or strike resistance

A VRD should switch to the low voltage state (35 V d.c. 25 V a.c. or less) when the circuit resistance reaches or exceeds 200 Ohms. Conversely the VRD should turn on (switch to a high voltage state) when the circuit resistance is less than a specified value, which is usually significantly less than the turn off resistance.

6.3.3.8.2 Duty Cycle

VRDs of Type 1 and Type 2 carry full welding current through the secondary circuit and have duty cycles determined by the current carrying capacity of the current switching components. Switches used are mechanical contactor types or solid state switching types. Selection of a VRD should be based on the expected service performance.

6.3.3.8.3 Thermal Overload

Type 1 or Type 2 VRDs should have thermal overload circuit protection.

6.3.3.8.4 Status Indicators

VRDs should have status indicator lights that clearly indicate high voltage or low voltage status.

6.3.3.8.5 Test circuits

Some VRDs are supplied with an internal test circuit that applies a low resistance across the output from the welding machine. The status indicator lights should change to red, indicating high voltage when the test button is depressed and return to green, indicating low voltage when the test button is released.

6.3.3.9 Fail to Safe

It is desirable that VRDs be designed to be “Fail-to-Safe”. VRDs are electronic or electromechanical devices and components used in their construction may fail. This could lead to a potentially unsafe situation where the VRD ceases to perform the function of reducing the unregulated open circuit voltage of the welding power source without indicating such failure to the user.

At the time of writing this note, there were no units known to be on the Australian market that were designated by manufacturers as "Fail-to-Safe".

6.3.3.10 Testing of VRDs

6.3.3.10.1 Daily Check

A daily check should be made by the user of a VRD that indicator lights operate in accordance with equipment manufacturer's specifications during a welding cycle.

6.3.3.10.2 Compliance

Compliance of the sensing circuit of a VRD should be tested regularly. Compliance of the sensing circuit is checked by connecting an insulated load resistor of suitable power rating across the output terminals of the welding machine, or if using a Type 1 VRD, across the output terminals of the VRD. The resistance value should be variable, from 50 Ohms to, say 220 Ohms. Voltage measurements shall be taken while resistance is being increased from 50 Ohms. The VRD should switch the unreduced no-load voltage to a voltage of 20 V or less when the resistance value is more than or equal to 200 Ohms.

6.3.3.11 Malfunctioning VRDs

If there is any indication of a malfunction of a VRD, the unit should be immediately withdrawn from service and the fault investigated by a competent service agent.

6.3.3.12 Personal Protective Equipment and Safe Working Practices

Always use personal protective equipment including rubber-soled boots, dry gloves, complete coverage with no bare skin on arms and legs and dry clothing.

Always use safe working practices. Avoid contact with workpiece, avoid contact with electrode, ensure safe placement of leads, use additional insulation such as rubber mats or duckboards, power off before changing electrodes.

Ensure all welding equipment, especially electrode holders, leads and connections are fully insulated, well maintained and frequently inspected for damage.

Never work alone and don't fall into the trap "It's only a small job, no need for all that gear"

Electrocution is a shocking business you can be killed in less than a second

6.3.4 Appendix C4 - Inspection Schedules

(Informative from WTIA)

6.3.4.1 Daily Inspection and Pre-Start Checks

The purpose of this inspection is for the user of the equipment to identify, by a thorough visual inspection of the equipment, any physical damage to the welding equipment. This inspection includes the body of the welding machine, electrical leads to the primary and secondary circuits, instruments, indicator lamps and controls, hand pieces, return work lead clamps, plugs and connectors. For mobile equipment this inspection may be carried out at the end of a days work to identify potential hazards that can be addressed before the equipment leaves the workshop for the next job.

It is recommended that welding equipment be checked on a daily basis and before use. Daily checks involve a complete visual inspection of the equipment by the person using the equipment. Guidance on the method of carrying out the check is given in 6.3.4.2. The person carrying out the checks may fill in a record of inspection.

For machines fitted with hazard reduction devices such as VRDs the operation of the VRD should be verified at the start of a shift by observation of the correct operation of the status indicator lamps during a welding cycle.

6.3.4.2 Recommended Welding Machine Daily Inspection and Pre-Start Check List

6.3.4.2.1 Power Supply

Disconnect and isolate the power supply to the welding machine prior to performing these pre-start checks.

6.3.4.2.2 Mains Supply Socket and Switch

Visual inspection for any obvious damage and defects to switch or socket.

6.3.4.2.3 Primary Cable and Plug on the Welding Machine

Check for any visible damage to plug or power supply cable. Special attention should be given to any cuts, abrasions, fraying or other damage to the cable insulation, which may expose live wires. Ensure the mains supply cable is located away from welding cables and connections. Ensure the cable is securely anchored onto welding machine and plug.

6.3.4.2.4 Electrical Inspection Tag

Check that a **current month** electrical inspection tag is attached to the welding machine.

6.3.4.2.5 Welding Machine and Cable Connections

Visually check the welding machine for obvious damage to the cabinet or power switches. Check that all cable connections to the welding machine are in good condition, contact surfaces are clean and are properly tightened. If terminal posts are used ensure only brass washers and the correct insulated type brass nut is used. Any unused terminal posts shall have an insulated brass nut in place. Check that all connections are fully insulated and cables are firmly anchored to fittings.

For a.c. machines check that work return leads and electrode leads are connected to the correct terminals on the welding machine.

For d.c. machines check polarity and ensure electrode leads are connected to the correct terminals on the welding machine and that any other machines in the vicinity are connected with the same polarity.

6.3.4.2.6 Welding Leads

Examine all leads for damage such as cuts or abrasions, damaged insulation or frayed wires or any other damage that may expose live wires. Electrode and work return leads should be of similar length. Electrode and work return leads should be of the same current carrying capacity and rated for the maximum output and duty cycle of the welding machine.

6.3.4.2.7 Welding Lead Extension Connections

Check that both the male and female connections are fully insulated with clean contact surfaces and cable clamps are tightened properly with no conductors exposed.

6.3.4.2.8 *Welding Handpieces*

Check that the welding handpiece is in good condition and is fully insulated. The hand piece must be rated for the maximum current rating and duty cycle of the welding power source. Cracked or damaged handpieces should be taken out of service immediately.

6.3.4.2.9 *Work return leads*

Work return leads should be of similar length to welding leads. Work return leads should be of the same current carrying capacity as welding leads and of sufficient rating for the rated current output and duty cycle of the welding machine.

6.3.4.2.10 *Work Return Clamp*

Check that the work return clamp is securely connected to the work return lead.

6.3.4.2.11 *Engine Drive Welding Machines*

Check that all exhaust fume emissions are dispersed away from the work area and any other personnel working in the immediate vicinity. Do not use in an enclosed area or building.

6.3.4.2.12 *Voltage Reduction Device*

If a voltage reduction device (VRD) is used ensure that the indicator lights are functioning and indicating low voltage (Safe • green) and high or welding voltage (Unsafe • green flashing or red) condition as the welding machine is operated in a normal welding cycle. This check is done with power on.

Warning – If on completion of this pre-start checklist you are unsure of the safety of any part of this equipment - DO NOT USE. Isolate the equipment and notify your supervisor immediately, in order that remedial action can be taken.'

Ensure that you have all necessary Personal Protective Equipment in place before turning on the welding power source. PPE must be in good order and dry.

6.3.4.3 *Visual Inspections*

The purpose of visual inspections is to identify any electrical faults and mechanical damage. The inspection is to identify, by means of a thorough visual inspection of the equipment followed by prescribed electrical tests, any significant damage to or electrical malfunction of the welding equipment. Items inspected must include, as a minimum, the body of the welding machine, electrical leads connected to the primary and secondary circuits, welding hand pieces, work return lead clamps, plugs and connectors. Resistance levels of mains power conductors to earth and primary to secondary windings on the power source must be checked. Earth continuity must be checked.

An authorised person should be inspected welding equipment being used. Visual inspections are usually required on a monthly basis. After completion of any necessary maintenance an inspection tag is placed on the equipment.

For specific information on the electrical requirements for welding power sources refer to AS 1966.1 or AS 1966.2, AS/NZS 1995, AS/NZS 3195.

For machines fitted with a VRD the operation of the VRD should be verified by placing load resistors across the output circuit. Results of the test must verify the VRD switches between the low-voltage state and the open circuit voltage of the welding power source at resistance levels and within maximum time frames in accordance with the manufacturers data sheet. Response time shall be verified for switching from full OCV to low-voltage state. Indicator lamps shall also be checked to verify they correctly indicate status of the electrical circuit in accordance with the manufactures data sheet.

6.3.4.4 *Welding Machine Monthly Inspection List - Visual*

6.3.4.4.1 *Mains Supply Socket and Switch*

Visual inspection for any obvious damage and defects to switch or socket.

6.3.4.4.2 *Primary Cable and Plug on the Welding Machine*

Check for any visible damage to plug or power supply cable. Special attention should be given to any cuts, abrasions, fraying or other damage to the cable insulation, which may expose live wires. Ensure the cable is securely anchored onto welding machine and plug.

6.3.4.4.3 Welding Machine and Cable Connections

Visually check the welding machine for obvious damage to the cabinet or power switches. Check that all cable connections to the welding machine are in good condition, contact surfaces are clean and are properly tightened. If terminal posts are used ensure only brass washers and the correct insulated type brass nut is used. Any unused terminal posts shall have an insulated brass nut in place. Check that all connections are fully insulated and cables are firmly anchored to fittings.

For a.c. machines check that work return leads and electrode leads are correctly connected to the welding machine.

6.3.4.4.4 Welding Leads

Examine all electrode and work return leads for damage such as cuts or abrasions, damaged insulation or frayed wires or any other damage that may expose live wires. Electrode and work return leads should be of similar length. Electrode and work return leads should be of the same current carrying capacity and rated for the maximum output of the welding machine.

6.3.4.4.5 Welding Lead Extension Connections

Check that both the male and female connections are fully insulated with clean contact surfaces and cable clamps are tightened properly with no conductors exposed.

6.3.4.4.6 Welding Handpieces

Check that the welding handpiece is in good condition and with a secure connection to the lead and of sufficient rating for the welding power source. Check that the welding handpiece is fully insulated. Cracked or damaged handpieces should be taken out of service immediately.

6.3.4.4.7 Work return leads

Work return leads should be of similar length to welding leads. Work return leads should be of the same current carrying capacity as welding leads and of sufficient rating for the rated output of the welding machine.

6.3.4.4.8 Work Return Clamp

Check that the work return clamp is in good condition, with a secure connection to the work and work return lead and of sufficient rating for the welding power source.

6.3.4.4.9 Engine Drive Welding Machines

Check operation of battery isolator.

6.3.4.4.10 Voltage Reduction Device

Regular verification of the correct functioning of a VRD must be carried out. Guidance on selection, performance and testing of VRDs is given in Appendix E. The operation of the VRD should be verified by placing load resistors across the output circuit. Results of the test must verify the VRD switches between the low-voltage state and the open circuit voltage of the welding power source at resistance levels and within maximum time frames in accordance with the manufacturers data sheet. Response time shall be verified for switching from full OCV to low-voltage state. Indicator lamps shall also be checked to verify they indicate correctly in accordance with the manufactures data sheet. If a voltage reduction device (VRD) is used ensure that the indicator lights are functioning and indicating low voltage and high or welding voltage condition as the welding machine is operated. This check is done with power on.

6.3.4.5 Major Inspections

The purpose of these inspections is to carry out a thorough inspection of the overall condition of the equipment and ensure electrical safety and functionality. Servicing should extend to a thorough visual inspection of the internal components and removal of accumulated dust and debris from within the casing of the welding machine. The service should include a thorough inspection of all internal wiring including terminations, anchoring of cables, earth bonding, protection of wiring harnesses from abrasion and damage, the condition of switches, instruments, indicator lamps, the condition of insulation and the condition of all connections.

It is recommended that welding equipment be given a major service at least annually. More frequent inspections are recommended in harsh environments where mechanical damage, corrosion or

accumulation of potentially hazardous materials could lead to an electrical hazard. Servicing of welding power sources should be carried out by a competent service organisation.

Compliance of the welding equipment with the requirements of relevant Australian Standards shall be verified. Australian Standards include AS 1966.1 or AS 1966.2, AS/NZS 1995, AS 2374, AS/NZS 3000, AS 3100, AS 3108, AS 3109, AS 3123, AS/NZS 3191, AS/NZS 3195.

6.3.4.6 Electrical Inspections

Electrical inspections shall be carried out to ensure the welding equipment is functioning in accordance with the requirements of Australian Standards.

6.3.4.6.1 Schedule 1 – AS/NZS 3195 – Refer AS3195 Table 2

- a) Insulation resistance test
- b) High voltage test
- c) No-load voltage test
- d) Test of earthing facilities
- e) Cord anchorage test
- f) Screw threads and fixings
- g) Maximum short-circuit input current test or maximum rated input current test
- h) Test for magnetic material entry
- i) Temperatures during normal operation
- j) Leakage current test
- k) Temperatures during abnormal operation
- l) High voltage test
- m) Test of overheating protective device
- n) Rated load voltage test
- o) Current rating of supply flexible cord
- p) Test for degree of protection
- q) Determination of ignitability and combustion propagation
- r) Test for d.c. component
- s) Test of appliances connected to supply by plug

6.3.4.6.2 Schedule 2 – AS1966.1 – Refer AS1966.1 Table E1

- a) Insulation Resistance
- b) High Voltage
- c) Earthing Connection
- d) Open Circuit Voltage
- e) Earth Leakage
- f) Insulation Resistance

6.3.4.6.3 Schedule 3 – AS 1966.2 – Refer AS 1966.2 Table E1

- a) Insulation Resistance
- b) High Voltage
- c) Earthing Connection
- d) Open Circuit Voltage
- e) Earth Leakage

f) Insulation Resistance

Warning – ‘If on completion of this monthly inspection you are unsure of the safety of any part of this equipment - DO NOT USE. Isolate the equipment and notify your supervisor immediately, in order that remedial action can be taken.’

6.3.4.7 Electrical Inspection Tag

On satisfactory completion of inspections and tests, remove the out of date tag and replace with an electrical inspection tag attached to the welding machine.