



AUSTRALIAN  
CONSTRUCTORS  
ASSOCIATION

# Construction & Building Industry Safety Guideline

## Welding Electrical Safety



### **Disclaimer**

This Guideline contains information regarding work health and safety. It includes some of your obligations under the work health and safety and electrical safety legislation that jurisdictional regulators administer. To ensure you comply with your legal obligations you must refer to the appropriate Acts and Regulations that apply in the jurisdiction where you are conducting your work.

This publication may refer to legislation that has been amended or repealed. When reading this Guideline you should always refer to the latest jurisdictional laws. It is the responsibility of the businesses and the individuals involved to ensure that a safe system of work is employed and that statutory requirements are met.

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# Construction & Building Industry Safety Guideline

## Welding Electrical Safety

### Intent

The intent of this guideline is to ensure appropriate electrical risk controls are in place for welding and allied processes to prevent persons being electrocuted or injured by electricity (electric shock, burns) or property being destroyed or damaged.

### Scope

This guideline sets out the minimum safe work practices to perform welding and allied processes as described within AS 1674.2 - 2007 "Safety in welding and allied processes Part 2: Electrical" and the Safe Work Australia: Code of practice – Welding Processes.

### Safety Imperatives

- a. A risk assessment is to be undertaken at all stages of the work process life to identify the specific category of the welding area / environment.
- b. Employees involved with welding and welding activities, including those assessing and inspecting finished welding and welding standards are to be deemed competent.
- c. Contractor documentation is to be reviewed to ensure it is adequate and that all contractors are suitably experienced and competent to undertake the work assigned.
- d. Prior to undertaking welding tasks outside of Cat "A" environments (workshops and designated areas), specific planning and controls, of this standard for category "B" and "C" environments are to be implemented.
- e. Welding tasks that are required to be undertaken in, or adjacent to, a hazardous area are to be carried out strictly in accordance with a "safe system of work for hazardous areas."
- f. Electrodes and work pieces are to be considered electrically 'live' at all times.
- g. Voltage reduction devices (VRDs) and remote isolation devices (RIDs) should be fitted to the arc welding units and used wherever practicable by personnel and contractors to minimise electrical hazards.
- h. If, during any welding activity, a faulty or unsafe item of welding equipment is identified, and the piece being worked on becomes unsafe or the environment becomes unsafe, the activity is to cease until the equipment or situation is corrected and it is safe to re-start work.
- i. As a minimum, this standard will be reviewed following implementation, and annually thereafter.

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## Electrical Safety Guideline

Imperative Item.	Safety Imperative	Element Guidance	Element Timing	Safety Observer	Welder	Electrical worker	Supervisor	Safety Practitioner	Workplace Manager	General Manager	Expected Outcome	Standard, Regulation Reference
a.	A risk assessment is to be undertaken at all stages of the work process life to identify the specific category of the welding area / environment.	<p><b>Tender / Pre – contract stage</b></p> <ul style="list-style-type: none"> <li>At tender stage the scope of works is assessed for the risks associated with welding activities to ensure the allocation of resources and finance to manage the specific requirements outlined within AS 1674.2</li> <li>For example this may include the need to appoint safety observers and or supply special equipment (within budgets).</li> </ul> <p><b>Subject Matter Expert (SME)</b></p> <ul style="list-style-type: none"> <li>Specialist welding and engineering personnel may need to be sourced to assist in the determination of required welding and expected welding outcomes, (e.g. specific welds, welding techniques, inspections) as part of welding planning processes.</li> </ul> <p><b>Normal Environment</b></p> <ul style="list-style-type: none"> <li>A normal environment is one where there is a low risk of becoming part of the welding circuit. This is equivalent to AS 1674.2 - Category A environments</li> </ul> <p><b>Hazardous Environment</b></p> <ul style="list-style-type: none"> <li>This environment is where the welder is required to work while in contact with the workpiece or conducting materials connected to the workpiece. This is equivalent to AS 1674.2 - Category B environments</li> </ul> <p><b>Environment with a high risk of electric shock/ electrocution</b></p> <ul style="list-style-type: none"> <li>Where an electrically hazardous or normal environment is also hot, humid, damp or wet there is a high risk of electric shock/electrocution. This is equivalent to AS 1674.2 Category C environments.</li> </ul>	Prior to commencing welding task	P	P	P	P	P	P	S	<p>The budget for works is not affected critically by changes in environments and conditions.</p> <p>All the risks associated with welding activities are identified prior to commencing any works and the appropriate risk treatments implemented.</p> <p>People and property remain electrically safe throughout the life of the welding activities.</p>	<p>General WHS requirements - WHS Act &amp; Regulations or jurisdictional equivalent (Vic &amp; WA) Refer Table 1</p> <p>WHS Regulations Regulations 32-38</p> <p>AS 1674.2 Clauses 2.1 – 2.4</p> <p>Safe Work Australia Code of practice – Welding Processes Section 2</p> <p>WHS Regulations Regulation 44</p> <p>AS 1674.2 Clause 3.1</p>

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Imperative Item.	Safety Imperative	Element Guidance	Element Timing	Safety Observer	Welder	Electrical worker	Supervisor	Safety Practitioner	Workplace Manager	General Manager	Expected Outcome	Standard, Regulation Reference
		<ul style="list-style-type: none"> <li>The above occurs if the temperature exceeds 32°C, so that the welder’s clothing, particularly gloves become dampened in perspiration.</li> <li>The above also occurs if welding is performed in rain, partially submerged, in damp mines, where waves can splash the welder or underwater</li> </ul> <p><b>Personal Protective Equipment (PPE)</b></p> <p>The following <b>minimum PPE</b> is to be worn at all times by workers when undertaking welding activities on site:</p> <ul style="list-style-type: none"> <li>welding gloves - dry and hole free (particularly when changing electrodes);</li> <li>fire retardant/ protective clothing;</li> <li>welding helmet or face shield;</li> <li>goggles or safety glasses with side shields;</li> <li>suitable respirator (where relevant); and</li> <li>rubber soled boots (without bare steel toe caps).</li> <li><b>Refer to AS 1674.2 and Appendix B for further guidelines.</b></li> </ul>										Safe Work Australia Code of practice – Welding Processes Section 4.2
b.	Employees involved with welding and welding activities including those assessing and inspecting finished welding and welding standards are to be deemed competent.	<ul style="list-style-type: none"> <li>Workers involved with welding and welding activities are to be deemed competent, having received appropriate training in the operation of the particular welding equipment, to enable workers to have an understanding of the full range of normal operating duties and emergency procedures.</li> <li>Training provided to workers involved with welding and welding activities is to include (as a minimum):                             <ol style="list-style-type: none"> <li>specific health and safety hazards;</li> <li>classification of welding categories;</li> <li>operating procedures; and</li> <li>emergency procedures.</li> </ol> </li> </ul>	At employment for employees and prior to issue of any welding tasks	P	P	P	P	S	S	S	The risk of employees not being competent to perform their assigned tasks in a safe manner and the risk to others exposed to employees not competent is reduced or eliminated.	WHS Regulations Regulation 39  Safe Work Australia Code of practice – Welding Processes Section 1

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		<ul style="list-style-type: none"> <li>Refer to AS 1674.2 for further guidelines.</li> </ul>										
c.	Contractor documentation is to be reviewed to ensure it is adequate and that all contractors are suitably experienced and competent to undertake the work assigned.	<ul style="list-style-type: none"> <li>Where contractors that may be unfamiliar with company work processes are procured to undertake specific site welding activities, the company is to provide relevant site specific information such as the following during a pre-work meeting or the site induction process:               <ol style="list-style-type: none"> <li>details regarding site specific rules and access restrictions;</li> <li>details about the specific welding task(s) to be performed and any site specific hazards; and</li> <li>the work authority process information and associated supervision under which the contractors are to perform work.</li> </ol> </li> <li>Prior to contractors being procured and confirmed to undertake work on site, information such as the following is to be verified:               <ol style="list-style-type: none"> <li>work experience, training and competency evidence to verify that contractors are capable of performing the work and are conversant with industry hazards;</li> <li>work procedures or safe work method statements that identify key high-risk tasks, hazards (including falls) and controls to be implemented; and</li> <li>details listing the plant and equipment to be brought onto site with respect to Australian Standards</li> <li>compliance, inspection and maintenance details (e.g. inspection records, logs).</li> </ol> </li> </ul>	Prior to contract issue	S	S	S	P	P	P	S	The risk of contractors not being competent to perform their assigned tasks in a safe manner and the risk to others exposed to contractors not competent is reduced or eliminated.	WHS Regulations Regulation 39  Safe Work Australia Code of practice – Welding Processes Sections 2 &4          WHS Regulations Regulation 150  AS 1674.2 Section 5

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		<ul style="list-style-type: none"> <li>Ensure Electrical Contractors testing the Welders on site are competent to conduct the electrical tests required by AS 1674.2</li> <li>Ensuring Welding equipment on hire meets the requirements of AS 1674.2, including testing.</li> <li><b>Refer to AS 1674.2 for further guidelines and the required tests.</b></li> </ul>										
d.	Prior to undertaking welding tasks outside of Cat “A” environments (workshops and designated areas), specific planning and controls, of this standard for category “B” and “C” environments are to be implemented.	<p><b>Category A Environment</b></p> <p><b>General Controls</b></p> <ul style="list-style-type: none"> <li>Electrodes and work pieces are to be considered electrically ‘live’ at all times.</li> <li>During manual metal arc welding and arc-air welding, the welder frequently changes electrodes while the electrode holder is live. Fuses or earth leakage contact breakers do not protect the welder from such a hazard. Therefore, personnel are to take every precaution to ensure they do not simultaneously touch the electrode and the work piece.</li> </ul> <p><i>Note: Voltage reduction devices (VRDs) and remote isolation devices (RIDs) should also be fitted to the arc welding units and used wherever practicable by personnel and contractors to minimise the electrical hazards during arc welding tasks.</i></p> <ul style="list-style-type: none"> <li>Faulty lead insulation and faulty insulation on the electrode holder is also a common way in which an electric shock may occur, therefore personnel are to inspect their equipment to ensure that it is safe to</li> </ul>	Prior to commencing welding activities and during the life of the activity.	P	P	P	P	S	S	S	The risk of receiving a hazardous level of electrical shock or equipment being damaged is reduced or eliminated.	WHS Regulations Regulation 147  AS 1674.2 Clause 2.2  Safe Work Australia Code of practice – Welding Processes Sections 2 & 3

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Imperative Item.	Safety Imperative	Element Guidance	Element Timing	Safety Observer	Welder	Electrical worker	Supervisor	Safety Practitioner	Workplace Manager	General Manager	Expected Outcome	Standard, Regulation Reference
		<p>work with prior to commencing welding tasks.</p> <ul style="list-style-type: none"> <li>Where reasonably practicable, measures are to be taken to ensure that live welding leads are not dragged on the ground during work and that they are protected against damage.</li> <li>The work area and piece(s) being welded are to be made dry and electrically safe as best as possible by using dry, fire-resisting insulation. Wooden duckboards, leather covered cushions, leather aprons and heat resistant blankets can be used to achieve this.</li> <li>Areas where welding activities are to be undertaken are to be made or kept as dry and cool as possible.</li> <li>In hot conditions or where high levels of perspiration may occur, suitable ventilation, regular rest breaks and glove / clothing changes are to be implemented as required and as practicable during the work.</li> </ul> <p><b>Other electrical requirements include, but are not limited to:</b></p> <ul style="list-style-type: none"> <li>equipment is to be connected through a residual current device or safety switch;</li> <li>equipment, welding devices, leads and connections are to be checked and inspected prior to work to ensure that they are safe;</li> <li>Ensure that the terminal on each machine marked "Electrode" is connected to the electrode and not the work piece, and vice versa;</li> <li>Test the voltage between adjacent electrode holders to ensure correct polarity so dangerous voltages do not exist;</li> </ul>										<p>WHS Regulations Regulations 147,149,150 &amp;164</p>



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		<ul style="list-style-type: none"> <li>Do not locate two electrode leads close to one another unless there is no voltage between the holders;</li> <li>Ensure multiple alternating current (a.c.) machines are installed by a competent person and connected in phase</li> </ul> <p><b>Refer to Appendix A for polarity schematic</b></p> <ul style="list-style-type: none"> <li>When not in use, electrode holders are to be placed in a location where they cannot make electrical contact with persons or the work piece / conductive objects;</li> <li>All equipment is to be turned off or disconnected, and manual metal arc welding (MMAW)</li> <li>Electrodes and stubs removed from electrode holders, when not in use;</li> <li>Manufacturer’s instructions regarding electrical precautions for all equipment is to be implemented at all times;</li> <li>Electrical and welding equipment is not to be used in a wet environment.</li> <li>Unauthorised repairs or modifications (other than those by the manufacturer or SCL authorised electrician for electrical work tasks) on electrical and welding equipment is not to be undertaken; and</li> <li>Extension cords and return leads are not to be left across access ways.</li> </ul> <p><b>Category B Environments</b></p> <p>In addition to the controls listed in <b>General Controls</b> for Category A , the following apply:</p> <ul style="list-style-type: none"> <li>Where practicable, attempt to convert a Category B Environment to a Category A Environment;</li> <li>Open circuit voltage is not to exceed 113 V d.c. and 48 V a.c. (hazard-reduction device to be fitted where required);</li> </ul>										

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		<ul style="list-style-type: none"> <li>Safety observer required (or other person capable of necessary emergency / rescue response); OR</li> <li>Where no safety observer – open circuit voltage is not to exceed 35 V d.c. or 25 V a.c. (voltage reduction device typically required);</li> <li>Where the environment is a confined space, the provisions of AS 2865: 2009 – Confined spaces, apply.</li> </ul> <p><b>Category C Environments</b></p> <p>In addition to the controls listed in Category B Environment, the following apply:</p> <ul style="list-style-type: none"> <li>Where practicable, attempt to convert a Category C Environment to a Category B Environment;</li> <li>Environment to be made as cool and dry as possible;</li> <li>Safety observer required (or other person capable of necessary emergency / rescue response);</li> <li>No welding equipment maintenance to be undertaken; and</li> <li>Voltage between the electrode holder and the work piece, while an arc is not present, is not to exceed 35 V d.c. or 25 V a.c.</li> </ul> <ul style="list-style-type: none"> <li><b>Refer to AS 1674.2 for further guidelines</b></li> </ul>										
e.	Welding tasks that are required to be undertaken in, or adjacent to, a hazardous area are to be carried out strictly in accordance with a documented safe system of work for hazardous areas.	<ul style="list-style-type: none"> <li>For confined spaces reference shall be made to AS/NZS 2865:2009 “Confined spaces”</li> <li>Care must be taken when working within the vicinity of intrinsically safe areas (explosive gas atmospheres). Refer to AS/NZS 2381.1 for guidance.</li> <li>Control measures must be put in place to manage risks of personnel falling when conducting welding activities</li> </ul>	Prior to commencing welding activities and during the life of the activity.	P	P	P	P	P	S	S	The risk of receiving a hazardous level of electrical shock or equipment being damaged is reduced or eliminated.	WHS Regulations Regulations 32 - 38, 64 & 78  AS 1674.2 Clauses 2.2 & 2.3  Safe Work Australia Code of practice – Welding Processes

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		<ul style="list-style-type: none"> <li>Refer also to AS/NZS 1674.2 for guidelines</li> </ul>										Sections 2 & 3
f.	Electrodes and work pieces are to be considered electrically 'live' at all times.	<p>Faulty lead insulation and faulty insulation on the electrode holder is also a common way in which electrocution may occur.</p> <ul style="list-style-type: none"> <li>Personnel are to inspect their equipment to ensure that it is safe to work with prior to commencing welding tasks.</li> <li>Personnel are to take every precaution to ensure they do not simultaneously touch the electrode and the work piece.</li> <li>All equipment is to be turned off or disconnected, and manual metal arc welding (MMAW) electrodes and stubs removed from electrode holders, when not in use.</li> <li>Manufacturer's instructions regarding electrical precautions for all equipment are to be implemented at all times.</li> <li>Electrical and welding equipment is not to be used in a wet environment.</li> <li>Unauthorised repairs or modifications (other than those by the manufacturer or authorised electrical worker for electrical work tasks) on electrical and welding equipment are not to be undertaken.</li> <li>Measures are to be taken to ensure that live welding</li> </ul>	Prior to commencing welding activities and during the life of the activity.	P	P	P	P	P	S	S	The risk of receiving a hazardous level of electrical shock or equipment being damaged is reduced or eliminated.	WHS Regulations Regulation 147  AS 1674.2 Clause 2.3  Safe Work Australia Code of practice – Welding Processes Section 3

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		<p>leads are not dragged on the ground during work and that they are protected against damage.</p> <ul style="list-style-type: none"> <li>The work area and piece(s) being welded are to be made dry and electrically safe as best as possible.</li> <li><b>Refer to AS 1674.2 for further guidelines.</b></li> </ul>										
g.	<p>Voltage reduction devices (VRDs) and remote isolation devices (RIDs) should be fitted to the arc welding units and used wherever practicable by personnel and contractors to minimise the electrical hazards during arc welding tasks.</p>	<ul style="list-style-type: none"> <li>Daily or pre-start checks are described in Appendix A. The operator should carry out daily or pre-start inspections, based on observation of indicators, to verify operation of the VRD before commencing work.</li> <li>Routine verifications of the function of the VRD are described in Appendix B. A competent person, equipped with instruments capable of measuring voltage against time, is necessary for these tests.</li> </ul> <p>A voltage-reducing device or system should automatically reduce the no-load or open circuit voltage (OCV), to a no-load voltage of:</p> <ul style="list-style-type: none"> <li>35 V for d.c. and 35 V peak, 25 V rms for a.c. or less when the resistance of the output circuit exceeds 200 Ohms.</li> <li>Response time for switching to reduced voltage shall be 0.3 seconds for a.c. circuits and 0.5 seconds for d.c. circuits.</li> <li>The function of a VRD is to reduce the OCV to a safer, lower level when welding ceases.</li> <li><b>Refer to AS 1674.2 for further guidelines and the required tests.</b></li> </ul>	<p>Prior to commencing welding activities and during the life of the activity.</p>	S	S	S	P	P	P	S	<p>The risk of receiving a hazardous level of electrical shock or equipment being damaged is reduced or eliminated.</p>	<p>WHS Regulations Regulation 147</p> <p>AS 1674.2 Clause 2.3</p>

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h.	If, during any welding activity, a faulty or unsafe item of welding equipment is identified, the piece being worked on becomes unsafe or the environment becomes unsafe, the activity is to cease until the equipment or situation is corrected and it is safe to re-start work.	<ul style="list-style-type: none"> <li>Faulty equipment is to be removed from service and tagged with an appropriate “Out of service” tag.</li> <li>If not discarded, faulty equipment is to be placed in “quarantine” until repairs are performed and where it is electrical equipment, retested and tagged.</li> </ul>	Prior to commencing welding activities and during the life of the activity.	P	P	S	P	S	S	S	Faulty equipment is identified and managed in a manner that assures people and property remain electrically safe.	WHS Regulations Regulation 149  AS 1674.2 Clause 2.3
i.	As a minimum, this standard will be reviewed following implementation, and then annually thereafter.	<ul style="list-style-type: none"> <li>Inspections on the implementation of this standard by welding personnel shall be conducted on a regular basis.</li> <li>Audits on the implementation of this standard by electrical personnel and or contractors shall be conducted on a regular basis.</li> <li>Audit and inspection reports, findings and corrective actions shall be recorded and referenced in the review process.</li> <li>The review process shall be documented.</li> </ul>	Prior to, during and after all welding activities	S	S	S	S	S	P	S	Any systems failures or process breaches are identified and managed in a manner to assure continuous improvement with this standard and work practices.	WHS Regulations Regulations 32 - 38  AS/NZS –ISO 31000  AS/NZS 9001

**Key references applicable to this Safety Guideline are:**

**Safe Work Australia**

Code of practice: Welding Processes

Code of practice: Managing Electrical Risks in the Workplace

Code of practice: Work health and safety consultation, Co-operation and Co-ordination

**Australian Standards**

AS 1674.2 Safety in welding and allied processes – Electrical

AS 60974.1 Arc welding equipment – Welding power sources (Section 11 and 13 for hazard reducing devices)

**Industry Guidelines**

Welding Electrical Safety – WTIA Technical Note 22 published by the Welding Technology Institute of Australia

<b>Table 1 - Legislative Summary</b>	
<b>Jurisdiction</b>	<b>Legislation</b>
Commonwealth	Work Health and Safety Act, 2011 Work Health and Safety Regulations, 2011
Australian Capital Territory	Work Health and Safety Act, 2011 Work Health and Safety Regulations, 2011
New South Wales	Work Health and Safety Act, 2011 Work Health and Safety Regulations, 2011
Northern Territory	Work Health and Safety (National Uniform Legislation) Act, 2011 Work Health and Safety (National Uniform Legislation) Regulations, 2011
Queensland	Work Health and Safety Act, 2011 Work Health and Safety Regulations, 2011 Electricity Safety Regulations, 2013
South Australia	Work Health and Safety Act, 2012 Work Health and Safety Regulations, 2012
Tasmania	Work Health and Safety Act, 2012 Work Health and Safety Regulations, 2012
Victoria	Occupational Health and Safety Act 2004 Occupational Health and Safety Regulation, 2007 <b>Note:</b> WHS Act and Regulations not yet introduced in this jurisdiction.
Western Australia	Occupational Health and Safety Act 1984 Occupational Health and Safety Regulation, 1996 <b>Note:</b> WHS Act and Regulations not yet introduced in this jurisdiction.

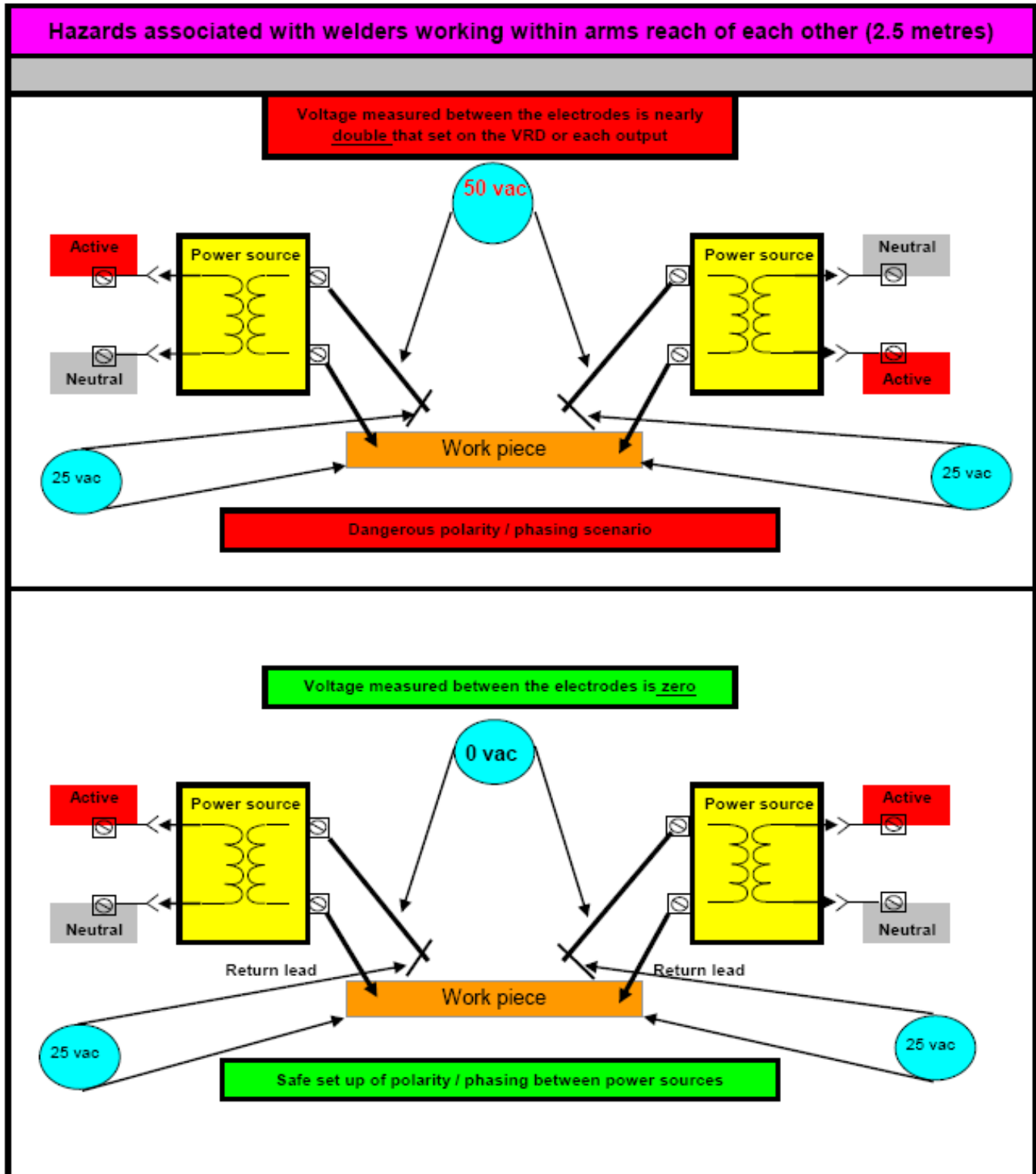
**Table 2: Regulatory Guide – Particular requirements that may be relevant to welding electrical safety. Note: This is not a complete list of all regulations that may be applicable for the work. Reference must be made to the relevant Work Health and Safety Regulation or jurisdictional equivalent OHS Regulation for a complete list of regulatory requirements.**

<b>Work Health and Safety Regulation</b>	<b>Subject area</b>
Regulation 32	Application of Part 3.1
Regulation 33	Specific requirements must be complied with
Regulation 34	Duty to identify hazards
Regulation 35	Managing risks to health and safety
Regulation 36	Hierarchy of control measures
Regulation 37	Maintenance of control measures
Regulation 38	Review of control measures
Regulation 39	Provision of information, training and instruction
Regulation 44	Provision and use of personal protective equipment
Regulation 64	Confined space – Duty to eliminate or minimise risk
Regulation 78	Management of risk of fall
Regulation 147	Electrical safety – Risk management
Regulation 149	Unsafe electrical equipment
Regulation 150	Inspection and testing of electrical equipment
Regulation 164	Residual current devices – Use of socket outlets in hostile operating environments

**Appendix A – Polarity hazard.**

A simplified electrical polarity schematic of welding sources working in close proximity.

The risk associated with the situation illustrated below is that unless the polarity of welding sources are matched, hazardous voltages may be present between electrodes.





## Appendix B - Welding Process Flow Chart

**Note:** The term 'risk treatments' is the same as the more common term 'risk controls'.

