

Procedure

Welding in a Confined Space

Key Control Data Sheet

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Scope of Application: Ok Tedi Mining Limited

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Why is the Control Important — The hazards of welding are intensified when carried out in confined spaces. The risk of electric shock is increased as the metal of the enclosure can become “live” and part of the welding circuit. The risk of electric shock can be exacerbated by moisture and high humidity when working. There is also a danger flammable gas and vapour may collect in a confined space, and these may ignite due to heat, flames and sparks when welding or cutting takes place leading to an explosion. Gas, fume or vapour can arise from welding which can quickly lead to the generation of a toxic atmosphere during the welding activity. In order to prevent injury to personnel from electrocution, welders must be insulated from the metal enclosure with shut down mechanisms such as low voltage safety switches and residual current devices fitted on electrical welding equipment. In order to prevent injury to personnel from hazardous atmospheres arising during welding the space must be continually ventilated and the atmosphere monitored.

Exemption — No exemptions permitted.

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Operational Requirements**1. Performance Metrics**

Gas cylinders and electric welding power sources are located outside the confined space and all cables entering the area are properly insulated and all gas hoses are leak free.	Flashback arrestors are fitted at the blow pipe and to the oxygen and fuel gas regulators. For long lengths of hose, arresters are fitted on both the torch and the regulator.
Welding torches are lit outside the confined space.	When not in use, all torches and other gas or oxygen supplied equipment are shut off and removed from the space. Fuel gas and oxygen supply are shut-off outside the space when the welder leaves the workplace for any reason.
Low voltage welding machine used. Voltage limiting safety devices are fitted to any electric welding machine. Such a device automatically limits the voltage to less than 25 volts and only applies the full Open Circuit Voltage (OCV) when the electrode is struck.	Welders using electric welding are insulated from the workpiece and grounded by dry insulation. Where practicable they stand, lay or sit on non-conducting material while carrying out welding.
Confined spaces are tested for an explosive atmosphere each time before taking a lighted torch into the space or commencing welding task.	The atmospheres in confined spaces is continuously monitored with a gas meter during welding to ensure fumes and gases do not exceed safe exposure limits or 10% of lower explosive limit.
Confined spaces are continuously ventilated during welding to ensure fumes and gases do not exceed safe exposure limits work and to prevent accumulation of flammable vapours in the work area. A ventilation fan is set up to remove air from the confined space with a suction point located close to, and above the welding to remove fumes.	All welding/cutting hoses and electrical leads are suspended above the ground of the confined space to prevent damage from falling objects.
Internal combustion engines are not operating in the vicinity of a confined space.	

2. Utilisation

Continuous during the confined space welding or cutting activity including use of gas flames, electric arcs, and electric resistance.

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3. Safety Critical Defeat Requirements

No defeats allowed.

4. Testing & Verification

At least once per confined space welding activity:

- Verify the sentry is in place, in contact with personnel inside space and has the ability to raise the alarm in case of emergency.
- Verify the space is continuously ventilated with the fan set up to remove air from confined space with the suction point located close to, and above the welding to remove fumes.
- Verify the atmosphere in the space is continuously monitored during welding activity.

Welders inspect electric welding machine power source leads and accessories daily, and report defects.

Welders check gas welding equipment cylinder fittings, hoses and connections are not damaged or in poor condition prior to use and report defects.

5. Maintenance

Check cylinder fittings, hoses and connections are not damaged or in poor condition. Check all gas welding equipment connections and equipment for faults and leaks.

Inspect electrical welding equipment and repair or replace all damaged parts before further use. An electrical technician should inspect and test the welding power source at least quarterly, and the welding leads/accessories monthly. All repairs to equipment are to be carried out by a qualified electrical technician.

Testing must ensure that the output welding circuit is electrically insulated from the frame of the power source and from any input or auxiliary output power circuits. At least 1 megohm insulation must be maintained.

Testing must ensure that the electrical resistance between the earth terminal of the power source and 'earthed' metallic parts does not exceed 0.1 ohms (AS1966).

Low voltage transformers and earth leakage protection units are maintained as per manufacturer recommendations and tested prior to use.

6. Training & Competency

Welders - trained in the operation and use of the equipment including:

- Work methods
- Hazards
- Control measures
- Use of PPE
- First aid and emergency plans.

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Task Requirements

The following are the key day to day requirements operators/maintainers and supervisors must follow to ensure the control is being used correctly.

1. Task Requirements

No.	Supervisor	Operator/Maintainer
1	Check work areas are well ventilated to prevent accumulation of flammable vapours in the space.	Ventilate work areas to prevent accumulation of flammable vapours in the space.
2		Check electrical welding equipment including power switches, terminals, connections, cables and insulation are not damaged or in poor condition prior to use. Don't use welding equipment with damaged insulation on the welding cables, plugs, clamps or torch/electrode holder.
3		Check gas welding equipment cylinder fittings, hoses and connections are not damaged or in poor condition prior to use.
4		Ensure flashback arrestors are fitted at the blow pipe and to the oxygen and fuel gas regulators. For long lengths of hose, fit arresters on both the torch and the regulator.
5		Drain and purge equipment, such as gas hoses, and shut the gas off at the cylinder valve immediately after use.
6		Use non-conducting material while carrying out electric welding to insulate from the metal of the enclosure that may become part of the welding circuit. Ensuring no direct contact with wet or conductive surfaces. Avoid physical contact with surrounding metalwork whilst welding. Use a wooden pallet or rubber floor mat that is large enough to offer protection if required to kneel or lie down to complete the task.
7		Continuously monitor the confined space atmosphere with a gas meter during welding to ensure fumes and gases do

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		not exceed safe exposure limits or 10% of lower explosive limit.
8		Continuously ventilate during welding to ensure fumes and gases do not exceed safe exposure limits or 10% of lower explosive limit. If welding ventilation fan is set up to remove air from confined space the suction point must be located close to and above welding to remove fumes. Exhaust must be directed away from personnel and where it cannot be recirculated into the space.
9		Light welding torches outside the confined space.
10		Test the confined space for an explosive atmosphere each time before taking a lighted torch into the confined space or striking an arc.
11		Keep firefighting equipment near welding area.
12		Sentry has available and wears arc-flash eye protection when arc-flash is visible from their location.

2. Skills Requirements

Welding on pressure vessels and structural steel fabrications requires a high level of skill and competence. Welders must hold appropriate industry qualifications and have appropriate experience.

3. Permits

Confined Space Entry Permit.

Hot work permit for welding activity.

4. Task Specific PPE Requirements

Welding mask or helmet with grade of visor designed for type of welding, or welding goggles, leather gloves, cotton clothing, rubber soled safety shoes or rubber boots.

Arc-flash eye protection for the sentry

For added protection from foreign objects and radiation, goggles or safety glasses with side shields must be worn under welding masks.

When chipping welding slag wear protective goggles under an impact resistant face shield (as per grinding) to protect the eyes from hard particles which may be hot.

Where it is not possible to ensure good ventilation use a respirator.

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Particulate respirators applicable where thermal particulates/ fume is generated. Use a Class P2 filter or higher.

Gas and vapour respirators applicable where there may be exposure to ozone, nitrogen oxides, organic vapours and decomposition products from surface treatments.

Air supplied respirator (where required by regulations).

5. Special Task Related Tooling

Ventilation fans and ducting. Ducts are used to provide local exhaust ventilation for welding and must be constructed of non-combustible materials.

Insulating or non-conductive timber or rubber material for welder to stand, sit or lie on.

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Design Requirements

1. Design Standard

Welding equipment and its use in confined spaces conforms to the appropriate international standards:

- OSHA 29 CFR 1910 Subpart Q, Welding, cutting, and brazing
- 1910.251, Definitions
- 1910.252, General requirements
- 1910.253, Oxygen-fuel gas welding and cutting
- 1910.254, Arc welding and cutting
- 1910.255, Resistance welding
- NFPA 51: Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes
- ANSI Z49.1:2012 An American National Standard Safety in Welding, Cutting, and Allied Processes (American Welding Society)
- ISO 14731 - Welding coordination — Tasks and responsibilities
- ISO 10882 - Health and safety in welding and allied processes — Sampling of airborne particles and gases in the operator's breathing zone
- Standards under ISO catalogue 25.160.30: Welding equipment.

2. Safety Parameters

Use local exhaust ventilation to capture welding fumes. To be effective the ventilation must:

- have the extraction point close to the welding arc or flame;
- have sufficient velocity to draw away the contaminants (a capture velocity of 0.5 m/sec at the fume source is recommended as a minimum);
- not be drawing fumes into or past the welders breathing zone

OSHA 29 CFR 1910.252 requires:

- provide at least 2000 cfm of airflow for each active welder; or
- provide each welder with a local exhaust device
- local exhaust devices must be capable of maintaining a velocity of 100 fpm toward the air intake

For electric welding a Direct Current (DC) welding machine, is preferred to an alternating current supply (AC is 2 to 3 times more dangerous than DC, because AC causes muscles to grip tightly). For confined spaces use the following equipment in priority (preferred) order:

1. a semiautomatic DC constant voltage (wire) welder;
2. a DC manual (stick) welder; or
3. an AC welder with reduced open-circuit voltage.

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3. Design Life

Not applicable.

4. Safe Separation

Not applicable.

5. Special Requirements

For electric welding, keep the work area, insulation and clothing dry. In hot conditions, the risk of electrocution is increased because of clothing and equipment being soaked in perspiration. The risk is far worse in closed environments, such as tanks or vessels, particularly when these are exposed to the sun's heat. Take frequent rest periods, during which time dry off equipment and clothing. Frequently change or alternate gloves and protective clothing to avoid perspiration accumulating. If clothing becomes saturated with perspiration, it must be changed.