

WELDING

LEARNING OUTCOME

Describe the requirements of the Work Health and Safety legislation and the control strategies needed to minimise or manage the hazards associated with the processes relating to welding.

ASSESSMENT CRITERIA

- Describe the statutory and minimum requirements relating to welding processes.
- List the hazards that are associated with the processes of welding.
- Describe the control measures that are available to minimise or remove the risk associated with these hazards.

REFERENCES

- Welding processes Code of Practice 2013 (WHSQ);
- AS1674 – Safety in Welding and Allied Processes – Part 1 – Fire Precautions
- AS1674 – Safety in Welding and Allied Processes – Part 2 – Electrical
- Welding Technology Institute of Australia (WTIA);
 - WTIA TN 07 Health and Safety in Welding (2013)
 - WTIA TN 22 Welding Electrical Safety (2003)
- Welding Processes Code of Practice 2012 (SafeWork Australia)

ATTACHMENTS

[Welding processes Code of Practice 2013](#)

WELDING

Welding is the process of permanently joining two or more materials together, usually metals, by heat or pressure or both. When heated, the material reaches molten state and may be joined together with or without additional filler materials being added.

Welding techniques number over 80 different processes. Shielded Metal Arc Welding being by far the most common, followed by Gas Metal Arc, Gas Tungsten Arc and Oxy - fuel welding. More than half of all welding jobs are performed using Shielded Metal Arc Welding.

Welding hazards include electric shock, burns, fire and explosions, radiation, heat, fumes & gases, noise and numerous other physical hazards. Exposure to any of all of these can be minimised by using an effective combination of control measures.

GAS WELDING SAFETY

Most construction workplaces have some type of equipment for welding and cutting metals. Acetylene is the most commonly used fuel gas. Acetylene is very flammable and hazardous and can ignite at a wide range of concentrations. Oxygen won't burn or explode, but it helps other objects burn at greater rates. Gases are stored in cylinders which can rupture. A cylinder containing compressed gas can shoot through the air like a rocket if its valve is damaged or broken.

Storage and Handling

- Keep cylinders away from physical damage, heat, and tampering;
- Securely chain equipment to prevent falling;
- Store away from flammable and combustible materials;
- Store extra gas and oxygen cylinders separately;
- Store in an upright position;
- Close cylinder valves before moving;
- Protective caps or regulators should be kept in place;
- Roll cylinders on bottom edges to move -- Do not drag;
- Allow very little movement when transporting;

General Gas Welding Safety Tips

- Inspect equipment for leaks at all connections using approved leak-test solution;
- Inspect hoses for leaks and worn places;
- Replace bad hoses;
- Protect hoses and cylinders from sparks, flames and hot metal;
- Use a flint lighter to ignite the flame;
- Stand to the side (away from the regulators) when opening cylinder valves;
- Open cylinder valves very slowly to keep sudden high pressures from exploding the regulators;

- Only open the acetylene cylinder valve 1/4 - 3/4 turn; leave wrench in place so the cylinder can be quickly closed in an emergency;
- Open and light acetylene first, then open and adjust oxygen to a neutral flame;
- Close the acetylene torch valve first when shutting off the torch (a "pop" might occur as the oxygen "blows out" the flame, but this eliminates the possibility of the flame burning up the acetylene line);
- When finished, close cylinder valves, bleed the lines to take pressure off regulators, neatly coil hoses and replace equipment;
- Have a fire extinguisher easily accessible at the welding site.

Personal Protective Equipment:

- Infrared radiation is a cause of retinal burning and cataracts. Protect your eyes with safety glasses.
- Protect your body from welding spatter and arc flash with protective clothing. Such as:
 - Woolen clothing
 - Flame-proof apron
 - Gloves
 - Properly fitted clothing that is not frayed or worn.
 - Shirts should have long sleeves.
 - Trousers should be straight-legged and covering shoes when arc welding.
 - Fire resistant cape or shoulder covers are needed for overhead work.
- Check protective clothing equipment before each use to make sure it is in good condition.
- Keep clothes free of grease and oil.

Proper Ventilation

Be sure there is adequate ventilation available when welding in confined areas or where there are barriers to air movement. Natural drafts, fans and positioning of the head can help keep fumes away from the welder's face.

Ventilation is Sufficient if:

- Cross ventilation is not blocked by partitions, equipment, or other structural barriers.
- Welding is not done in a confined space.
- Gas leakage is one of the greatest risks involved with gas welding. Leaking fuel gas is usually recognised by odour. Oxygen leaks are potentially more dangerous as they are usually not recognised easily.
- Leaking oxygen leads to an oxygen enriched atmosphere where normal events such as naked flames, cigarettes, sparks and electrical faults become more dangerous situations. Oils and greases may spontaneously ignite in the presence of pure oxygen.
- Under no circumstances should any fittings of oxy-acetylene equipment be allowed to be contaminated with grease or oil.

- Regulators can fail in two ways - by the controlled forward flow of gas which is known as regulator creep or by the reverse flow of another gas in the gas lines. Regular maintenance should avoid these situations.
- Either of these failures can be recognised by a higher than expected reading on the operational or low pressure gauge. The gauge needle creeps beyond the pressure set for actual welding or cutting.
- Excess pressure or the presence of a different gas in a regulator can cause fire and explosion in varying degrees of severity, resulting in damaged equipment and operator injury.
- Operators should never use equipment fitted with a regulator in which a creep condition is known to exist.
- Use the correct colour and type of hoses and fittings recommended by the manufacturers. Copper must never be used on acetylene lines as substances which may spontaneously detonate are formed.
- Flashback arresters should be fitted to all oxy-acetylene equipment to overcome the danger of flashback.
- Oxy-acetylene equipment should not be left near hot equipment or metals which could burn the leads. Gas leaks can be tested by using soap and water.
- Proper attention to maintenance of equipment is necessary to prevent accidents.
- Don't smoke when welding or near welding and don't keep your lighter in your pocket - it could explode. Simple prevention may save your life.

WELDING - ELECTRICAL SAFETY

Each year welders die from electric shock. Below are some safety notes on electric shock hazards and general welding safety:

- Servicing and installation must only be undertaken by a qualified licensed electrician. Never tamper with electrical supply circuits or systems. The welder is only responsible for making connections in the welding circuit and for setting external welding machine controls.
- Equipment should be well maintained and checked regularly, particularly the insulation and connections on work return leads and holders.
- Wherever possible work should be performed on a dry insulated floor. Wooden platforms, rubber mats, or dry areas provide extra protection especially in confined spaces.
- Electrodes or welding wire should never be touched with bare hands when in the holder or welding gun. Holders or welding guns should never be held under the armpits. Remember, hot work increases risk due to the reduced skin resistance when sweating occurs.
- Always use Australian Standards - approved welding helmets and lenses.
- Where practicable consideration should be given to the use of Welding Voltage Reducers that maintain an output no greater than 12v until the arc is struck.

Further information is available in AS1674.2 Safety in welding and allied processes Part 2; and WTIA TN-07 – Health and Safety in Welding (2013) from the Welding Technology Institute of Australia.

BURNS, FIRE AND EXPLOSION

Flame cutting and welding operations are a major cause of industrial fires. The precautions necessary to avoid such incidents depend largely upon the processes being used and the location of the work, and include the following:

- Prevent burn hazards with proper Personal Protective Equipment that includes gloves, overalls, safety footwear, aprons and head covering. Remember sparks and molten metal can fly and work - pieces can be hot even though the glow has gone.
- Protect eyes with helmet and grade of visor designed for the type of welding.
- Prevent fire with welding blanket, by removing or covering flammable materials, and maintaining a proper distance from flammable substances.
- Prevent explosion by checking before welding or cutting that tanks and drums are free of substances that are flammable or give off flammable substances.
- Use appropriate flash arresters and non - return valves on gas cutting and welding equipment.
- Ensure threads and fittings to Oxygen supplies are clean and oil free.
- Store Oxygen and fuel gasses separately.
- Ensure gas equipment is well maintained and leak free.
- Protect gas supply lines from hot metal and abrasion.
- Ensure appropriate fire fighting equipment is maintained and readily available.

DANGER



A “Hot Work Permit” which addresses these issues is a good control.

FUMES AND GASES

During the welding process certain health and safety hazards may be present in the form of metal fumes and gases.

Evidence suggests that welding is not a particularly hazardous occupation provided the welder is appropriately protected. General ventilation, local point exhaust and personal respiratory protection all serve to remove or reduce risk to the worker.

- Aluminium appears to pose less of a hazard than many other metals, but inhalation of fumes should be avoided.
- Cadmium occurs in some alloys. It may also be part of the coating of the welding electrode, or in other protective coatings. Cadmium can cause serious pulmonary oedema (fluid in the lungs). Chronic effects are emphysema and kidney damage. Potential exposure to cadmium fumes warrants stringent preventative measures.

- Chromium is used as an alloying agent in stainless steel. Prolonged excessive exposure to chromium may result in skin irritation and a greater risk of lung cancer. Welders may also become sensitised to chromium, and develop skin eczema when exposed to small amounts.
- Copper is found in many alloys, such as brass and bronze, as well as in welding electrodes. Copper can cause respiratory irritation, nausea and metal fume fever.
- Fluorides are present in some electrodes and in flux. Long - term exposure to very high concentrations may cause bone changes and joint deterioration. Milder excessive exposure may have chronic effects such as pulmonary oedema and skin rashes.
- Iron is a very common constituent of welding fumes. Acute effects include respiratory irritation. Iron is also capable of causing siderosis, a benign accumulation of iron oxide in the lungs.
- Manganese is used in most stainless steel carbon alloys and welding electrodes. Welders are unlikely to be exposed to hazardous concentrations if adequate ventilation is provided.
- Lead is found in solder, brass, bronze and is also used as a metal primer and steel coating. Exposures must be controlled to prevent lead poisoning.
- Molybdenum can cause respiratory irritation and impaired breathing, but welders are unlikely to be exposed to excessive amounts.
- Nickel is found in many alloys and stainless steel. Eye and throat irritation are acute effects. Scientists are currently disagreeing on whether nickel compounds are capable of causing or promoting cancer in welders.
- Tin is present in some bronze alloys and solders. The fumes are known to cause stenosis, a benign pneumoconiosis, but it is improbable that soldering work could place the worker at risk.
- Titanium is found in stainless steel, alloys, flux and coatings, but it is not known to have any ill effects on welders.
- Vanadium is present in certain alloys and welding electrode coatings. Acute symptoms are eye and respiratory irritation. Chronic conditions may comprise bronchitis, rhinitis, pulmonary oedema and pneumonia.
- Zinc: welding galvanised or zinc plated metals can result in the inhalation of zinc oxide fume and cause metal fume fever.
- Ozone is formed when air is exposed to ultraviolet radiation, as happens in the welding arc. Ozone may be very detrimental to health, causing pulmonary congestion, oedema, and haemorrhage. Minute concentrations of about 0.1 ppm - even for short periods - dry out the eyes and cause headaches. Prolonged exposure may result in severe changes in lung function.
- Oxides of nitrogen (NO₂, N₂O₄, NO) can cause eye, nose and lung irritation at 20 - 25ppm. At higher concentrations, pulmonary oedema and other serious lung conditions can result.
- Carbon monoxide is colourless and odourless. The gas is an asphyxiant, causing headache, dizziness and confusion.

Decomposition products may also be hazardous to health. Solvents used to clean and degrease metal before welding may release toxic gases or fumes when welding starts. These gases include:

- Phosgene
- Phosphine
- Hydrogen chloride
- Chloroacetic acids
- Acrolein
- Formaldehyde
- Acetaldehyde
- Teflon welding (thermoplastic welding) may also include several dangerous gases, such as carbonyl fluoride, hydrogen fluoride and perfluorobutylene.

Of these substances, phosgene may warrant special mention. Phosgene is formed through the decomposition of chlorinated hydrocarbons (trichlorethylene, perchlorethylene) which are quite common degreasing agents in places where welding is carried out. Metal inert gas (MIG) welding electrodes are particularly prone to the creation of high concentrations of phosgene. Normal welding is unlikely to cause excessive amounts, but care should be taken to keep these substances well away from all welding work.

Smoking and Welding

Welders who smoke are more likely to be severely affected by welding fumes.

CONTROL MEASURES

The most effective way to reduce exposures is to eliminate the offending substance or process. This is not practical, however, in most instances. Ventilation is the most common way of controlling exposure to fumes, gases and heat in welding operations. There are two types of ventilation - dilution ventilation or local exhaust ventilation.

General or Dilution Ventilation

This type of ventilation relies on diluting airborne contaminants with fresh air from open doors, windows or fans. General ventilation is limited in its usefulness for controlling welding hazards.

Heat and humidity can usually be controlled with general ventilation. It is difficult for this type of ventilation to provide enough air movement to keep the fumes and gases out of the welder's breathing zone.

Local Exhaust Ventilation

Local exhaust ventilation is much more effective in controlling welding fumes and gases because it captures the fumes and gases close to the source and keeps them from entering the welder's breathing zone.

To be effective, local exhaust ventilation must:

- Be close to the welding arc or flame where the fumes, gases and heat are generated, and
- Have enough velocity to draw away the contaminants.

- Ensure protection from fume and gases by (depending on circumstances) one or a combination of:
 - good general ventilation
 - use of a booth
 - local exhaust ventilation on the handpiece
 - air supply to the helmet, and
 - suitable respirator which fits inside the helmet.

PHYSICAL HAZARDS

Safe work practices should exist for all welding activities including handling and storage of compressed gas cylinders and oxy - acetylene or electric arc welding equipment.

Injuries can be prevented by following established procedures and practices:

- Always use proper supports.
- Ensure that you are comfortable.
- Always wear suitable eye protection which protect the eyes from radiation. For added protection from foreign objects and radiation, goggles or safety glasses with side shields should be worn even when other eye or face protection is worn.
- DON'T weld near cleaning tanks containing chlorinated solvents - the heat breaks down the vapours into very toxic gases.
- Laser cutting requires protection from accidental eye contact with the beam or beam reflections.
- Properly mount cylinders.
- Use correct cylinder regulators.
- Ensure adequate lighting.
- Ensure proper earthing of arc - welding equipment.
- Wear appropriate eye protection during slag removal (chipping).
- Avoid radiation exposure from weld check equipment.
- Use welding screens to prevent welding flash from affecting others.

Note:

Not all hazards of all types of welding, cutting and brazing and the precautions are given here. For additional information refer to the [Welding Hazards Code of Practice 2016](#).

Version	Date	Author
1	30/06/2018	WHSQ