Hot works

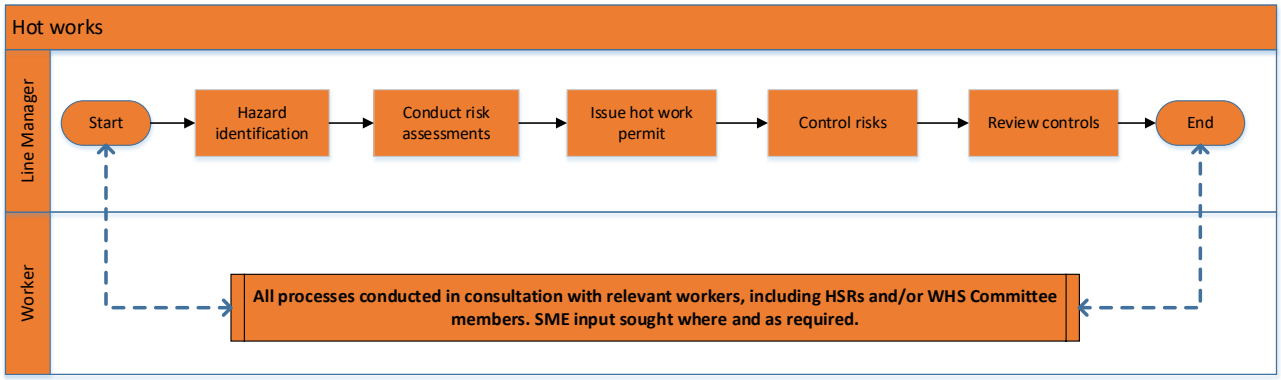
Purpose

This procedure describes the process for managing risks resulting from *hot works* related activities and outlines minimum requirements and methods for the identification, classification and control of work involving hot works in accordance with the *NSW Code of Practice – Welding processes*.

Working with ignition sources near flammable materials is referred to as "hot work." Welding, soldering and cutting are examples of hot work. Fires are often the result of the "quick five minute" job in areas not intended for welding or cutting. Getting a hot work permit before performing hot work is just one of the steps involved in a hot work management program. Getting a permit helps to reduce the risk of starting a fire by hot work in areas where there are flammable or combustible materials.

Scope

All Sydney Trains workers (including contractors) are required to comply with this procedure where their work involves any type of hot works. Specifically, this procedure is relevant to workers responsible for planning, overseeing or managing work that may involve workers and contractors performing work activities relating to hot works. These roles typically include **Line Managers, Project Managers** and/or **Construction Managers**.



Process description

1. Hazard identification

The risk management process commences with hazard identification, as hazards cannot be assessed or controlled if they have not been identified in the first instance. Hazard identification is an ongoing process and **workers/Line Manager(s) or person (s) responsible to conduct risk management activities** shall manage this process through the processes defined in the SMS-06-OP-3026 WHS Risk Management Procedure.

Welding and allied processes can have similar hazards. For example, both welding and allied processes produce ultra violet and infra-red radiation which can cause burns, cancer and blindness. The *specific hazards and control measures* section in the *Control* Risks section on page 4 of this procedure provides prompts and information to support the identification of hazards.

Some key elements that assist with the identification of potential hazards include:

- conducting a walk through assessment of the workplace;
- observing the work and talking to workers about how work is carried out;
- inspecting the materials and equipment that will be used during the welding process;
- reading product labels, SDS and manufacturer's instruction manuals;
- talking to manufacturers, suppliers, industry associations and health and safety specialists; and
- reviewing incident reports.

What is welding? Welding is the process of permanently joining two or more materials together 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. Thermoplastics, for example can be welded together using a suitable heat source to form permanent joins.
Many different energy sources can be used for welding including gas flames, electric arcs, electric resistance, lasers, electron beams, friction, molten metal baths and ultrasound. Welding includes joining methods as diverse as fusion welding, forge welding, friction welding, braze welding, brazing, soldering and explosion welding. Welding is a potentially hazardous activity and precautions are required to avoid electrocution, fire and explosion, burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radiation (Source: NSW *Code of Practice – Welding processes*).

The identification of reasonably foreseeable hazards that could give rise to health and safety risks shall be conducted by a team of knowledgeable and competent personnel, including those who have demonstrable knowledge, experience

and skills in facilitating risk assessments and personnel who have subject matter expertise in the hot-work related activity such as welding, cutting or soldering.

2. Conduct risk assessments

In managing the risks associated with hot works, the **Line Manager**, in consultation with relevant stakeholders who will be involved with working in or managing the works involving hot works, must ensure that a risk assessment is conducted. The risk assessment will assist with:

- identifying workers at risk of exposure;
- determining the sources and processes that cause that risk;
- identify if and what kind of control measures should be implemented; and
- checking the effectiveness of existing control measures.

Risks will depend on various factors, including the:

- properties of the materials subject to hot works activity e.g. grinding rail noses;
- surface coating of the items being welded, ground, soldered or cut (for example whether they contain lead or other toxic materials);
- condition of the equipment used for hot works;
- conditions under which the hot works is carried out (for example, confined spaces); and/or
- skills, competence and experience of the person conducting the hot works activity.

Different hot works processes also influence the risk. For example, the risk of electric shock is lower using *gas metal arc welding* (GMAW) than manual metal arc welding based on the fact that the open circuit voltages are lower, only direct current is used and the power is switched off at the hand piece.

The **Line Manager(s) and/or person (s) responsible to conduct risk management activities** shall ensure that *all* the relevant information in the SMS- 06-FM-4107 WHS Risk Assessment Form is filled out[1].

Under the WHS Regulations a risk assessment is not mandatory for welding however, it is required for specific situations, for example when working in a confined space.

The risk assessment relating to hot works must be undertaken by a competent person and be recorded in writing and must be reviewed and revised by a competent person whenever any risks change. A copy of the risk assessment must be available to any relevant worker on request.

3. Issue hot work permit

There may be a need to develop specific procedures for welding in a hazardous atmosphere or hazardous area. For example, the *WHS Regulations* requires a 'confined spaces entry permit' for work in a confined space. When welding in an area that is not a confined space, specific procedures should still be documented, which should include the issue of a *hot work permit*.

A hot work permit is a written authority issued by an authorised worker (not the worker performing the work). For locations at underground stations or in an underground network hot work permits are issued by a Sydney Trains Rail Emergency Response Team (RERT) Officer. For all other areas (excluding designated hot work areas such as welding bays) hot work permits are issued by a competent worker for their area of responsibility.

Further guidance relating to 'hot work' or 'hot work permit' is provided through *AS 1674.1: Safety in welding and allied processes - Fire precautions*.

Hot work permits are required when conducting hot work in all areas except for designated hot work areas (such as welding bays). There are specific requirements for the issuing of hot work permits depending on where the hot work is to be performed.

The **Line Manager and/or authorised delegate** will ensure that a hot work permit is issued in the following circumstances:

- hot work performed in confined spaces;
- hot work performed in areas where there is a potential for flammable atmospheres;
- open flame used in enclosed spaces (except in designated hot work areas such as welding bays);
- hot work performed in underground stations;
- hot work performed in underground networks; and
- hot work performed in other areas.

[1] A risk assessment for each welding job e.g. aluminothermic welding is not required as the relevant Safe Work Method Statement (SWMS) would suffice. However, a risk assessment should be carried out as a result of an incident or assurance activities that demonstrate that the process and associated controls are ineffective or inadequate.

In relation to underground stations and networks: unless the work is required for urgent repair to essential operational equipment, issuers will not authorise hot work during peak operating times (.e. Monday to Friday: 0600 – 0930 and 1400-2000). Restrictions may also apply during special events.

Underground networks and stations include:

- Airport Line, Central and Sydney Terminal City Circle, Eastern Suburbs Line, Chatswood, Hurstville, Kogarah , Olympic Park Line, North Sydney, Redfern (Platforms 11 and 12), and St Leonards.
- Hot Work at Epping will be managed by Sydney Metro and Sydney Trains.

Prior to hot work commencing, **Line Managers** must determine the location of the hot work i.e. whether it is at an underground station, an underground network (excluding stations) and/or any other area (excluding designated hot work areas). Once the location has been established, the following processes must be adhered to:

Hot work performed at an underground station or in an underground network:

- Complete the SMS-06-FM-4899 Hot Work Permit/Fire Isolation Systems Request form and submit it to the *Rail Emergency Response Unit* (RERU) for authorisation, **at least 24 hours before the work is to be carried out**; and
- Do not allow hot work to be carried out without authorisation from an RERU officer.

Hot work performed at all other locations (excluding designated hot work areas):

- Authorise a competent worker to issue the hot work permit;
- The Issuing Officer must:
  - generate a local permit issue number;
  - complete SMS-06-FM-4382 Hot Work Permit and specify the required controls;
- The following need to be checked prior to issuing the permit:
  - flammable atmosphere, gases and dusts;
  - flammable and combustible materials;
  - access and egress locations;
  - adequate ventilation; and
  - suitable fire-fighting equipment, making sure it is available and tested prior to hot work being undertaken.
- Once satisfied that the specified controls have been implemented, approve, sign and issue the permit to the supervisor of the work;
- Arrange for a firewatcher to be in attendance where a hot work permit has been issued;

- Firewatchers are to continuously monitor the area during hot work and for 30 minutes after the completion of work.
- The correct fire-fighting equipment needs to be at the site for the duration of the hot work.
- The permits are retained for a minimum of 3 months after last action and then destroyed.

Conducting hot work during total fire ban periods.

Workers must not carry out burning off, hot work or use naked flames of any type in open areas during a Total Fire ban, other than where specifically exempted in the Sydney Trains' *MN C 10501 Bush Fire Hazard Management* document.

Hot work may be carried out in areas at underground stations and underground networks during Total Fire Ban periods. In these situations, the **Line Manager** must undertake the following:

1. Contact the Local Fire Control Officer and advise of the location and nature of the hot work.
2. Complete a *Total Fire Ban – Hot Work Authority* Form that is accessible through *MN C 10501 Bush Fire Hazard Management* document.
3. Forward the competed *Total Fire Ban – Hot Work Authority* Form to the nominated Authorised Officer.
4. Once the *Total Fire Ban – Hot Work Authority* has been issued, ensure all the controls stipulated in the Authority have been met before work commences.

The relevant *Engineering Instruction* for *Bushfire Danger Period and Total Fire Ban* set out the relevant requirements and should be referred to for the most up-to-date information relating to Total Fire Ban periods.

4. Control risks

The **Line Manager** and/or an authorised delegate shall, in consultation with the relevant stakeholders, develop and implement appropriate control measures. WHS Regulation requires duty holders to work through control measures from the highest level of protection and reliability to the lowest. Refer to the table on the following page and SMS-06-OP-3026 WHS Risk Management Procedure for further detail on the *hierarchy of control.*

Risks associated with hot works must be eliminated *so far as is reasonably practicable*, and therefore the type of question that should be asked is: ***can fabrications may be designed to include many pre-cast components or extruded shapes to eliminate the need to weld?***

Type of control	How it controls risk
1. Substitution	Minimise the risk by substituting or replacing a hazard or hazardous work practice with something that gives rise to a lesser risk. For example, using submerged arc welding instead of flux-cored wire welding will reduce the risk of exposure to radiation and fumes. In welding, such types of substitution are not always practical or technically suitable.
2. Isolation	Minimise the risk by isolating or separating the hazard or hazardous work practice from any person exposed to it, for example removing the welder and nearby workers from the hazard or isolating or screening the hazard from the welder, for example ancillary processes like plasma cutting, gouging, grinding, fettling and guillotining can be carried out in specified areas away from general fabrication, to reduce risk of exposure to loud noise at the welding station.
3. Engineering	When designing and installing equipment to counteract the hazard e.g. forced extraction ventilation to remove welding fumes. Appendix 1 provides information on different types of ventilation systems.
4. Administrative	When you administrate or use procedural controls e.g. if a welding process takes place in a very hot environment, allowing the welder to weld for a limited time followed by a suitable rest and cooling-off period will reduce the risk of heat exhaustion. **Note:** refer to SMS-06-OP-3043 Managing Risks Using Safe Work Practices for information relating to Safe Work Method Statements (SWMS) and Safe Work Instructions (SWIs).
5. Personal Protective Equipment (PPE)	PPE does not address controlling the source of the hazard, exposure or risk, and this is the reason why it is low on the hierarchy. An example of PPE is if the welder has to stand on metallic surfaces that form part of the electric circuit it may become live. The use of rubber-soled boots will reduce the risk of electric shock. Four (4) main principles relating to the use of PPE include ensuring it is: • suitable for the nature of the work and any hazard associated with the work; • a suitable size and fit and reasonably comfortable for the person wearing it; • maintained, repaired or replaced so it continues to minimise the risk; and • used or worn by the worker, so far as is reasonably practicable. **A worker must, so far as reasonably able, wear the PPE in accordance with any information, training or reasonable instruction and must not intentionally misuse or damage the equipment.**

Table 1: Hierarchy of control guidance.

Specific hazards and control measures

Hazard	Control measures
Airborne contaminants *Hot works can generate fumes, mists, dust, vapours and gases, including ozone. The amounts and types of fumes produced vary greatly depending on the process involved and the materials being used such as metals, solvents, flux, paint and plastics. The health effects of exposure to fumes, dust, vapour and gases can vary.*	• **Eliminate**, so far as is reasonably practicable, any exposure to airborne contaminants that are hazardous chemicals. • If it is not reasonably practicable to eliminate the risk, measures to minimise it must be used. For example: o **substituting** a hazardous chemical with a less hazardous one; o reducing the quantity of a hazardous chemical that is used, handled or stored; o **isolating** the source of exposure to the hazardous chemical e.g. welding in isolation booths away from others. • Using **engineering** control measures e.g. installing ventilation systems to capture or remove airborne contaminants. • Implement **administrative** control measures e.g. procedures to handle hazardous chemicals safely. • Provide appropriate respiratory protection. **Note:** Air monitoring should be carried out by a person such as an occupational hygienist with skills to carry out the monitoring according to standards and to interpret the results. Where monitoring of airborne contaminants is used to determine a person's exposure, the monitoring must be undertaken in the breathing zone of the person. If monitoring identifies that the exposure standard is being exceeded, the control measures must be reviewed and any necessary changes made. Records of air monitoring for airborne contaminants with exposure standards must be kept for a minimum of 30 years and must be available to workers who are exposed.
Radiation *Radiation is energy travelling as waves of electromagnetic radiation or subatomic particles. Electric arc and laser welding emit ultraviolet, visible light and infra-red radiation.*	• Install non-flammable screens and partitions. • Use signs to warn that welding is occurring. • If welding is being carried out, entry into the work area is not permitted unless safeguards are used such as PPE. • Provide PPE including filter shades for goggles and face shields to protect the eyes from radiation. • Gloves and other protective clothing should be worn to cover exposed skin. The effects of ultraviolet and infra-red radiation are not normally felt until sometime after exposure. Radiation from laser welding is less obvious than from electric welding arcs but both are serious hazards.

Hazard	Control measures
Radiation…continued *Gas welding emits visible light and infra-red radiation.*	**Note:** The potential effect of radiation on the body depends on the type, intensity, the distance you are from it and the duration of exposure. Eye disorders and skin burns may be caused by exposure to intense ultraviolet and infra-red radiation in welding.
Electrical risks *Using electrical welding equipment involves a risk of electric shock or electrocution. Exposure to electromagnetic fields is also a potential hazard for workers with some medical conditions.* *Electric arc welding produces strong electric and magnetic fields close to the power source and around the current-carrying cables. Electromagnetic fields can disrupt the operation of pacemakers, permanent defibrillators or other medical devices which could cause the heart to stop or slow down.*	Electric shock • Check the condition of the equipment is well maintained. • Install shut down mechanisms such as fuses, low voltage safety switches or residual current devices on equipment. • Use fully insulated electrode holders. The holder should never be dipped into water to cool, or be placed on conductive surfaces. • Prevent contacting electrodes or welding wire with bare hands when in the holder or welding gun (wear dry welding gloves); ensure that holders or welding guns are never held under the armpits. • Prevent holders or electrodes coming into contact with any other person. • Wear PPE including welding gloves and rubber insulated shoes while working. • Check the working area does not have any potentially live structures, components or wet areas. • Install a Residual Current Device (RCD). • Where devices have an earth (ground) connection, it is essential it is connected at all times. • Inspect all equipment to check that it is in good condition prior to use, including power switches, terminals, connections, cables and insulation. Electromagnetic fields • Use barriers to isolate people who are not directly involved in the welding process. • Use signs indicating there are strong electromagnetic fields should be used to alert people to risks. • Workers should not stand close to the power source or drape the welding cable around their body. • Workers with pacemakers or other susceptible devices should substitute work that involves exposure to electromagnetic fields for another type of welding process, such as performing oxy-fuel welding instead of electric arc welding. Seek medical advice before exposing a worker wearing such a device to welding related electromagnetic fields. **Note: the level of electromagnetic fields can usually be determined from the *Original Equipment Manufacturer's* manual to help determine the level of risk. In addition, workers with pacemakers should get medical clearance to confirm that they are allowed to perform electric arc based welding.**
Fire and explosion *Welding generates heat, flames and sparks—all of which are sources of ignition. When combined with sources of fuel and oxygen, sources of ignition present a significant risk of fire and explosion.*	• Isolate fuel sources from ignition sources. • Purge all traces of flammable or combustible materials from drums, vessels and tanks which are to be welded prior to welding, and preferably filled with an inert substance such as nitrogen gas or water. • Use fire resistant barriers to prevent welding sparks accidently reaching flammable and combustible materials. • Specific procedures for welding in a hazardous atmosphere or hazardous area may need to be developed. For example, the WHS Regulations requires a 'confined spaces entry permit' for work in a confined space. • Check work areas are well ventilated to prevent accumulation of flammable vapours in the work area. • Check work area is free from rubbish, paper or dust that could be potential fuel sources or produce dust explosions. • Wet down immediate work area if working outdoors in a vegetated environment. • Use flash back arrestors on gas hoses and regulators to prevent the flames travelling back and igniting the gas in cylinder. • Drain and purge equipment, such as gas hoses, and lock the gas off at the valve immediately after use. • Obtain a hot authority during total fire bans or obtain a hot work permit any other time. • Do not store flammable and combustible materials near the welding area. • Keep and maintain firefighting equipment near the welding area.
Burns and exposure to heat *Burns are one of the most common injuries in welding. The temperature of a welding arc can reach 6000 degrees Celsius.*	• Isolate workers from contacting hot work pieces, for example, carrying out post-weld heat treatment in areas where work pieces cannot be accidently touched. • Keep unauthorised persons out of the hot work area. • Mark or label as 'hot' equipment, metals, plates or items likely to be hot in the welding area to minimise accidental burns. Contact with heated surfaces can be avoided by using thermal insulating materials and wearing personal protective equipment as set out in the SWMS or SWI. • Ventilate work areas to reduce the build-up of heat in the workplace.

Hazard	Control measures
Burns and exposure to heat…continued *The intense ultraviolet and infra-red rays can be harmful to both the welder and anyone else nearby.*	• Workers should drink cool drinking water and take regular scheduled rest breaks.
Compressed and liquefied gases *Compressed and liquefied gases are used as fuel, a source of oxygen or as shielding gases in certain types of welding. Cylinders contain large volumes of gas under high pressure and precautions need to be taken when storing, handling and using cylinders.* *The hazards associated with compressed and liquefied gases include fire, explosion, toxicity, asphyxiation, oxidisation and uncontrolled release of pressure.*	• Store and handle cylinders appropriately. For further guidance refer to *AS 4332: The storage and handling of gases in cylinders*. • Keep cylinders maintained free from leaks or dents. • Store cylinders in an upright position to ensure the safety device functions correctly. • Secure cylinders to prevent dislodgement/falling over. • Flashback arrestors should be fitted at the blow pipe and regulator end of both the oxygen and fuel gas lines. • Keep the cylinder valve closed when the cylinder is not being used. • Keep all sources of heat and ignition away from gas cylinders, even if the cylinders do not contain flammable material.
Asphyxiation *Asphyxia is a condition that occurs where there is lack of oxygen. All gases, including fuel gases (for example, hydrogen, acetylene and liquid petroleum gas) and inert gases (for example, argon, helium and nitrogen) are an asphyxiation hazard in high concentrations*	• Avoid work being carried out in oxygen-enriched (over 23 per cent) or oxygen-depleted (under 19.5 per cent) atmospheres. • Keep the work area well ventilated, particularly in low lying areas and roof spaces where gases can accumulate. • Use an air supplied respirator, particularly in confined spaces. • Monitor the atmosphere to check it is free of harmful contaminants and contains an adequate oxygen level. • Check cylinder fittings, hoses and connections are not damaged or in poor condition.
Noise *A person conducting a business or undertaking (PCBU) must manage the risk to health and safety relating to hearing loss associated with noise. This involves ensuring that the noise a worker is exposed to at the workplace does not exceed the exposure standard for noise.*	• The most effective control measure is to remove the source of noise completely. If this is not possible, modify equipment and processes to reduce the noise, or isolate the source of noise from people by using distance, barriers, welding bays and sound absorbing surfaces (types of engineering control measures). • If the above-mentioned measures are not reasonably practicable, implement administrative control measures which limit the amount of noise people are exposed to and how long they are exposed to it. • Lastly, personal hearing protection must be provided to protect workers from any remaining risk.
Lead *Lead can become an airborne contaminant when soldering and welding materials. A welder may be exposed to lead when welding on steel painted with leaded paints, on leaded steel, flame cutting of batteries and materials contaminated with lead.*	• Ensure SFAIRP that lead is confined to a lead process area at the workplace and that, the lead process area is kept clean. • Ensure that methods used to clean a lead process area do not create a risk to health of persons in the immediate vicinity or have the potential to spread the contamination of lead. • Take all reasonable steps to ensure that a person does not eat, drink, chew gum, smoke or carry materials used for smoking in a lead process area. • Provide and maintain clean changing rooms, washing, showering and toilet facilities. • Provide workers with eating and drinking facilities that, SFAIRP, cannot be contaminated with lead from a lead process. • Ensure that workers remove clothing and equipment that is or likely to be contaminated with lead and wash their hands and faces before entering an eating or drinking area.

Health monitoring

Health monitoring identifies changes in a person's health status due to exposure to certain substances. It involves the collection of data in order to evaluate the effects of exposure and to confirm that the absorbed dose is within safe levels. This allows decisions to be made about implementing ways to eliminate or minimise the worker's risk of exposure e.g. reassigning other duties that involve less exposure or improving control measures.

Schedule 14 of the *WHS Regulations 2017* includes the type of health monitoring that must be carried out for each hazardous chemical listed, unless:

- an equal or better type of health monitoring is available;
- the use of that other type of monitoring is recommended by a registered medical practitioner with experience in health monitoring.

Further detail on health monitoring process can be sourced from SMS-16-OP-3109 Manage Health Monitoring Requirements.

5. Review controls

Line managers and/or authorised delegates shall manage the review process. The control measures must be reviewed and revised as necessary so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health or safety. Examples of where controls should be reviewed and revised include (but are not limited to):

- when the control measure does not control the risk so far as is reasonably practicable;
- before a change at the workplace that is likely to give rise to a new or different risk to health and safety that the measure may not effectively control;
- a new or relevant hazard or risk is identified; or
- the results of consultation indicate a review is necessary.

Further detail on maintaining and reviewing control measures can be sourced from the SMS-06- OP-3026 WHS Risk Management Procedure.

Further information

SMS-06- OP-3026 WHS Risk Management Procedure
SMS- 06-FM-4107 WHS Risk Assessment Form
SMS-06-TP-4026 SWMS Template
SMS-06-OP-3043 Managing Risks Using Safe Work Practices
SMS-16-OP-3109 Manage Health Monitoring Requirements

Document control

Document custodian:	Senior Safety Specialist Safety Systems
Document approver:	Director Safety and Standards
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Version history

Version	Effective Date	Change notes
2.0	24/09/2020	Document previously withdrawn and updated/reinstated. New template.

Appendix 1: Information relating to ventilation systems

There are three main types of ventilation: *local exhaust ventilation*, *forced dilution ventilation* and *natural dilution ventilation*. The choice of ventilation system should take into account the:

- amount and type of fumes and contaminants produced;
- proximity and location of the welding process relative to the ventilation system;
- level of ventilation, natural or mechanical, both for the whole workplace and the welding area – this will also depend on screens and partitions which may restrict cross-flow at the work area; and
- proximity of the welder's breathing zone to the fume source.

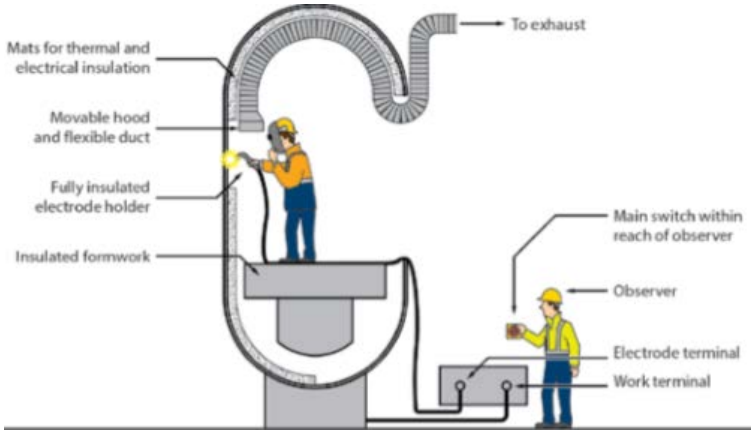
<table>
<tr><th>Ventilation type</th><th>Pictorial view (extracted from Welding Processes Code of Practice)</th></tr>
<tr><td rowspan="2">Examples of Local Exhaust Ventilation
Fixed installations, such as side-draught or down-draught tables and benches, and partially or completely enclosed booths;
Portable installations, such as movable hoods that are attached to flexible ducts (Figure 1);
Low volume high velocity fume extractors attached directly to the welding gun (Figure 2).</td><td> 

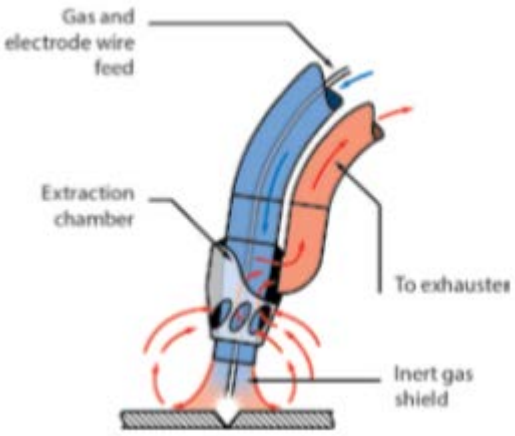
Figure 1: Portable installation attached to flexible duct.</td></tr>
<tr><td> 

Figure 2: Fume extractor attached directly onto welding gun.</td></tr>
<tr><td colspan="2">Forced dilution ventilation
An elevated concentration of atmospheric contaminants can be diluted with a sufficient volume of clean air.
Although forced dilution ventilation systems are not as effective in controlling atmospheric contaminants as local exhaust ventilation systems, they may be useful to control minor emissions of low toxicity contaminants.</td></tr>
<tr><td colspan="2">Natural ventilation
Natural ventilation should only be used for general comfort not as an engineered control measure for atmospheric contaminants and fumes. It can assist with the transfer of contaminants from the work area however it is not a reliable way of diluting or dispersing contaminants. For example, if a worker is working in a fixed position and the natural wind velocity is mild or wind is in a direction towards the worker, the worker may remain exposed to contaminants that have not been removed from the worker's breathing zone.</td></tr>
</table>