

Fire Protection in Welding and Cutting Operations

IAMC Toolkit
Innovative Approaches for the Sound
Management of Chemicals and Chemical Waste



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION



Introduction

Welding and cuttings operations in industry happen to be one of the most hazardous activities. The main hazards include mechanical hazards (e.g. toppling of gas cylinders, etc.), the spread of harmful gases and smoke as well as explosion and fire hazards. The presentation aims at providing sound measures to avoid such incidents.

The reader will familiarize with the main hazards related to these activities and the preventive measures to implement before and during the execution of the works.

Hazard Management

1. Risk Identification and safety	2. Transport and storage	3. Fire and explosion protection	4. Emergency response
1.1 Chemical classification and labelling	2.1 Internal transport of chemicals	3.1 Fire protection	4.1 Emergency response plan
1.2 Risk assessment	2.2 Internal pedestrian routes	3.2 Fire protection in welding and cutting operations	
1.3 Safety rules	2.3 Storage	3.3 Explosion protection	
1.4 Personal protective equipment		3.4 Container cleaning	
1.5 Skin protection			
1.6 Emergency escape routes			
1.7 Solvents, acids, bases handling			
1.8 Safety in gas tank handling			

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 - Welding and cutting operations
 - Hazards
2. Prevention Measures
3. Sources



Context

Welding and Cutting Operations

- Welding and cutting operations produce:
 - Heat
 - Sparks
 - Droplets

Often at the source of fires and explosions



San Francisco fire: Welding explored as cause of inferno

San Francisco Chronicle - il y a 5 jours

Smoldered an hour Whatever the cause, officials said, the **fire** appears ... rise to the possibility that the **fire** was caused by a construction **accident**.



Welding spark may have caused crane fire at Barangaroo ...

The Daily Telegraph - 12 mars 2014

The **fire** started in the basement of a building under construction before ... investigate claims a **welding accident** may have sparked the blaze.

+ Plus

The Age

www.google.com

Welding and Cutting Operations

- In terms of fire/explosion prevention, one needs to distinguish between welding and cutting operations carried out at different locations:
 - Executed in specially **adapted workplaces**
 - More or **less improvised on construction sites**

It is relatively easy to take prevention measures in specially adapted workplaces but less easy on construction sites.



Source: Suva



Source: Suva

Hazards – General Facts

Examples of **flammable materials** that could be found in the surroundings

- Wood
- Cork
- Synthetic materials
- Paper
- Textiles
- Organic materials

For organic materials, the ignition temperature is often between 200 °C and 300 °C.

Special precautions should be taken in the presence of:

- Liquids
- Vapours
- Flammable gases

The energy accumulated in sparks and drops is sufficient to provoke a fire.



Smouldering fires provoked by open fires can be particularly **dangerous**. They can stay **unnoticed** for hours before open flames appear.

Hazards

- Main hazards associated with welding and cutting operations:
 - **Flames and electric arcs:** Flames used for gas welding reach 3,000 °C, the temperature at the centre of the electric arc can be as much as 10,000 °C.
 - **Sparks:** Contain enough energy to ignite easily flammable materials and flammable gas mixtures, size: 0.01-0.2 mm.
 - **Droplets:** Contain a considerable amount of energy and can provoke smouldering fires, size: 2-5 mm.
 - **Thermal radiation and combustion gases:** Can provoke a fire even out of the range of the flame or electric arc.
 - **Secondary flames:** Combustible gas mixture of CO, H₂ and ambient air can ignite.
 - **Thermal conduction:** Combustible materials in contact with the welded metal can ignite by thermal conduction.
 - **Electric current:** Can trigger a short circuit.

Protection Measures

Prevention Measures

- **Obtain a welding and cutting permit**
 - If required by local legislation, obtain a welding and cutting permit before starting any related activities.
 - Welding and cutting works in premises where there is a risk of explosion or fire can require a written authorization.
 - Workers using welding and cutting equipment should participate in safety training.



Prevention Measures

- **Preparation**

- Zones where open flame work will take place must be marked with clear signs.
- Extinguishers should be available in sufficient quantity.
- Electrode butts should be thrown away in a tank full of water or sand.
- Access to the gas bottles should always be free of obstacles (to evacuate them or cool them down in case of an emergency).
- Gas bottles should be secured with chains.



Prevention Measures

- **Flames and electric arcs:**
 - Combustible materials (including dusts) should be removed or placed out of reach of the flame/electric arc.
 - If the previous measures are not feasible:
 - Protect the combustible materials with non-combustible and insulating materials or
 - Keep them wet by spraying water



Source: Suva

Prevention Measures

- **Sparks and droplets:**
 - Droplets should be captured in tanks filled with water or sand
 - Caulk cavities, holes and cracks with non-combustible materials to prevent droplets and sparks from penetrating



Source: Suva

Prevention Measures

- **Personal protective equipment**
 - Workers should wear autonomous respiratory protection equipment and a harness, if sufficient ventilation is not possible.
 - Respiratory devices with filters should not be worn.
 - Workers should wear safety shoes to prevent foot injury from falling objects.



D14_1_Personal safety equipment

Prevention Measures

■ Surveillance

- If the risk of a fire cannot be excluded, an additional person should inspect the area periodically after operations have ceased (e.g. several hours after the operations, over night).
- Monitor flames, projections and heat flow.
- During and after the operation, make sure that the prevention measures are effective.



Verify the potential presence of smoke, incandescent zones and **smouldering fires.**

Prevention Measures

- **Secondary flames:**
 - Caulk cavities, holes and cracks with non-combustible materials to prevent welding and combustion gases from penetrating them.



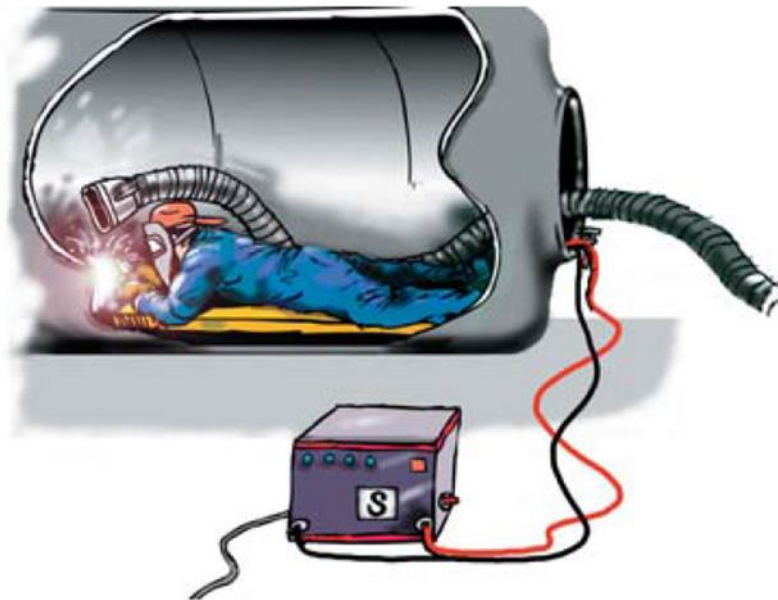
Prevention Measures

- **Thermal conduction:**
 - Continuously cool down the metal parts being welded as well as the metal parts in the vicinity of the flame.



Prevention Measures

- **Equipment:**
 - Have a device immediately repaired if any element is defective.
 - Ensure that maintenance is carried out regularly.
 - To avoid electric shocks, never place the welding power source in confined spaces.



Prevention Measures

■ Gas bottles

- Gas hoses should be regularly checked and defective ones replaced.
- Gas hoses should be secured (e.g. with clips).
- Fittings used with oxygen should neither be oiled nor greased.
- Systems with mixed gas burners should be fitted with suitable protective devices (e.g. gas non-return valve, flashback arrester, reverse flow protector).

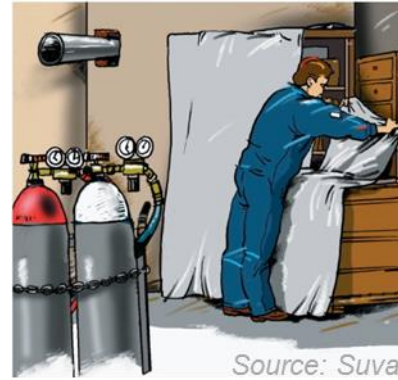


Gas welding station with pressure reducing valve, non-return valve, flashback arrester

Prevention Measures – Exercise

What would you do if you had to weld a pipe?
What prevention measures would you take?
How would you organize your work?

Prevention Measures – Exercise



Key messages

- Obtain a welding and cutting permit if required by local regulations.
- Prepare the working area (warning signs, free access to gas bottles, gas bottles secured with chains, extinguishers, etc.).
- Ensure continuous surveillance (workers, smouldering fires, etc.).
- Wear personal protective equipment.
- Protect combustible materials.
- Caulk cavities, holes and cracks.
- Cool down metal parts being welded.
- Ensure the maintenance and repair of the equipment.
- Check the condition of the gas bottles regularly.

Sources

Sources

- CSD Engineers, Switzerland/ISSPPRO, Germany, 2015
- Suva: Soudage à l'intérieur de réservoirs et dans des espaces exigus, Switzerland, 2013
- Suva: Checklist – Welding, cutting, soldering and heating (flame processes), Switzerland, 2008
- Suva: Checklist – Welding and cutting (arc processes), Switzerland, 2008
- Suva: Coupage et soudage – Protection contre les fumées, poussières, gaz et vapeurs, Switzerland, 2012

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