

**NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING**



LABORATORY OF WELDING

**Mechanical Engineering Program
Mechanical-Electrical Engineering Program
Mechatronics Engineering Program
Naval Engineering Program**

SAFETY MANUAL

Lima, Peru

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WARNING

PROTECT yourself and others. Read and understand this information.

FUMES AND GASES can be hazardous to your health.

ARC RAYS can injure eyes and burn skin.

ELECTRIC SHOCK CAN KILL

- Before use, read and understand manufacturer's instructions, material safety data sheets (MSDSs) and university safety practices.
- Keep your head out of the fumes.
- Use enough ventilation, exhaust at the arc, or both, to keep fumes and gases from your breathing zone and the general area.
- Wear correct eye, ear, and body protection.
- Do not touch live electrical parts.
- Revise American National Standard ANSI Z49.1: *Safety in Welding, Cutting, and Allied Processes*, American Welding Society



Personal Protection and Safety Rules

Safety and health are extremely important. All students using the Welding Laboratory are continually exposed to potential hazards. There are a number of potential safety and health problems associated with welding, cutting, and allied processes. When correct precautionary measures are followed, welding is a safe operation.

Companies and governments have become increasingly active concerning the safety and health of workers and have enacted laws prescribing safety regulations and the publication of safety information to insure the safety of workers. In Peru, Congress Law 29783 – Occupational Health and Safety makes many national consensus standards enforceable.

The American National Standard “ANSI Z49.1, Safety in Welding, Cutting, and Allied Processes”, states that welding and cutting operations pose potential hazards from fumes, gases, electric shock, heat radiation, and sometimes noise. All personnel shall be warned against these hazards where applicable by the use of adequate precautionary labeling. There are other hazards which apply to all metal working occupations. These are accidents resulting from falling, being hit by moving objects, working around moving machinery, exposure to hot metal, etc. Normal precautions are required with regard to these hazards as well. Hazards that relate to welding are:

- Electrical shock
- Arc radiation
- Air contamination
- Fire and explosions
- Compressed gases
- Welding cleaning
- Other hazards

Welding Workplace Safety

Faculty and supervisors are responsible for assuring the students are trained in the safe conduct of their activities. Students must be informed and trained so that they are able to detect when hazards are present and protect themselves from them.

Students have an obligation to learn and use safe practices and to obey safety rules and regulations. They are responsible for the proper use of equipment. They have an obligation to learn safe practices, to obey safety rules and regulations and are expected to work in a safe manner. It is the responsibility of supervisors to assure safety rules and regulations are followed.

Combustible materials must not be allowed to collect in or near the welding workplace. Good housekeeping practices should always be employed. Adequate safety devices should be provided

Safety Precautions for Arc Welding and Cutting

The following Safety Precautions must be read and understood by all welders, cutters and helpers:

1. Make sure your arc welding equipment is installed properly and grounded and is in good working condition. This will help prevent fatal electric shocks.
2. Always wear protective clothing suitable for the welding to be done. This will help prevent injuries and burns.
3. Always wear proper eye protection, when welding, cutting, or grinding. Do not look at the arc without proper eye protection. This will prevent eye injuries and "arc flash".
4. Avoid breathing the air in the fume plume directly above the arc. This will prevent illness due to overexposure to hazardous materials in the fume plume.
5. Keep your work area clean and free of hazards. Make sure that no flammable, volatile, or explosive materials are in or near the work area. Good housekeeping will help prevent accidents.
6. Handle all compressed gas cylinders with extreme care. Keep caps on when not in use. Damaged cylinders can rupture with explosive violence.
7. Make sure that compressed gas cylinders are secured to the wall or to other structural supports. The impact of a fall can cause cylinder rupture or valve failure.
8. When compressed gas cylinders are empty close the valve and mark the cylinder "empty". This will prevent contamination from entering the cylinder.
9. Do not weld in a confined space without special precautions. Poor ventilation can lead to asphyxiation. Accumulation of flammable gases can explode. Always practice "confined space" safety.
10. Do not weld on containers that have held combustibles without taking special precautions. The heat of welding can ignite residual gases and cause an explosion. The heat can cause the release of hazardous fumes. Always assure a container is clean and safe for welding.
11. Do not weld on sealed containers or compartments without providing vents and taking special precautions. The heat of welding can cause gases to expand. The increased pressure can lead to an explosion.
12. Use mechanical exhaust at the point of welding when welding lead, cadmium, chromium, manganese, brass, bronze, zinc, or galvanized steel, and when welding in a confined space. These "low allowable-limit materials" can cause serious injury. Ventilation will prevent overexposure.
13. When it is necessary to weld in a damp or wet area, wear rubber boots and stand on a dry insulated platform. This will minimize the chance of electric shocks.
14. Do not use cables with frayed, cracked, or bare spots in the insulation. This will prevent stray arcs between the bare cable and the ground. It will prevent electric shocks.

15. When the electrode holder is not in use, hang it on brackets provided. Never let it touch a compressed gas cylinder. This will help prevent damage to the holder. An energized holder can arc to a grounded cylinder and cause an explosion.
16. Dispose of electrode stubs in proper container since stubs on the floor are a safety hazard. Hot stubs can ignite fires or can cause trips and falls.
17. Shield others from the light rays produced by your welding arc. Ultraviolet arc rays can cause "arc flash" to the eyes of nearby people.
18. Do not weld near degreasing operations. Arc rays can interact with fumes of some cleaning agents and produce hazardous gases. Some of these gases can kill.
19. When working above ground, make sure that scaffold, ladder, or work surface is solid. Falls from elevated positions can cause injury or even death.
20. When welding in high places, use safety belt or lifeline. Falls from high places are more likely to cause serious injury or death.

Safety Precautions for Oxyacetylene Welding and Cutting

The following Safety Precautions must be read and understood by all welders, cutters and helpers:

1. Make sure that all gas apparatus shows UL or FM approval, is installed properly and is in good working condition. Make sure that all connections are tight before lighting the torch. Do not use a flame to inspect for tight joints. Use soap solution to detect leaks. This will minimize the chance of fuel gas leaks. Gas leaks can cause fires and explosions.
2. Always wear protective clothing suitable for welding or flame cutting. This will prevent injuries and burns.
3. Keep work area clean and free from hazardous materials. When flame cutting sparks can travel up to 10.7 m. Do not allow flame cut sparks to hit hoses, regulators, or cylinders. Good housekeeping will help prevent fires and explosions.
4. Handle all compressed gas cylinders with extreme care. Keep cylinder caps on when not in use. Damaged cylinders can rupture with explosive violence.
5. Make sure that all compressed gas cylinders are secured to the wall or to other structural supports. Keep acetylene cylinders in the vertical position. The impact of a fall can cause cylinder rupture or valve failure. With horizontal acetylene cylinders, acetone will be mixed in with the delivered gas.
6. Store compressed gas cylinders in a safe place with good ventilation. Acetylene cylinders and oxygen cylinders should be kept apart. This will prevent the accumulation of leaking gases and possible fires and explosions.
7. When compressed gas cylinders or fuel gas cylinders are empty, close the valve and mark the cylinder "empty". This will prevent contamination from entering the cylinder.
8. Use oxygen and acetylene or other fuel gases with the appropriate torches and only for the purpose intended. This will minimize the chance of sustained backfires and flash-backs.
9. Avoid breathing the air in the fume plume directly above the flame. This will prevent illness due to overexposure to hazardous materials in the fume plume.
10. Never use acetylene at a pressure in excess of 15 PSI (103.4 KPa). Higher pressure can cause an explosion. The high pressure can cause acetylene to detonate spontaneously.
11. Never use oil, grease or any material on any apparatus or threaded fittings in the oxyacetylene or oxyfuel system. Oil and grease in contact with oxygen may cause spontaneous combustion.
12. Do not weld or flame cut in a confined space without taking special precautions. Poor ventilation can lead to asphyxiation. Accumulation of fuel gas can explode. Always practice "confined space" safety.

13. When assembling apparatus, crack gas cylinder valve before attaching regulators (cracking means opening the valve on a cylinder slightly, then closing). This blows out any accumulated foreign material. Make sure that all threaded fittings are clean and tight. The impact of foreign material can cause regulators to explode, when they are pressurized upon opening of the cylinder valve.
14. Always follow the torch manufacturer's instructions when lighting the torch. This will prevent damage and the release of excess gases.
15. Always follow the torch manufacturer's instructions when shutting down a torch. This will prevent damage and re-verse gas flows in the hoses.
16. Use mechanical exhaust when welding or cutting lead, cadmium, chromium, manganese, brass, bronze, zinc, or galvanized steel. These "low allowable-limit materials" can cause serious injury. Ventilation will prevent overexposure.
17. If you must weld or flame cut with combustible or volatile materials present, take extra precautions, make out a hot work permit, and provide for a lookout, etc. This will minimize the chance of fires.
18. Do not weld or flame cut on containers that have held combustibles without taking special precautions. The heat of the flame can ignite residual gases and cause an explosion. The heat can cause the release of hazardous fumes. Always assure a container is clean and safe for welding or cutting.
19. Do not weld or flame cut into a sealed container or compartment without providing vents and taking special precautions. The heat of the flame can cause gases to expand. The increased pressure can lead to an explosion.
20. Do not repair damaged hoses with tape. Only trained persons should repair hoses. Gas leaks can cause fires and explosions and, in some cases, asphyxiation.

PERSONAL PROTECTION

Always use all protection equipment according to the type of welding process.

SKULLCAP. Protects hair and scalp, especially when welding in upward positions

METAL SMOKE RESPIRATORY MASKS. It should always be used under the helmet for welding. They must be replaced at least once a week.

WELDING HELMET. Protects eyes, face, neck, and it must be provided with inactive filters according to the process, and intensity of the current used.

LEATHER GLOVES. Musketeer type with internal seam to protect hands and wrists.

LEATHER APRON. To protect yourself from splashes and exposure to ultraviolet rays from the arc.

LEGGINGS AND LEATHER JACKET. They should be used in overhead and upright welding to avoid burns that can be caused by molten metal spatter.

SAFETY SHOES. Covering the ankles to avoid the catch of splashes.



Safety in Welding, Cutting, and Allied Processes

Standard ANSI Z49.1

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1. Purpose and Scope

- 1.1. Purpose
- 1.2. Scope and Applicability
- 1.3. Exclusions

2. Definitions

- 2.1. Approved
- 2.2. Confined Space
- 2.3. Cylinder Storage
- 2.4. Immediately Dangerous to Life or Health
- 2.5. Other Definitions
- 2.6. Qualified Person
- 2.7. Shall
- 2.8. Should
- 2.9. Unit
- 2.10. Welder

3. General Provisions, Management, and Supervision

- 3.1. Setup and Installation
- 3.2. Responsibilities

4. Protection of Personnel and the General Area

- 4.1. Protection of the General Area
- 4.2. Eye and Face Protection
- 4.3. Protective Clothing
- 4.4. Nose Control
- 4.5. Respiratory Protective Equipment
- 4.6. Training

5. Ventilation

- 5.1. General
- 5.2. Breathing Zone Sampling
- 5.3. Avoid the Fume
- 5.4. Types of Ventilation
- 5.5. Special Ventilation Concerns

6. Fire Prevention and Protection

- 6.1. Areas Containing Combustibles
- 6.2. Fire Protection
- 6.3. Hot-Work Authorization
- 6.4. Welding or Cutting Containers

7. Confined Spaces

- 7.1. Ventilation in Confined Spaces
- 7.2. Location of Service Equipment
- 7.3. Adjacent Areas
- 7.4. Emergency Signal
- 7.5. Attendants in Areas Immediately Dangerous to Life and Health
- 7.6. Brazing Furnaces

8. Public Exhibitions and Demonstration

- 8.1. Application
- 8.2. Supervision
- 8.3. Site
- 8.4. Fire Protection
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- 8.7. Process Hoses, Cables, and Conduits

9. Precautionary Information

- 9.1. General
- 9.2. Precautionary Information for Arc Welding and Related Processes and Equipment
- 9.3. Precautionary Information for Oxyfuel Gas Processes and Equipment
- 9.4. Hazardous Materials Information
- 9.5. Brazing Filler Metals Containing Cadmium
- 9.6. Brazing and Gas welding Fluxes Containing Fluorides
- 9.7. Material Safety Data Sheets
- 9.8. Graphic Symbols
- 9.9. Hazards Communications

Part II. Specific Processes

10. Oxyfuel Gas Welding and Cutting Safety

- 10.1. Scope
- 10.2. Terminology
- 10.3. Oxygen and Combustibles
- 10.4. Attachments for Gas Mixings
- 10.5. Torches
- 10.6. Hose and Hose Connections
- 10.7. Pressure-Reducing Regulators
- 10.8. Compresses and Oxyfuel Gas Cylinders (Containers)
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11. Arc Welding and Cutting Equipment Safety

- 11.1. General
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- 11.3. Installation of Arc Welding Equipment
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12. Resistance Welding Safety

- 12.1. General
- 12.2. Installation
- 12.3. Guarding
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- 12.5. Static Safety Devices
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13. Electron Beam Welding and Cutting Processes

- 13.1. General
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14. Laser Beam Cutting and Welding

- 14.1. General

15. Brazing and Soldering Safety

- 15.1. General
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