

# SAFETY IN WELDING & GAS CUTTING OPERATIONS

## 1. Introduction

Welding and cutting are common industrial operations, But there is lack of adequate awareness of the hazards. Injuries are in the form of eye injuries, infections, burns and injuries are due to lifting, slips, falls, and dropped or falling objects. It also poses great fire hazard.

## 2. Gas Welding & Cutting Equipment

### Welding Gases:

Oxygen is supplied in cylinders under a pressure of 2200 psi. at 70 degree F.

Acetylene is either supplied in cylinders or generated as needed. Range of flammable limits of acetylene (2.5 to 81% acetylene in air) is greater than that of other commonly used gases, with consequently greater hazard.

Hydrogen is supplied in cylinders under a pressure of 2000 psi at 70 degree F. Hydrogen-air mixture are flammable in the range from 4 to 74% hydrogen.

Other fuel gases propane Butane , and their mixtures are also used with oxygen in welding touches. These are supplied in cylinders in liquid form.

Acetylene is the most popular welding gas. When burnt with oxygen it can produce a higher flame temperature (6000 degrees F) than any other gas used commercially.

### Acetylene Generators

Acetylene should never be generated distributed, or utilized at a pressure in excess of 15 psi. At greater pressure acetylene becomes unstable.

All acetylene generators should conform to the requirements specified in the Calcium Carbide Rules, 1937 issued by Govt. of India.

Anything which may cause a spark must be kept away from generator room. It is better to install electric or any other lamps outside the generator room positioned to light inside the room through windows, doors etc. Charged generators should not be moved by crane or derrick. Suppliers instructions should be explicitly followed. Generators should be cleared or repaired during daylight avoiding artificial light. Whenever repairs are to be made or the generator is to be charged or carbide is to be removed the water chamber should be completely filled to avoid the danger of explosive mixtures of air and

acetylene within the water space and also to prevent the dropping of carbides into insufficient amount of water.

### **Handling, Storage; and use of compressed gas Cylinders:**

#### **Handling (some of the important point to remember)**

1. No tampering with numbers or marks stamped
2. Mechanical device advisable for carrying. They may be rolled on bottom edge, but never dragged.
3. Never lift with electromagnet. For handling by crane or derrick cradle should be used.
4. Never drop cylinders or allow them to strike each other violently.
5. No misuse of cylinder.
6. No tampering with safety devices
7. Before returning empty cylinders positively mark them 'EMPTY' with chalk. Close valves and replace valve protection cap.
8. Always consider cylinders full, if not definitely known.
9. When in doubt, ask supplier

#### **Storage**

1. Keep away from radiators and all sources of heat.
2. Inside building, cylinders in a well protected well ventilated dry location, at least 20 feet away from highly combustible materials, such as oil. There should be definitely assigned place for storing away from elevators, stairs, gangways. Never keep at a place where these can be knocked over or damaged by passing or falling objects. Never store in unventilated enclosures, such as locker and cup-boards.
3. Cylinders containing oxygen and combustible gases, such as acetylene, hydrogen should not be store in same room. If stored in the same room under unavoidable circumstances they be kept far apart (20 feet) a noncombustible barrier in between of at least 5 feet having a fire-resistance rating of atleast half-an-hour.
4. Store Acetylene cylinder always upright,

#### **Use**

1. Use cylinders in upright position and secure them against accidentally being knocked over.
2. Keep metal cap in place to protect valve, when not connected for use.
3. Do not force connections that do not fit.
4. Open valves slowly. Use opening tool provided by supplier
5. Do: not use a compressed gas cylinder without pressure reducing regulator device attached to the valve.
6. Use regulators and pressure gauges only with gases only designed.

7. Leaking cylinders must be taken out of use immediately, valve closed cylinder removed, outdoor and supplier notified.
8. Do not permit any source of ignition to come in contact with the cylinder or attachment.
9. Never use oil or grease as a lubricant on valves or attachment and do not handle cylinders with oily hands gloves or clothings.
10. Never use oxygen as a substitute for compressed air.
11. Before removing a regulator from a cylinder valve, close the valve and release the gas from the regulator.

### **Manifolding of Cylinders Distribution Piping**

Manifolds shall be of substantial construction of a design material suitable for the particular gas and service for which they are to be used. Distribution piping carrying oxygen from manifold or other centralized supply should be of steel, wrought iron, brass or copper. For pressure over 150 psi, extra-heavy pipe and fittings should be used. Only steel or wrought iron piping should be used for acetylene, distribution systems. Flanged connections in acetylene lines should be electrically bonded.

### **Arc Welding & Cutting Equipment**

For arc welding, two welding leads, **electrode lead & work lead** are required from source of current supply. One lead is connected to work and the other to electrode holder. The work lead (Cable) is not satisfactory means of providing return (ground) circuit.

**Converter:** AC or DC may be used. Rectifier for DC and Transformer for AC supplies used for converter must be well protected both mechanically and electrically.

**Voltages:** Voltage across welding varies from 15 to 50volts depending on type and size of electrode used. Welding circuit must supply high voltage to strike the arc. This voltage is called the "open circuit". Or "No Load" voltage which should not exceed following limits:

#### **(a) A.C. Machines**

- i) Manual Arc welding and cutting – 80 volts
- ii) Automatic (or mechanised) arc welding & Cutting –100volts.

#### **(b) D.C. Machines**

- i) Manual Arc welding & cutting ---100 volts
- ii) Automatic arc welding & cutting --- 100 volts

**Currents:** With small diameter electrodes used on this sheets for manual arc welding, current values vary from 10 to 50 amp.

## **Service, Cables & connectors**

All cables must be of completely insulated, flexible type, capable of handling the max. current requirements.

Only rubber-covered cable free from splices must be permitted for a Minimum distance of 10 ft from electrode holder.

For connecting two lengths of cables substantial insulated connectors of latest equivalent capacity must be used.

## **Electrodes & Holders**

Electrodes Holders are used to connect the electrode to the welding cable supplying secondary current. They should be specifically designed for arc-welding & capable of safely handling the max. rate of current required by the electrode. Electrode holders should be fully insulated for providing superior protection to the operator. Practice of dipping hot electrode holders in water is dangerous- It may expose worker to electric shock.

## **Electric Shock**

Work set up is such that the work is ground and if welder is not careful, he cannot be easily grounded. Welder may be exposed to the “open circuit voltage” during the off-arc or no-load period while changing electrodes, setting up work, or changing working position. Danger is more in hot weather when welder is sweaty.

## **Common Hazards**

**Light Rays:** Electric arcs and gas fumes both produce ultraviolet and infrared rays which are harmful to the eye and skin upon continued or repeated exposure. Permanent eye injury may result.

Arcs welding should be isolated as far as practicable to safeguard other worker from direct or indirect exposure from rays. Walls, ceilings, partitions, etc should be of non-reflective nature. Where work permits welder should be enclosed in an individual booth painted with a finish of low reflectivity such as zinc Oxide (an important factor for absorbing UV Radiation) and lamp black. Booth should be designed to permit circulation of air at floor level

**Fire:** No welding near combustible materials, Segregation is a must. No welding near or in room having flammable or combustible vapours, liquids, or dust, or on or inside closed tanks or other containers which have held such materials until all fire and explosion hazards have been eliminated. The surrounding premises should be thoroughly ventilated and frequent gas testing provided. Local exhaust ventilation equipment should be used for removal of

hazardous air vapour, fumes that general ventilation fails to dispel. Closed containers that have held flammable liquids or other combustibles should be thoroughly cleaned before welding.

Following steps taken in that order will make the container safe for welding:

1. Degrease the container thoroughly using an alkaline or any other degreasing solution
2. Rinse the container thoroughly with hot water and allow to dry completely.
3. After drying and before welding the container should be purged thoroughly for a period of at least five minutes with an inert gas.
4. That inert gas should be allowed to flow through the container under a positive pressure while welding is taking place.

As an added precaution for prevention of fire, a fire watcher equipped with suitable fire extinguisher should be stationed at or near welding operations conducted in hazardous locations. Fire watch should be continued for at least 30 minutes after the job is completed to make sure that smouldering fire have not started.

### **Personnel Protection**

#### **Eye and Face Protection**

The object of protective equipment here is to protect eyes and face from the heat and injurious effects of infrared, visible light and ultraviolet rays.

These equipment should, therefore, be-

1. Constructed of heat-resisting non-ignitable material which is also injurious to harmful rays
2. Light, but strong enough to withstand rough service.
3. Goggles, helmets and shields that give max. eye protection for each welding process should be worn by welders and also their helpers.
4. Goggles and Spectacless must have side shields.

The following is a guide for the selection of glass with proper shade numbers. These recommendations can be varied to suit individual needs.

<b>Welding operation</b>	<b>Shade No. of lenses</b>
i) Sheilded metal-arc welding 1            3            1 ----- 16          16          8 ---- inch electrodes	10
i) Gas-sheilded arc welding(non-ferrous) $\frac{1}{16}$ $\frac{3}{32}$ $\frac{1}{8}$ $\frac{5}{32}$ --- inch electrodes	11
ii) Gas-sheilded arc welding (ferrous) 1            3            1            5 ----- 16          32          8          32 -- inch electrodes	12
iii) Sheilded metal-arc welding 3            7            1 ----- inch electrodes 16          32          4  5            7 ----- inch electrodes 15          8	12  14
iv) Atomic Hydrogen welding	10 - 14
v) Carbon-arc welding	14
vi) Soldering	2
vii) Torch Brazing	3 - 4
viii) Light cutting upto 1-inch	3 - 4
ix) Medium cutting 1 to 6 inches	4 - 5
x) Heavy cutting 6 inches and over	5 - 6
xi) Gas welding (light) upto $\frac{1}{8}$ inch	4 - 5
xii) Gas welding (med) $\frac{1}{8}$ to $\frac{1}{2}$ inch	5 - 6
xiii) Gas welding (heavy) $\frac{1}{2}$ inch and over	6 - 8

**Note:** In gas welding or oxygen cutting where the torch produces high yellow light, it is better to use a filter or lens that absorb the yellow light of operation.

### **Protective clothing**

- i) Flame resistant Gauntlet gloves, exception very light work
- ii) Apron of leather, asbestos, or other flame-resistant materials to withstand radiated heat and sparks

- iii) For heavy work, fire-resistant leggings, high boots or similar protection
- iv) Safety shoes wherever heavy objects are handled. Low-cut shoes with unprotected tops should not be used because of spark hazard
- v) For overhead work, caps or shoulder covers of leather or other suitable material
- vi) Safety hats or other head protection against sharp or heavy falling objects.

### **Respiration Protection**

During welding toxic gases, fumes, and dusts may be evolved depending on the type of electrodes used, the base metal being welded, and whether or not the base metal is coated with such material as tar, paint, lead or zinc, gases-the oxides of in varying degrees present inhalation hazards, if adequate respiratory protection is not used.

Welding or cutting involving zinc lead-sodium or mercury-bearing base or stainless steel shall be done using mechanical ventilation adequate to remove the fumes generated. Alternatively use of airline respirator may be resorted to.

### **USES OF WELDING EQUIPMENT SAFELY**

#### **DOS AND DON'TS**

1. **DO:** Wear protective equipmentd, such as leather sleeves, jacket, apron and welder's leather gloves to protect the skin from intense heat and sparks, protect the eye and face by means of a suitable helmet or shield equipped with a filter glass plate. Wear safety shoes, tightly laced.

**DON'T:** Leave if any portion of protective clothing when welding, even through the job takes only a few minutes. Do not leave shirt open at the neck or any other openings where sparks or globules of molten metal may fall inside the clothing.

2. **DO:** Erect large screen around welding work to protect nearby employees from arc rays.

**DON'T:** Weld in an unprotected spot where near by employees will be exposed to arc rays. Do not weld when anyone is looking at the

3. **DO:** Make sure the electrode holder is hung up when not in use and not left on the table or in touch with a grounded object.  
**DON'T:** Leave electrode holder on table or in contact with a grounded metallic surface. These precautions prevent damaging your equipment and causing injury to yourself.
4. **DO:** See that cable connections to electrode holder and ground are tight and insulated. Make sure electrode holder is in good condition and grips electrode firmly. Always use well insulated holders.  
**DON'T:** Use an electrode holder with defective jaws or a loose cable connection, as this will cause excessive heating.
5. **DO:** Erect suitable safeguarding around any flammable materials near work and keep a handy extinguisher. Where sparks may come through floor or partition, have helper or fire watcher stationed where he can control the situation.  
**DON'T:** Weld on any drum or container without first thoroughly purging it of flammable or explosive vapors. Many a welder has been seriously injured because of failure to take the time necessary to thoroughly purge a container.
6. **DO:** Always wear safety goggles under helmet for protection when chipping or grinding a weld. Clear or light tinted goggles will also help to prevent eye flashes when other welders are working nearby.
7. **DON'T:** Chip or grind a weld without wearing proper safety goggles, even if it is only a small job.

\*\*\*