INTER PLANT STANDARD – STEEL INDUSTRY		
IPSS	**SAFETY PROCEDURE FOR WELDING & CUTTING**	**IPSS: 1-11-020-15**
	Corresponding IS does not exist	

0. FOREWORD

0.1 This Inter Plant Standard prepared by the Standards Committee on Safety Appliances and Procedures IPSS 1:11, with the active participation of the representatives of all steel plants and associated organizations in the field, was adopted in February, 2015.

1. SCOPE

1.1 To ensure safety in all welding and cutting operation.

2. Procedure:

2.1. General Requirements:

- The procedure has to be implemented by all departmental Heads with the help of their authorized representative at work place and is also applicable to Contractor's employees.

- Work permit shall be issued to working agency before start of gas cutting/welding, by the authorized person of the department

- If the gas cutting/welding job is to be carried out at height (more than 2 meters) from ground level/in confined space/gaseous hazardous area/ near electrical installation, separate entry permit/work permit should be obtained from authorized agency.
  Falling of spatters from height must be prevented. For this a metal trough should be used and spatters should be collected in a trough at the point of generation. Moist ceramic cloth may also be used wherever required. In case of problem in preventing of all the spatters falling down at the area below the site of hot work the area has to be barricaded. No cylinders should be kept in the barricaded area. Proper covering of the knob, valves etc of the cylinders adjacent to the barricading, must be ensured.

- After completion of the job, the cylinders, hose pipe, torch, cables, spatters, etc. are to be properly removed and kept at designated place. Area to be cleaned and waste matter removed.

- After completion of the job, the work permit shall be returned by working agency and the receiving authority of owner department shall enter the form in the original along with the white copy.

- Always use seamless tubing for connections with cylinder. All cracked hoses are to be scraped and removed from the site.

- Test the area for flammables before welding and cutting when the atmosphere is vulnerable to such hazards.

2.1.1. Fire Prevention and protection.

- All gas cylinders should be kept with safety protective caps when not in use.

- It should be ensured that before starting the job surrounding area of the work side should be made free of fire hazard.

- Employees engaged on working, cutting and other hot jobs should be trained and capable to use fire equipments in case of any fire emergency.

- Adequate fire fighting provision to be made available close to each area of welding, cutting and other hot job.

- Emergency telephone number should be made available and displayed at work site by concerning agencies.

- When practical, objects to be welded, cut, or heated shall be moved to a designated safe location or, if the objects to be welded, cut, or heated cannot be readily moved, all movable fire hazards in the vicinity shall be taken to a safe place, or otherwise protected.

- If the object to be welded, cut, or heated cannot be moved and if all the fire hazards cannot be removed, positive means shall be taken to confine the heat, sparks, and slag, and to protect the immovable fire hazards from them.

- No welding, cutting, or heating shall be done where the application of flammable paints or the presence of other flammable compounds, or heavy dust concentrations creates a hazard.

- Suitable fire extinguishing equipment shall be immediately available in the work area and shall be maintained in a state of readiness for instant use.

- When the welding, cutting, or heating operation is such that normal fire prevention precautions are not sufficient, additional personnel shall be assigned to guard against fire while the actual welding, cutting, or heating operation is being performed, and for a sufficient period of time after completion of the work to ensure that no possibility of fire exists. Such personnel shall be instructed as to the specific anticipated fire hazards and how the firefighting equipment provided is to be used.

- When welding, cutting, or heating is performed on walls, floors, and ceilings, since direct penetration of sparks or heat transfer may introduce a fire hazard to an adjacent area, the same precautions shall be taken on the opposite side as are taken on the side on which the welding is being performed.

- For the elimination of possible fire in enclosed spaces as a result of gas escaping through leaking or improperly closed torch valves, the gas supply to the torch shall be positively shut off at some point outside the enclosed space whenever the torch is not to be used or whenever the torch is left unattended for a substantial period of time, such as during the lunch period. Overnight and at the change of shifts, the torch and hose shall be removed from the confined space. Open end fuel gas and oxygen hoses shall be immediately removed from enclosed spaces when they are disconnected from the torch or other gas-consuming device. In no case a gas cutting torch should be kept in gas release condition when not in use.

- Except when the contents are being removed or transferred, drums, pails, and other containers, which contain or have contained flammable liquids, shall be kept closed. Empty containers shall be removed to a safe area apart from hot work operations or open flames.

- Drums, containers, or hollow structures which have contained toxic or flammable substances shall, before welding, cutting, or heating is undertaken on them, either be filled with water or thoroughly cleaned of such substances and ventilated and tested.

- Before heat is applied to a drum, container, or hollow structure, a vent or opening shall be provided for the release of any built-up pressure during the application of heat.

- Flash back arrester is to be provided in oxygen and fuel line at both ends.

2.2. Gas welding and cutting:

2.2.1. Transporting, moving, and storing compressed gas cylinders:

- Valve protection caps shall be in place and secured.
- When cylinders are hoisted, they shall be secured on a cradle, sling board, or pallet. They shall not be hoisted or transported by means of magnets or choker slings.
- Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dropped, struck, or permitted to strike each other violently.
- When cylinders are transported by powered vehicles, they shall be secured in a vertical position.
- Valve protection caps shall not be used for lifting cylinders from one vertical position to another
- Unless cylinders are firmly secured on a special carrier intended for this purpose, regulators shall be removed and valve protection caps put in place before cylinders are moved.
- A suitable cylinder trolley, chain, or other steadying device shall be used to keep cylinders from being knocked over while in use. Such cylinders are not considered to be “in storage.”
- When a job is finished, when cylinders are empty or when cylinders are moved at any time, the cylinder valve shall be closed.
- Compressed gas cylinders shall be secured in an upright position at all times except, if necessary, for short periods of time while cylinders are actually being hoisted or carried.
- Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of **3.0** m.

2.2.2. Placing cylinders.

- Cylinders shall be kept far enough away from the actual welding or cutting operation so that sparks, hot slag, or flame will not reach them. When this is impractical, fire resistant shields shall be provided.
- Cylinders shall be placed where they cannot become part of an electrical circuit. Electrodes shall not be struck against a cylinder to strike an arc.
- Fuel gas cylinders shall be placed with valve end up whenever they are in use. They shall not be placed in a location where they would be subject to open flame, hot metal, or other sources of artificial heat.

- Cylinders containing oxygen or acetylene or other fuel gas shall not be taken into confined spaces.

2.2.3 Treatment of cylinders.

- Cylinders, whether full or empty, shall not be used as rollers or supports.
- No person other than the gas supplier shall attempt to mix gases in a cylinder. No one except the owner of the cylinder or person authorized by the owner, shall refill a cylinder. No one shall use a cylinder's contents for purposes other than those intended by the supplier.
- No damaged or defective cylinder shall be used.

2.2.4 Use of fuel gas. The employer shall thoroughly instruct employees in the safe use of fuel gas, as follows:

- Before a regulator to a cylinder valve is connected, the valve shall be opened slightly and closed immediately. (This action is generally termed “cracking” and is intended to clear the valve of dust or dirt that might otherwise enter the regulator.) The person cracking the valve shall stand to one side of the outlet, not in front of it. The valve of a fuel gas cylinder shall not be cracked where the gas would reach welding work, sparks, flame, or other possible sources of ignition.
- The cylinder valve shall always be opened slowly to prevent damage to the regulator. For quick closing, valves on fuel gas cylinders shall not be opened more than 1-1/2 turns. When a special wrench is required, it shall be left in position on the stem of the valve while the cylinder is in use so that the fuel gas flow can be shut off quickly in case of an emergency. In the case of manifold or coupled cylinders, at least one such wrench shall always be available for immediate use. Nothing shall be placed on top of a fuel gas cylinder, when in use, which may damage the safety device or interfere with the quick closing of the valve.
- Fuel gas shall not be used from cylinders through torches or other devices which are equipped with shutoff valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold.
- Before a regulator is removed from a cylinder valve, the cylinder valve shall always be closed and the gas released from the regulator.
- If on opening a fuel gas cylinder, leak is detected around the valve stem, the valve shall be closed and gland nut to be tightened. If this action does not stop the leak, the use of the cylinder shall be discontinued, and it shall be properly tagged and removed from the work area. In the event that fuel gas should leak from the cylinder valve, rather than from the valve stem, and the gas cannot be shut off, the cylinder shall be properly

tagged and removed from the work area. If a regulator attached to a cylinder valve effectively stops a leak through the valve seat, the cylinder need not be removed from the work area.

- If a leak should develop at a fuse plug or other safety device, the cylinder shall be removed from the work area.
- Cylinders not having fixed hand wheels shall have keys, handles, or nonadjustable wrenches on valve stems while in service. In multiple cylinder installations one and only one key or handle is required for each manifold.

2.2.5 Fuel gas and oxygen manifolds.

- Fuel gas and oxygen manifolds shall bear the name of the substance they contain in letters at least 1-inch high which shall be either painted on the manifold or on a sign permanently attached to it.
- Fuel gas and oxygen manifolds shall be placed in safe, well ventilated, and accessible locations. They shall not be located within non ventilated spaces.
- Manifold hose connections, including both ends of the supply hose that lead to the manifold, shall be such that the hose cannot be interchanged between fuel gas and oxygen manifolds and supply header connections. Adapters shall not be used to permit the interchange of hose. Hose connections shall be kept free of grease and oil.
- When not in use, manifold and header hose connections shall be capped.
- Nothing shall be placed on top of a manifold, when in use, which will damage the manifold or interfere with the quick closing of the valves.

2.2.6 Hose

- Fuel gas hose and oxygen hose shall be easily distinguishable from each other. The contrast should be made by different colors (Red for LPG/DA and black for Oxygen) Oxygen and fuel gas hoses shall not be interchangeable. A single hose having more than one gas passage shall not be used.
- All hose in use, carrying acetylene, oxygen, natural or manufactured fuel gas, or any gas or substance which may ignite or enter into combustion, or be in any way harmful to employees, shall be inspected at the beginning of each working shift. Defective hose shall be removed from service.
- Hose which has been subject to flashback, or which shows evidence of severe wear or damage, shall be tested to twice the normal pressure to

which it is subject, but in no case less than 300 psi. Defective hose, or hose in doubtful condition, shall not be used and be removed from site.

- Hose couplings shall be of the type that cannot be unlocked or disconnected (Use Jubilee clamp) by means of a straight pull without rotary motion.
- Boxes used for the storage of gas hose shall be ventilated.
- Hoses, cables, and other equipment shall be kept clear of passageways, ladders and stairs.
- Gas hoses and cable should not be allowed to touch each other and must have a minimum distance of 250mm between them, so that any heat or spark from the cable should not cause any fire in the gas hose.'

2.2.7 Torches.

- Clogged torch tip openings shall be cleaned with suitable cleaning wires, drills, or other devices designed for such purpose.
- Torches in use shall be inspected at the beginning of each working shift for leaking shutoff valves, hose couplings, and tip connections. Defective torches shall not be used and be removed from site.
- Torches shall be lighted by friction lighters or other approved devices, and not by matches or from hot work.
- Nozzle mixing cutting torches shall be used.

2.2.8 Regulators and gauges. Oxygen and fuel gas pressure regulators, including their related gauges, shall be in proper working order while in use.

2.2.9 Oil and grease hazards. Oxygen cylinders and fittings shall be kept away from oil or grease. Cylinders, cylinder caps and valves, couplings, regulators, hose, and apparatus shall be kept free from oil or greasy substances and shall not be handled with oily hands or gloves. Oxygen shall not be directed at oily surfaces, greasy clothes, or within a fuel oil or other storage tank or vessel.

2.3 Arc welding and cutting.

2.3.1 Manual electrode holders.

- Only manual electrode holders which are specifically designed for arc welding and cutting, and are capable of safely handling the maximum rated current required by the electrodes, shall be used.

- Any current-carrying parts passing through the portion of the holder which the arc welder or cutter grips in the hand, and the outer surfaces of the jaws of the holder, shall be fully insulated against the maximum voltage encountered to ground.

2.3.2 Welding cables and connectors.

- All arc welding and cutting cables shall be of the completely insulated, flexible type, capable of handling the maximum current requirements of the work in progress, taking into account the duty cycle under which the arc welder or cutter is working.

- Only cable free from repair or splices for a minimum distance of 3.0 m from the cable end to which the electrode holder is connected shall be used, except that cables with standard insulated connectors or with splices whose insulating quality is equal to that of the cable are permitted.

- When it becomes necessary to connect or splice lengths of cable one to another, substantial insulated connectors of a capacity at least equivalent to that of the cable shall be used. If connections are effected by means of cable lugs, they shall be securely fastened together to give good electrical contact, and the exposed metal parts of the lugs shall be completely insulated.

- Cables in need of repair shall not be used and removed from site. When a cable, other than the cable lead, becomes worn to the extent of exposing bare conductors, the portion thus exposed shall be protected by means of rubber and friction tape or other equivalent insulation.

2.3.3 Ground returns and machine grounding.

- A ground return cable shall have a safe current carrying capacity equal to or exceeding the specified maximum output capacity of the arc welding or cutting unit which it services. When a single ground return cable services more than one unit, its safe current-carrying capacity shall equal or exceed the total specified maximum output capacities of all the units it serves.

- Pipelines containing gases or flammable liquids, or conduits containing electrical circuits, shall not be used as a ground return.

- Under any circumstances, no structure or pipeline shall be used as ground return.

- The frames of all arc welding and cutting machines shall be grounded either through a third wire in the cable containing the circuit conductor or through a separate wire which is grounded at the source of the current. Grounding circuits, other than by means of the structure, shall be

checked to ensure that the circuit between the ground and the grounded power conductor has resistance low enough to permit sufficient current to flow to cause the fuse or circuit breaker to interrupt the current.

- All ground connections shall be inspected to ensure that they are mechanically strong and electrically adequate for the required current.

2.3.4 Safety Devices :

- ELCB/ RCCB shall be provided at the incoming side of welding machine.
- VRD (Voltage reducing device) shall be provided at the outgoing / secondary side of welding machine. These safety devices is to be used while doing the welding job in the following areas:

  i) Confined spaces like inside vessels, storage tank, tunnels etc.

  ii) Wet or damp location

  iii) Hot and Humid conditions

  iv) Working at heights

The safety device may not be used for the general fabrication jobs done at the shop floor & the area which is not hazardous as mentioned above. This safety device reduces the hazard of high voltage present at the welding electrodes only and does not replace the existing safe working practices during electrical arc welding. The device shall be installed as per the guidelines given by the supplier.

2.3.5 Operating instructions. Employers shall instruct employees about the safe means of arc welding and cutting as follows:

i) When electrode holders are to be left unattended, the electrodes shall be removed and the holders shall be so placed or protected that they cannot make electrical contact with employees or conducting objects.

ii) Hot electrode holders shall not be dipped in water; to do so may expose the arc welder or cutter to electric shock.

iii) When the arc welder or cutter has occasion to leave work or to stop work for any appreciable length of time, or when the arc welding or cutting machine is to be moved, the power supply switch to the equipment shall be opened.

iv) Any faulty or defective equipment shall be reported to the supervisor.

2.3.6 Shielding. All arc welding and cutting operations shall be shielded by noncombustible or flameproof screens which will protect employees, helpers and other persons directly looking at the arc.

2.3.7 Employee protection. Where welding or cutting operations are being performed in areas where it is possible for molten slag to come in contact with other employees, those employees shall be protected from being burned by providing overhead protection, by barricading the impact area, or other effective means.

2.4 Protective clothing:

2.4.1 General requirements: Employees exposed to the hazards created by welding, cutting, or brazing operations shall be protected by personal protective equipment in accordance with the requirements. Appropriate protective clothing required for any welding operation will vary with the size, nature and location of the work to be performed.

2.4.2 Specified protective clothing. Protective means which may be employed are as follows:

- Except when engaged in light work, all welders should wear flameproof gauntlet gloves. The welding gloves should be dry and free from holes and grease.
- Flameproof aprons made of leather, or other suitable material may also be desirable as protection against radiated heat and sparks.
- Cotton/Woolen clothing should be used while performing any gas cutting/welding. Outer clothing such as jumpers or overalls should be reasonably free from oil or grease.
- Sparks may lodge in rolled-up sleeves or pockets of clothing, or cuffs of overalls or trousers. It is therefore recommended that sleeves and collars be kept buttoned and pockets be eliminated from the front of overalls and aprons. Trousers or overalls should not be turned up on the outside.

  Note: *For heavy work, fire-resistant leggings, high boots, or other equivalent means should be used.*

- In protection work a sheet metal screen in front of the worker's legs can provide further protection against sparks and molten metal in cutting operations.
- Shoulder covers made of leather or other suitable materials should be worn during overhead welding or cutting operations. Leather skullcaps may be worn under helmets to prevent head burns.

2.5 Ventilation and protection in welding, cutting, and heating:

2.5.1 Mechanical ventilation. For purposes of this section, mechanical ventilation shall meet the following requirements:

- Mechanical ventilation shall consist of either general mechanical ventilation systems or local exhaust systems.

  General mechanical ventilation shall be of sufficient capacity and so arranged as to produce the number of air changes necessary to maintain welding fumes and smoke within safe limits.

- Local exhaust ventilation shall consist of freely movable hoods intended to be placed by the welder or burner as close as practicable to the work. This system shall be of sufficient capacity and so arranged as to remove fumes and smoke at the source and keep the concentration of them in the breathing zone within safe limits.

- Contaminated air exhausted from a working space shall be discharged into the open air or otherwise clear of the source of intake air.

- All air replacing that withdrawn shall be clean and respirable.

- Oxygen shall not be used for ventilation purposes, comfort cooling, blowing dust from clothing, or for cleaning the work area.

2.5.2 Welding, cutting, and heating in confined spaces.

- Either general mechanical or local exhaust ventilation meeting the requirements of clause 2.5.1 shall be provided whenever welding, cutting, or heating is performed in a confined space.

- When sufficient ventilation cannot be obtained without blocking the means of access, employees in the confined space shall be protected by air line respirators , and an employee on the outside of such a confined space shall be assigned to maintain communication with those working within it and to aid them in an emergency.

2.5.3 Welding, cutting, or heating of metals of toxic significance.

- Welding, cutting, or heating in any enclosed spaces involving the metals specified in this subsection shall be performed with either general mechanical or local exhaust ventilation meeting the requirements of clause 2.5.1:

  i. Zinc-bearing base or filler metals or metals coated with zinc-bearing materials.

  ii. Lead base metals;

  iii. Cadmium-bearing filler materials;

iv. Chromium-bearing metals or metals coated with chromium-bearing materials.

- Welding, cutting, or heating in any enclosed spaces involving the metals specified in this subdivision shall be performed with local exhaust ventilation in accordance with the requirements of clause 2.5.1, or employees shall be protected by air line respirators.

  i. Metals containing lead, other than as an impurity, or metals coated with lead-bearing materials;

  ii. Cadmium-bearing or cadmium-coated base metals;

  iii. Metals coated with mercury-bearing metals;

  iv. Beryllium-containing base or filler metals. Because of its high toxicity, work involving beryllium shall be done with both local exhaust ventilation and air line respirators.

- Employees performing such operations in the open air shall be protected by filter-type respirators. Except that employees performing such operations on beryllium-containing base or filler metals shall be protected by air line respirators.

- Other employees exposed to the same atmosphere as the welders or burners shall be protected in the same manner as the welder or burner.

2.5.4 Inert-gas metal-arc welding.

(a) Since the inert-gas metal-arc welding process involves the production of ultra-violet radiation of intensities of 5 to 30 times that produced during shielded metal-arc welding, the decomposition of chlorinated solvents by ultraviolet rays, and the liberation of toxic fuels and gases, employees shall not be permitted to engage in, or be exposed to the process until the following special precautions have been taken:

i. The use of chlorinated solvents shall be kept at least 200 feet, unless shielded, from the exposed arc, and surfaces prepared with chlorinated solvents shall be thoroughly dry before welding is permitted on such surfaces.

ii. Employees in the area not protected from the arc by screening shall be protected by filter lenses. When two or more welders are exposed to each other's arc, filter lens goggles of a suitable type shall be worn under welding helmets. Hand shields to protect the welder against flashes and radiant energy shall be used when either the helmet is lifted or the shield is removed.

iii. Welders and other employees who are exposed to radiation shall be suitably protected so that the skin is covered completely to prevent

burns and other damage by ultraviolet rays. Welding helmets and hand shields shall be free of leaks and openings, and free of highly reflective surfaces.

iv. When inert-gas metal-arc welding is being performed on stainless steel, the requirements of clause 2.5.3(b) shall be met to protect against dangerous concentrations of nitrogen dioxide.

2.5.5 General welding, cutting, and heating.

- Welding, cutting, and heating, not involving conditions or materials described in clauses 2.5.2, 2.5.3, and 2.5.4, may normally be done without mechanical ventilation or respiratory protective equipment, but where, because of unusual physical or atmospheric conditions, an unsafe accumulation of contaminants exists, suitable mechanical ventilation or respiratory protective equipment shall be provided.

- Employees performing any type of welding, cutting, or heating shall be protected by suitable eye protective equipment.

2.6 Welding, cutting, and heating in way of preservative coatings.

2.6.1 Before welding, cutting, or heating is commenced on any surface covered by a preservative coating whose flammability is not known, a test shall be made by a competent person to determine its flammability. Preservative coatings shall be considered to be highly flammable when scrapings burn with extreme rapidity.

2.6.2 Precautions shall be taken to prevent ignition of highly flammable hardened preservative coatings. When coatings are determined to be highly flammable, they shall be stripped from the area to be heated to prevent ignition.

2.6.3 Protection against toxic preservative coatings:

- In enclosed spaces, all surfaces covered with toxic preservatives shall be stripped of all toxic coatings for a distance of at least 4 inches from the area of heat application, or the employees shall be protected by air line respirators.

- In the open air, employees shall be protected by a respirator.

2.6.4 The preservative coatings shall be removed a sufficient distance from the area to be heated to ensure that the temperature of the un-stripped metal will not be appreciably raised. Artificial cooling of the metal surrounding the heating area may be used to limit the size of the area required to be cleaned.

2.7 CHECKING, CORRECTIVE & PREVENTIVE ACTION

Departmental HOD shall ensure implementation and regular compliance of above procedure through periodic interaction with Manager/Operators/Contractors and review of work permits system records. In case of any deviation, corrective and preventive action shall be immediately undertaken.

2.8 RECORD

- Concerned Sectional In-charge shall maintain record of work permits for Hot Job for at least one year.
- Record for Incident/Accident is to be maintained at the department and is also available at Safety Department for at least five years.
  Ensure if all persons left the place. They are informed not to return / restart work without a fresh permit.

Monitoring & Reviewing

Frequency	Mechanism	Record	Responsibility
Daily	Inspection of work permit issue	Record of work Permit	All Contractors, Consultant Contractors

Attachment - 1
Setting up the Equipment

Adhere to the following steps when setting up oxy-fuel equipment:

Step 1. When not in use, compressed fuel-gas cylinders must be secured in the upright position with cylinder valve protector caps in place. **Reason:** Cylinder valves can easily be knocked off, rapidly releasing the fuel gas and discharging the cylinder.

Step 2. Before installing a regulator on an oxygen or fuel cylinder, inspect the regulator valves and the cylinder valves for oil or contaminants. Do not use dirty components. Check the cylinder valves for leaks around the valve packing glands. Also check the cylinder valve threads for damage. **Reason:** Oil and grease in the presence of oxygen can cause an explosion. Dirt and foreign matter can prevent the regulator and the cutting equipment from working properly. Loose cylinder valves or fittings allow leaks.

Step 3. Standing to one side of the valve nozzle, crack the cylinder valves. (If the cylinder must be opened in a confined space, do this carefully.) **Reason:** This technique will blow any dirt out of the nozzle without injuring the operator.

Step 4. Release the tension on the regulator by adjusting the screw counterclockwise. Attach the regulator to the cylinder. Do not over-tighten the regulator compression nuts at the cylinder valves. **Reason:** This technique prevents damage to the regulator diaphragm and to the regulator valve seat. Also, this will not give the operator a "full system" of gases before he or she can check the hose and torch. Over-tightening pulls the threads on both the regulator valves and the cylinder valves, eventually causing leaks.

Step 5. Open the oxygen cylinder valve slowly, standing on one side of the regulator and the gauge. **Reason:** This technique limits the risk of explosions and injuries to the operator. These accidents typically occur in the front or the back of the regulator and the gauge.

Step 6. Fully open the oxygen cylinder valve. Reason: The oxygen valve tightly seals when it is fully open or fully closed, but may leak when it is in an intermediate position.

Step 7. Open the fuel-gas cylinder valve. (Acetylene cylinder valves should not be opened more than 3/4 turn. Other cylinder valves may be opened fully.) **Reason:** The fuel-gas cylinder valve (other than acetylene) tightly seals when it is fully open or fully closed, but it may leak when it is in an intermediate position.

Step 8. Attach the hose to the regulator. If the hose is new or has been out of service, purge it for five seconds for every 50 feet (15 meters) of hose. **Reason:** Purging removes contaminants from the hose, ensuring that it does not contain an explosive mixture of residual fuel gas and air.

Step 9. Check the seating surfaces and the O-rings of the torch. Assemble the torch. **Reason**: This technique reduces the risk of leaks that could cause a fire.

Step 10. Check the orifice of the nozzle. If it is blocked, clean it only with a nozzle cleaning tool. Do not rub the cutting or heating tip on any soft material (such as wood) to clean the tip. **Reason:** Cleaning the nozzle removes any obstructions, a prime cause of backfires.

Attachment -2
Lighting the Torch

Adhere to the following steps when lighting the torch:

Step 1. Open the fuel-gas valve on the torch. Then set the fuel-gas cylinder regulator to the recommended pressure: not more than 30 psi (205 kPa) for fuel gas, and less than 15 psi (105 kPa) for acetylene. Close the torch fuel-gas supply valve, then the fuel-gas cylinder valve. Watch the regulator pressure gauges. If the pressure drops, check for leaks in the assembly. If the pressure remains constant, reopen the fuel-gas cylinder valve slowly. **Reason:** These techniques set the correct pressure, check for leaks, and purge the line of any explosive gas mixtures.

Step 2. Open the oxygen valve on the torch. Then set the oxygen cylinder regulator to the recommended pressure per the tip manufacturer's tip chart, but not to exceed 80 psi (550 kPa). Close the torch oxygen supply valve, then the oxygen cylinder valve. Watch the regulator pressure gauges. If the pressure drops, check for leaks in the assembly. If the pressure remains constant, reopen the oxygen cylinder valve slowly. **Reason:** These techniques set the correct pressure, check for leaks, and purge the lines of explosive gas mixtures.

Step 3. Open only the torch fuel-gas valve to a high flow rate. Light the torch with an approved spark lighter. **Reason:** A high flow of fuel gas cuts down on smoke. Lighting only fuel gas reduces the risk of flashback.

Step 4. Reduce the gas flow until the flame starts to smoke. Open the oxygen valve on the torch slowly to get the desired flame. **Reason:** This technique sets the correct flow of fuel gas and oxygen for the torch tip. If less heat is required

for heating, welding, or brazing, change the tip. Do not reduce the pressure or the flow of either fuel gas or oxygen.

Attachment - 3
Re-Lighting the Torch

Adhere to the following steps when re-lighting the torch:

Step -1: Always re-purge the system by opening and re-closing the fuel gas torch valve. **Reason**: This technique removes any explosive mixtures that may have accumulated in the system.

Step -2: Re-purge the oxygen line by opening and re-closing the oxygen torch valve. **Reason:** This technique removes any explosive mixtures that may have accumulated in the system.

Step -3: Open only the torch fuel-gas valve to a high flow rate. Light the torch with an approved spark lighter. **Reason:** A high flow of fuel gas cuts down on smoke. Lighting only fuel gas reduces the risk of flashback.

Step -4: Step 4: Reduce the gas flow until the flame starts to smoke. Open the oxygen valve on the torch slowly to get the desired flame. **Reason:** This technique sets the correct flow of fuel gas and oxygen for the torch tip. If less heat is required for heating, welding, or brazing, change the tip. Do not reduce the pressure or the flow of either fuel gas or oxygen.

Attachment - 4
Closing the System

Adhere to the following steps when closing the system:

Step -1: Close the oxygen valve on the torch first. Then close the fuel-gas valve on the torch. Reason: If the oxygen valve leaks, the system may backfire. If the fuel-gas valve leaks, the flame will not go out. Either situation indicates that the equipment is defective and requires immediate repairs before continuing use.

Step -2: Close both cylinder valves. Release the hose pressure by opening the torch valves and allowing gas to escape from the system. Reason: This technique prevents leaks and fires. It also prepares the equipment for the next start-up.

Step -3: Close both regulator valves by releasing the tension on the regulator screw.

Step -4: When the regulator screw is turned counterclockwise, the valve is closed, and when turned clockwise, the valve is opened. **Reason:** This technique prepares the equipment for the next start-up.

Attachment – 5
Guidelines for Conducting Quarterly Tests

Use the following guidelines for quarterly testing of specific parts of oxy-fuel equipment.

Regulators and Gauges

1. Visually inspect for damage all components of fuel-gas and oxygen regulators, including the following:

   – compression nipples and nuts
   – filter screens in the inlet nozzles
   – gauges
   – regulator adjusting screws

2. Attach the fuel-gas and the oxygen regulators to inert gas or oil-free air systems for testing. Use transition test nipples for testing.
3. Release regulator-adjusting screws counterclockwise. Then open the cylinder valve and verify that the high-pressure gauge is operating properly. If no inert gas or air flows through the regulator when the cylinder valve is opened, the regulator adjustment valve is in good condition and the regulator diaphragm is not damaged.

4. Block with a valve the outlet nozzle of the regulator using a plug or hose.

5. Adjust the regulator-adjusting screw clockwise until the low-pressure gauge indicates a normal operating pressure. Use soapy water to inspect the regulator and gauge connections for leaks.

6. Close the cylinder valve, and watch the gauges for a drop in pressure. A drop in pressure indicates a leak. Reopen the cylinder valve, and check the low-pressure gauge for any slight drop in pressure (needle creep). Gauge needle creep greater than 2 to 3 psi (14 to 20 kPa) indicates that the diaphragm is damaged.

Hoses

1. Visually inspect each length of hose for burns, worn areas, decay, and other defects. If defects are found those could cause leaks, remove the hose from the system.

2. Pressurize each length of hose, and run it through a water vat to check for leaks. Use inert gas or oil-free air for this test at a pressure sufficient to indicate leaks, typically between 15 and 80 psi (103 and 550 kPa). Any length of hose that cannot be tested in the water vat must be tested with soapy water. Replace any length of hose that has leaks.

Combination Reverse-Flow Check Valves and Flame Arresters:

1. Visually inspect each check valve/arrester to verify that the inlet nozzle is free of oxidation, burns, and other defects.

2. Visually inspect each check valve/arrester by using reverse-flow pressure in the outlet nozzle to verify that the check valve is sealing. For this test, either blow through the unit or use inert gas or oil-free air at a pressure between 1 and 10 psi(7 and 70 kPa), sufficient to close the check valve.

3. Replace, but do not repair, defective check valves/arresters.

3. Between inspections and tests, if the units have significant backfires or flashbacks, remove the check valve/arrester for additional inspections and tests.

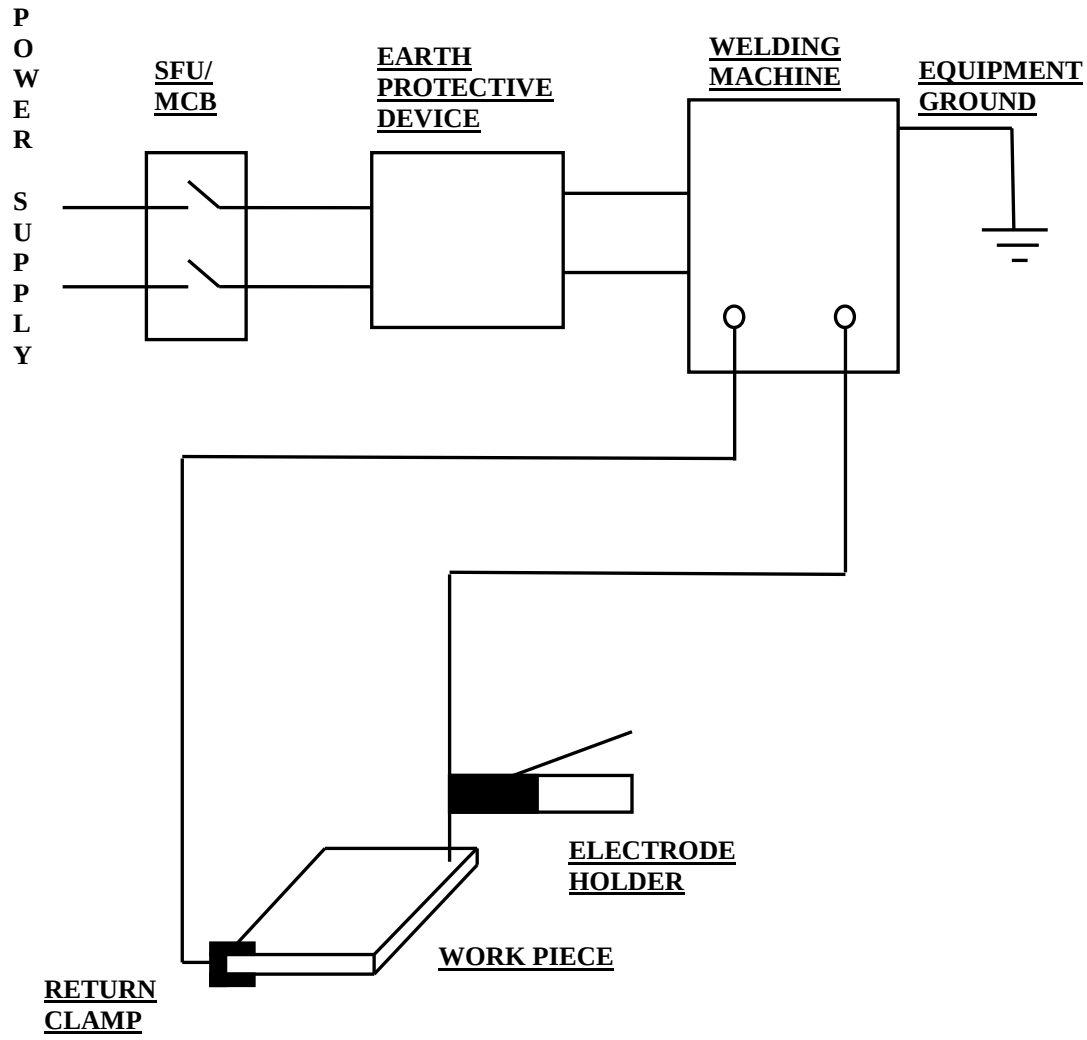
Cutting Torches and Mixing Chambers

1. Visually inspect for damage to all components of each torch and mixing chamber, including the following:
   – the O-rings on the torch
   – the seating surface in the mixing chamber
   – the cutting tip seating surface in the torch head

2. Test the complete system, including cutting torches and mixing chambers, by following the instructions for setting up the system, lighting the torch, and re-lighting the torch as stated in earlier attachments.

Electrical Circuit Diagram of Welding

NOTE- VRD Should be placed after the welding machine and before the electrode holder and return clamp



The checklist for Welding and gas cutting also includes the checklist of Storage, Handling and Use of gas cylinder

Checklist

Points.	Yes	No	NA
1. Is work permit in Form No – EHSMSM/WORKS/446/4007 issued to working agency before start of the job?			
2. Is the additional work permit issued to the agency if the job is to be carried out at height (more than 2 meter) / confined space/gaseous hazardous area/near electrical installation?			
3. Do all the manual transformer based welding machines contain manufacturer's name and detail technical specification?			
4. Is the gas storage area isolated, protected from sunlight, with adequate ventilation?			
5. Is the gas storage area free from salt and corrosive chemicals fumes and heat?			
6. Are full and empty cylinders stored separately?			
7. Are incompatible gas cylinders stored maintaining gap of 3 meters?			
8. Are cylinders kept upright and chained?			
9. Are cylinder caps in position when not in use?			
10. Are cap guards, collar coding and warning sticker as per Gas Cylinder Rules, 1981?			
11. Are more than 5 LPG cylinders stored? If yes, check license number?			
12. Are hoses, red for acetylene &black/green for oxygen?			
13. Are nozzle tips of gas cutters clean, in order to avoid back fire?			
14. Is 12" long wrench available to open the main valve?			
15. Are leak tests conducted?			
16. Is contingency plan available (building evacuation routes, emergency telephone numbers, chemical containment procedures, fire extinguisher usage)?			
17. Are all the hoses, torches checked before each shift?			
18. Is the flammability of the area checked?			

19. Is the name of the gas written prominently on manifolds?			
20. Are all the hose connections, oxygen cylinder and fittings free from grease and oil?			
21. Are the falling of spatter from height prevented by proper barricading?			
22. Are all arc welding and cutting cables completely insulated, flexible type and capable of handling the maximum current requirement of the work?			
23. Are all the exposed portion of the cable protected by suitable rubber and friction tape or other equivalent insulation?			
24. Are all frames of arc welding and cutting machine grounded properly?			
25. Is Wesguard safety device put in place, where required?			
26. Is the fire extinguisher available in the working area with readiness for use?			
27. Is there proper ventilation system in place, when the welding, cutting or heating is performed in confined space?			
28. Is the flammability test conducted if welding, cutting, heating to be done on the surface covered by a preserve coating?			
29. Is the working area free from all inflammable materials?			
30. Are all the work permits for hot job being recorded?			
31. Is there an arrangement for collecting the spatters at source?			
32. Is IR(Insulation Resistance) value of the Welding Machine >2 M-Ohm, measured with 500 Volt Megger			
33. Is the welding machine connected with separate circuit breaker or Switch Fuse Unit (SFU)			
34. Is Earth Leakage Protective Device used			