BASIC METAL WORK

Level-I

Learning Guide-45

Unit of Competence: **Perform Cutting Using Oxyacetylene Process**

Module Title: **Performing Cutting Using Oxyacetylene Process**

LG Code: **IND BMW1 M14 1019LO1-LG 45**

TTLM Code: **ND BMW1 TTLM1019V1**

LO1: Plan and select cutting work

Instruction Sheet	Learning Guide 45

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- OHS procedures
- Selecting and preparing Cutting equipment and consumables
- Preparing materials

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- OHS procedures
- Select and prepare Cutting equipment and consumables
- Prepare materials

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 **,** If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ”
5. Do the “LAP test (if you are ready).

Information Sheet-1	OHS procedures

1.1. INTRODUCTION

Cutting with the oxy-fuel process is just the opposite from of welding. Oxy-fuel cutting uses acetylene and oxygen to preheat metal to red hot and then uses pure oxygen to burn away the preheated metal. Because this is achieved by oxidation, it is only effective on metals that are easily oxidized at this temperature. Such metals are mild steel and low allow steels. Oxy-fuel cutting can be used to cut thicknesses from 2/8″ to up to 12″.

Traditionally oxy-fuel processes are used for brazing, fusion welding, flame hardening, metalizing, soldering, stress relieving, cutting and bending. The primary uses today are welding, brazing and cutting. This course describes the basic concepts of oxy-fuel welding and cutting including what equipment and safety precautions are needed.

1.1.1 Following safety procedures

Safety in gas welding, cutting and similar processes

Introduction

Oxy/fuel gas equipment has many uses - welding, cutting, heating, straightening, and descaling. The equipment is versatile, easy to move and cheap. It is so widely used that sometimes people forget about the dangers. Many people are injured each year by the incorrect or careless use of oxy/fuel gas equipment. Some people die. This leaflet describes the hazards associated with portable oxy/fuel gas equipment and the precautions for avoiding injury and damage to property.

The main hazards are:

- fire caused by heat, sparks, molten metal or direct contact with the flame;
- explosion when cutting up or repairing tanks or drums which contain or may have contained flammable materials;
- fire/explosion caused by gas leaks, backfires and flashbacks;

- fumes created during flame cutting;
- fire/burns resulting from misuse of oxygen;
- burns from contact with the flame or hot metal;
- crushing or impact injuries when handling and transporting cylinders.

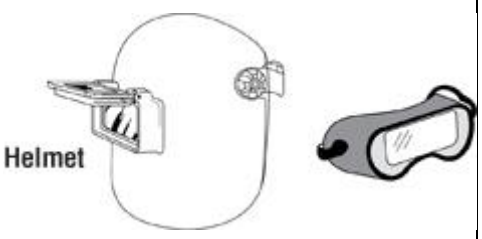
Fig 1.1 proper safety clothing

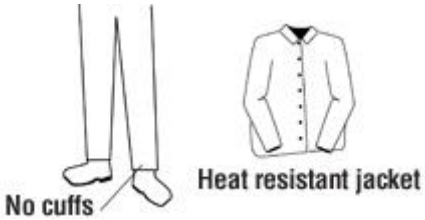
Cutting - Personal Protective Equipment and Clothing

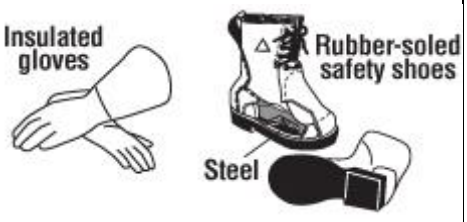
What type of PPE is available when cutting?

The chart below summarizes the types of personal protective equipment that can be used when welding and cutting.

Table 1.1 Personal protective equipment

Welding - Personal Protective Equipment			
Body Part	**Equipment**	**Illustration**	**Reason**
Eyes and face	Welding helmet, hand shield, or goggles		Protects from: • radiation • flying particles, debris • hot slag, sparks • intense light

			• irritation and chemical burns Wear fire resistant head coverings under the helmet where appropriate
Lungs (breathing)	Respirators		Protects against: • fumes and oxides
Exposed skin (other than feet, hands, and head)	Fire/Flame resistant clothing and aprons		Protects against: • heat, fires • burns • radiation Notes: pants should not have cuffs, shirts should have flaps over pockets or be taped closed
Ears – hearing	Ear muffs, ear plugs		Protects against: • noise Use fire resistant ear muffs where sparks or splatter may enter the ear, rather than plugs.

Feet and hands	Boots, gloves		Protects against: • electric shock • heat • burns • fires

Why is eye protection important?

Eye injury can occur from the intense light and radiation that a welding arc can produce. Eye injury can also occur from hot slag and other metal debris that can fly off from the weld during cooling, chipping or grinding.

- Protect your eyes from welding light by wearing a welder's helmet fitted with a filter shade that is suitable for the type of welding you are doing.
- ALWAYS wear safety glasses with side shields or goggles when chipping or grinding a work piece if you are not wearing a welding helmet.

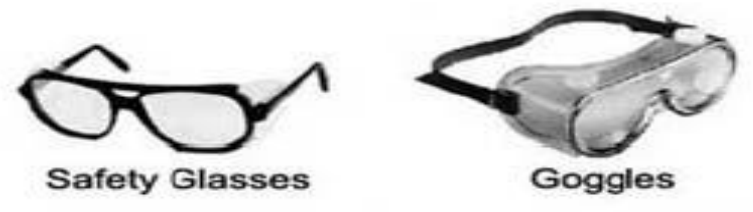


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Fig. 1.2.Welding goggles.

What type of eye and face protection is appropriate for my cutting task?

The various types of eye protection are broken down into classes in the CSA standard Z94.3-15 "Eye and face protectors". Each class is designed for a specific use. Eye and

face protectors should have distinctive markings to identify the manufacturer and their class. Classifications of common protectors for welding operations are listed below:

- Class 2C – direct / non-ventilated goggles with non-ionizing radiation protection
- Classes 3 and 4 – welding helmets and hand shields
- Class 6B – face shields for non-ionizing radiation protection
- Class 7B – respirator face piece for non-ionizing radiation protection

The following operations require full face protection by using either a welding helmet or a hand shield:

- arc welding,
- plasma arc cutting, gouging or welding, and
- Air carbon arc cutting.

For gas cutting, welding, or brazing, the intensity of the light is much less than from arc welding, cutting or gouging processes. Lighter shade filter lenses can be used with goggles in place of a helmet.

More information can be found in the OSH Answers on Eye and Face Protectors.

What are the various components of welding hand shields and helmets?

Hand shields or helmets provide eye protection by using an assembly of components:

- Helmet shell - must be opaque to light and resistant to impact, heat and electricity.
- Outer cover plate made of polycarbonate plastic which protects from radiation, impact and scratches.
- Filter lens made of glass containing filler which reduces the amount of light passing through to the eyes. Filters are available in different shade numbers

ranging from 2 to 14. The higher the number, the darker the filter and the less light pass through the lens.

- Clear retainer lens made of plastic prevents any broken pieces of the filter lens from reaching the eye.
- Gasket made of heat insulating material between the cover lens and the filter lens protects the lens from sudden heat changes which could cause it to break. In some models the heat insulation is provided by the frame mount instead of a separate gasket.

What else should you know about eye protection?

- Choose a tight fitting helmet to help reduce light reflection into the helmet through the space between the shell and the head.
- Wear the helmet correctly. Do not use it as a hand shield.
- Protect the shade lens from impact and sudden temperature changes that could cause it to crack.
- Use a cover lens to protect the filter shade lens. Replace the cover lens if it gets scratched or hazy.
- Make sure to replace the gasket periodically if your helmet uses one.
- Replace the clear retaining lens to protect your eyes from broken pieces.
- Clean lenses periodically.
- Discard pitted, cracked or damaged lenses

What should you know about filter shade selection?

For Arc welding, the correct filter shade is selected according to the welding process, wire diameter, and operating current. The table below gives the correct shade numbers for different situations.

- ALWAYS use suggested shade numbers instead of minimum shade numbers. The values below are from CSA Standard W117.2-12 Safety in welding, cutting and allied processes. Other processes are listed in the Standard.

- Provide additional task lighting that suits welders' needs.
- Use the same shade as the welder's if you are directly observing the welding arc.
- Do not use gas welding goggles for arc welding.
- Do not substitute modified glasses, sunglasses, smoked plastic or other materials for proper welding lenses.

The recommended shade numbers for oxygen cutting are shown in the table below.

Table 1.2. Shade numbers for cutting process

Shade Numbers for Cutting (from CSA W117.2)

Process	Plate Thickness (in mm)	Minimum Shade #	Suggested Shade #
Light	< 25	3	4
Medium	25 - 150	4	5
Heavy	> 150	5	6

** In the US use ANSI/AWS Standard F2.2 for selecting filter lens shade.*

Can you wear contact lenses when cutting?

The CSA Standard W117.2 states that contact lenses should not be worn by welders and welding personnel because foreign bodies (objects) in the eye can cause excessive irritation. Contact lenses do not provide protection from ultraviolet radiation and flying objects. All workers in proximity to welding procedures must wear appropriate eye protection according to the circumstances. The OSH Answers document Contact Lenses at Work discusses how dust particles or chemicals can irritate the eyes.

1.2. Safety in Oxy-acetylene cutting

1.2.1. Procedures in oxy-acetylene cutting

1. Move the work piece to a safe location for carrying out hot work;
2. Remove nearby combustible materials (such as flammable liquids, wood, paper, textiles, packaging or plastics);
3. Protect nearby combustible materials that cannot be moved. Use suitable guards or covers such as metal sheeting, mineral fiber boards or fire-retardant blankets;
4. Check that there are no combustible materials hidden behind walls or in partitions, particularly if the welding or cutting will go on for some time. Some wall panels contain flammable insulation materials, e.g. polystyrene;
5. Use flame-resistant sheets or covers to prevent hot particles passing through openings in floors and walls (doorways, windows, cable runs, etc);
6. If the consequences of a fire are severe, e.g. work inside ships, you may need to appoint a fire watch during and after the work finishes. It is normal to maintain fire watch for 30 minutes after hot work finishes;
7. Prevent flame, heat, sparks or hot spatter from landing on the hoses; keep fire extinguishers nearby.
8. Never use an oxy/fuel gas blowpipe on a drum or tank that has contained, or may have contained, flammable material, unless you know it is safe. It may be safer for a specialist company to carry out the work. If in doubt, ask.
9. Avoid welding or flame cutting on wheels which have tires fitted, even if the tyre is deflated.
10. Checking for leaks

If you can’t remove the tire, use cold cutting methods, e.g. a saw or hydraulic shears

The following precautions will help to prevent leaks:

1. turn the gas supply off at the cylinder when the job is finished or before the cylinders are moved or transported;
2. isolate and purge or remove hoses and equipment from enclosed or poorly ventilated spaces when there is a break in work;

3. keep hoses away from sharp edges and abrasive surfaces or where vehicles can run over them;
4. do not allow hot metal or spatter to fall on hoses;
5. Maintain all equipment and regularly check its condition.

6. Regularly check all connections and equipment for faults and leaks. Equipment used in aggressive conditions such as demolition work or heavy engineering will normally need more frequent checks, e.g. weekly.

7. Use a proprietary leak detecting spray or solution suitable for use with oxy/fuel systems. Do not use soapy water or solutions containing grease or oils on oxygen systems.
8. Never look for gas leaks with a naked flame.
9. Immediately repair or replace leaking components.
10. Leaking hoses should not be repaired, but they can be shortened to remove a damaged section. Refit hose tails using crimp clips designed for that task. Screw tightened crimps (jubilee clips) are not recommended. There is a risk of leaks due to over tightening or under tightening them.

Cylinder leaks when the valve is closed

i. If it is safe to do so, move the cylinder outside and away from sources of ignition (naked flames, sparks, electric motors, etc.). Prevent unauthorized access and notify the cylinder supplier immediately.

Self Check 1	Multiple choice

NAME_____ DATE_____

1. The cutting helmets protects from?

A.radiation B. intense light C. A and B D. none

2. The fire/burns resulting from misuse of _____

A.nitrogen B.oxygen. C. helium D.ALL

3. Oxy/fuel gas equipment has many uses which are?

A. cutting B.heating. C. straightening D. all

Information Sheet – 2	Selecting and preparing Cutting equipment and consumables

2.1. Introduction

2.1. **Selecting and preparing cutting equipment and consumables**

One of the fastest ways of cutting ferrous metals is by the use of the oxyacetylene torch. Other advantages of this cutting method are:

1. A relatively smooth cut is produced.
2. Very thick steel (over 4 feet) can be cut.
3. The equipment is portable.
4. Underwater cutting is possible with some adaptations.
5. The equipment lends itself to automatic processes in manufacturing.

The terms “cutting” and “burning” are used interchangeably to describe this process. Oxyacetylene flame cutting is actually a burning process in which the metal to be cut is heated on the surface to the kindling temperature of steel,(1,600• 1,800 degrees F.). A small stream of pure oxygen is then directed at the work. The oxygen causes the metal to ignite and burn to produce more heat. This additional heat causes the nearby metal to burn so that the process is continuous once it has started.

Only those ferrous metals which oxidize rapidly can be flame-cut. These metals include all the straight carbon steels and many of the alloys. Stainless steels and most of the so-called high-speed steels cannot be flame-cut.

In **oxy-fuel cutting**, a cutting torch is used to heat metal to kindling temperature. A stream of oxygen is then trained on the metal and metal burns in that oxygen and then flows out of the cut as an oxide slag.

2.2. Cutting equipment

Cutting is done with a special torch fitted with interchangeable tips so that it can be adapted to cut a wide variety of metal thicknesses. The torch and tips are constructed so that they can preheat the work to the kindling temperature. The torch also include

sleve for turning on and stopping the stream of high-pressure cutting oxygen as required.

- **Cutting torch**

The torch is usually made of forged brass and brasses tubing, for hand-manipulated flame-cutting operations, the tips are made of copper. If the tip of the torch is used as a hammer, lever, or crowbar, permanent damage is done.

A **cutting torch** head is used to cut materials. It is similar to a welding torch, but can be identified by the oxygen blow out trigger or lever.

The metal is first heated by the flame until it is cherry red. Once this temperature is attained, oxygen is supplied to the heated parts by pressing the "oxygen-blast trigger". This oxygen reacts with the metal, forming iron oxide and producing heat. It is this heat that continues the Cutting process. The cutting torch only heats the metal to start the process; further heat is provided by the burning metal.

The melting point of the iron oxide is around half that of the metal; as the metal burns, it immediately turns to liquid iron oxide and flows away from the cutting zone. However, some of the iron oxide remains on the work piece, forming a hard "slag" which can be removed by gentle tapping and/or grinding.

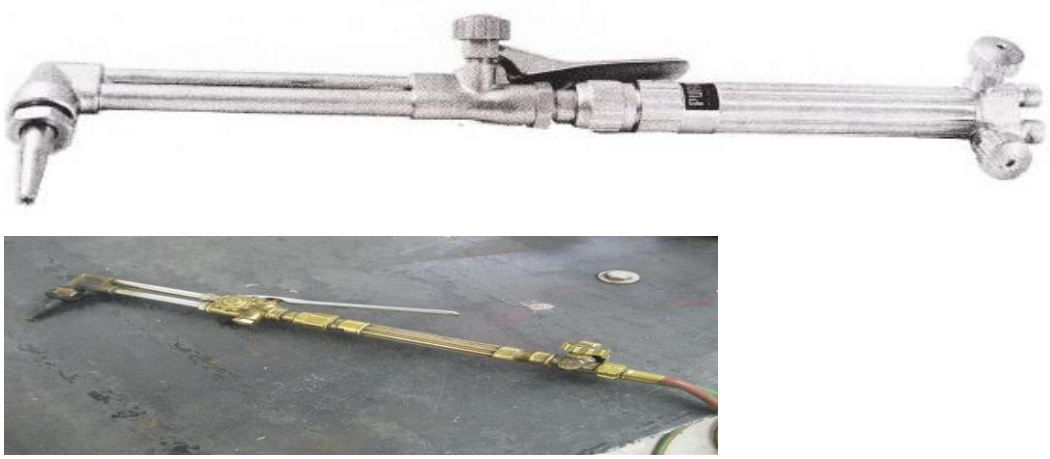


Fig.1.3. Cutting torches.

The torch's trigger blows extra oxygen at higher pressures down the torch's third tube out of the central jet into the work piece, causing the metal to burn and blowing the resulting molten oxide through to the other side. The ideal kerf is a narrow gap with a sharp edge on either side of the work piece; overheating the work piece and thus melting through it causes a rounded edge.

Oxygen Rich Butane Torch Flame

Fuel Rich Butane Torch Flame

Fig.1.4.cutting flame

Cutting a rail

A cutting torch is used to cut a steel pipe

Fig.1.5 cutting operations.

- **Gauges**

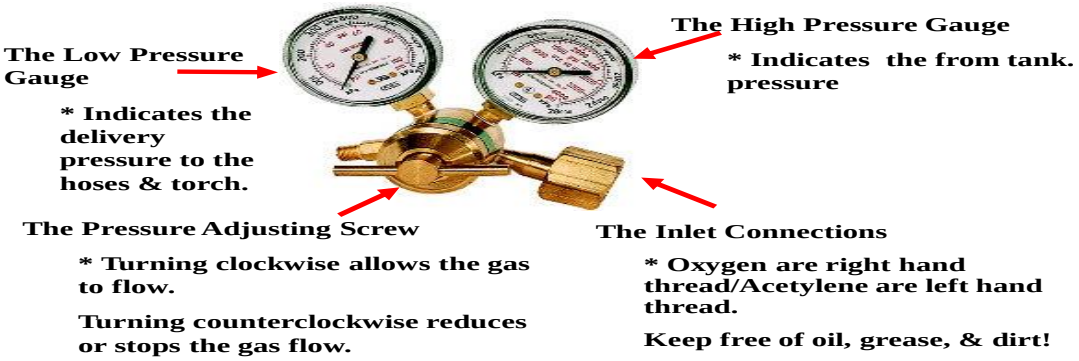


Fig.1.6. parts of gauge.

The hoses

- The hoses are usually color coded.

  -Oxygen (green).

  -acetylene (red.)

be carefull not use to other type of hoses!!

- They are neoprene over braided inner section.
  be careful around sharp objects they can be cut very easily.
- They are constructed of flame retardant materials ,but will burn if there is a flashed back or exposed to sustained heat .
- Hoses are draded.
- Make sure you are using the right hoses for the right gas.

Fig.1.6.parts of hose

Note: You have to select the following correct cutting outfit *equipment* including its accessories to start cutting procedures for using oxy acetylene cutting process.

1. Gauge

2. Cutting torch

3. Flash back arrestors

4. Cutting nozzle

1. **Cylinder opener**

2. **Hose connectors and clamps**

Fig 1.7. Oxyacetylene Cutting accessories

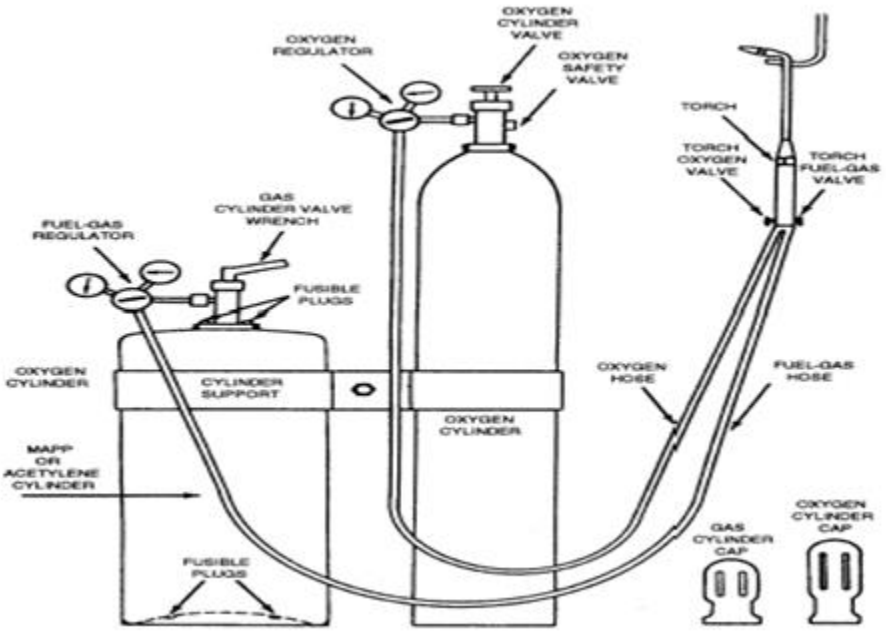


Fig1.8.Oxy-gas cutting outfit.

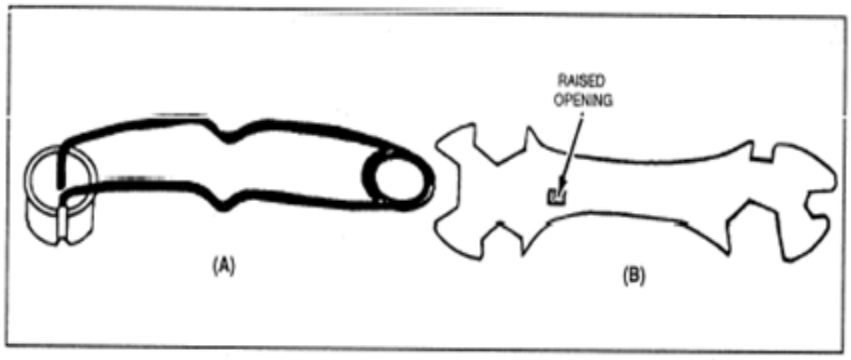


Fig 1.9 (A) spark igniter, (B) Apparatus wrench.

- **Oxygen Cylinder**

Usually painted blue color. This is done in order to avoid confusion.

Oxygen cylinder is drawn from a piece of high strength steel plate and is available in common sizes of:

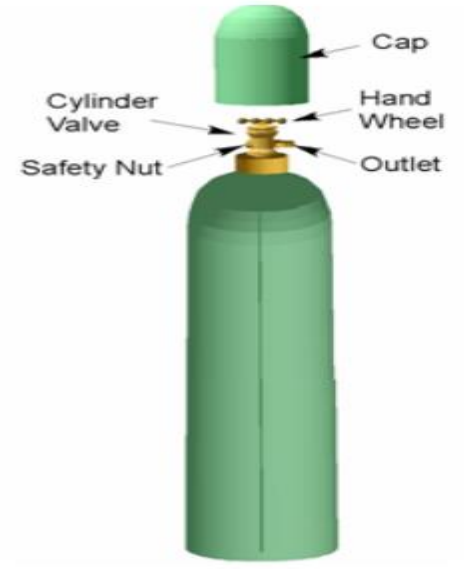


Fig 10. Oxygen cylinder

- **Acetylene Cylinder**

An acetylene cylinder is also a solid drawn steel cylinder and the common sizes are 300,120 and 75 cubic feet. Cylinder pressure is 250 PSI when filled. An acetylene cylinder is painted maroon and the valves are screwed **left handed** (with grooved hex on nut or shank).

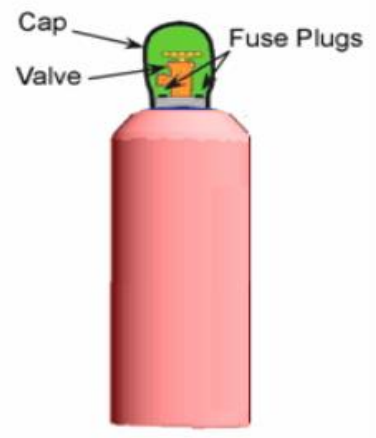


Fig 11.Acetylene Cylinder

- **Gas Hoses and Clamps:**

The hoses used to make the connections between the torch and the regulators must be strong, nonporous, light, and flexible enough to make torch movements easy. The most common type of cutting and welding hose is the twin or double hose that consists of the fuel hose and the oxygen hose joined together side by side.

Size is determined by the inside diameter, and the proper size to use depends on the type of work for which it is intended. Hose used for light work has a 3/1 6 or 1/4 inch inside diameter and one or two plies of fabric. For heavy-duty welding and cutting operations, use a hose with an inside diameter of 5/1 6 inch and three to five plies of fabric. Single hose is available in the standard sizes as well as 1/2-, 3/4-, and 1-inch sizes. These larger sizes are for heavy-duty heating and for use on large cutting machines.

- ✓ **Rubber Hoses**

Fig 12.rubber hoses

2.3. Consumable materials

- **Fuel gas properties and application**

Oxy-fuel cutting (commonly called oxyacetylene welding, oxy welding, or gas welding in the U.S.) and oxy-fuel cutting are processes that use fuel gases and oxygen to weld and cut metals, respectively. French engineers Edmond Fouché and Charles Picard became the first to develop oxygen-acetylene welding in 1903. Pure oxygen, instead of air (20% oxygen/80% nitrogen), is used to increase the flame temperature to allow localized melting of the work piece material (e.g. steel) in a room environment.

A common propane/air flame burns at about 3,630 °F (2,000 °C), a propane/oxygen flame burns at about 4,530 °F (2,500 °C), and an acetylene/oxygen flame burns at about 6,330 °F (3,500 °C). Oxy-fuel is one of the oldest welding processes, though in recent years it has become less popular in industrial applications. However, it is still widely used for welding pipes and tubes, as well as repair work. It is also frequently well-suited, and favored, for fabricating some types of metal-based art work.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid Some explanations/answers.

1. The color coded for oxygen hose is _____.

   a.yellow b. white c. green d. red

2. Which one of the following is the fastest ways of cutting ferrous metals?

   a. by hack saw b. by oxyacetylene torch c.by arc welding green d. a and b

3. An acetylene cylinder is painted _____color.

   a. maroon b. black c. Green d. yellow

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet – 3	Preparing material

3.1. Material preparations for oxy- acetylene cutting

The equipment and accessories for oxy-gas cutting are the same as for oxy-gas welding except that you use a cutting torch or a cutting attachment instead of a welding torch. The main difference between the cutting torch and the welding torch is that the cutting torch has an additional tube for high-pressure oxygen, along with a cutting tip or nozzle.

The tip is provided with a center hole through which a jet of pure oxygen passes. Mixed oxygen and acetylene pass through holes surrounding the center holes for the preheating flames. The number of orifices for oxyacetylene flames ranges from 2 to 6, depending on the purpose for which the tip is used. The cutting torch is controlled by a trigger or lever operated valve. The cutting torch is furnished with interchangeable tips for cutting steel from less than ¼" to more than 12.0" in thickness.

If equipment from other manufacturers is used, refer to the chart, "Comparison Guide of Cutting Tips uses' and choose a tip with a cutting or orifice size comparable to that indicated below**,**

Table 3.1 List of cutting Tips and sizes.

THICKNESS OF STEEL	1/4"	3/8"	1/2"	3/4"	1"	1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"
AIRCO TIP SIZE	0	1	1	2	2	2	3	3	4	5	5	6	6
GAGE PRESSURE OXYGEN P.S.I.	30	30	40	40	50	60	45	50	50	45	60	50	55
GAGE PRESSURE ACETYLENE P.S.I.	3	3	3	3	3	3	3	3	3	4	4	5	5
SPEED IN INCHES PER MIN.	20	19	17	15	14	13	12	10	9	8	7	6	5
OXYGEN CON-SUMPTION CU. FT. PER HOUR	50	75	90	120	140	160	185	200	250	310	385	460	495
ACETYLENE CON-SUMPTION CU. FT. PER HOUR	9	12	12	14	14	14	16	16	17	22	22	28	28
APPROXIMATE WIDTH OF KERF IN INCHES	.075	.095	.095	.110	.110	.110	.130	.130	.145	.165	.165	.190	.190
CUTTING ORIFICE CLEANING DRILL SIZE	64	57	57	55	55	55	53	53	50	47	47	42	42
PREHEAT ORIFICE CLEANING DRILL	71	69	69	68	68	68	66	66	65	63	63	61	61

3.2. MATERIAL PREPARATION METHOD

3 . 2 . 1 Cutting

Cutting and preparing the base metal to the required dimensions from the original material available is necessary before welding them. Different methods used to cut metals are:

1. By chiseling the sheets
2. By hack-sawing
3. By shearing using hand lever shear
4. By using guillotine shear
5. By gas cutting

For thin sheets the first 4 methods are used. For thick materials method 2, 4 and 5 are used.

Tools and equipments used to cut metals:

1. Cold chisel
2. Hacksaw with frame
3. Hand lever shear
4. Guillotine shear
5. Oxy-acetylene cutting torch

The cut edges of the sheet or plate are to be filed to removed burrs and to make the edges to be square (at 90° angle) with each other. For ferrous metal plates, which are more than 3mm thick, the edges can be prepared by grinding them on a bench/ pedestal grinding machine.

3.1.2 Cleaning

The base metals before cutting them to size will have impurities like dirt, oil, paint, water and surface oxides, due to long storage. These impurities will affect the welding and will create some defects in the welded joint. So in order to get a strong

welded joint, it is necessary to clean the surfaces to be joined and remove the dirt, oil, paint, water, surface oxide etc. from the joining surfaces before welding.

Importance of cleaning

The basic requirement of any welding process is to clean the joining edges before welding. The joining edges or surfaces may have oil, paint, grease, rust, moisture, scale or any other foreign matter. If these contaminants are not removed the weld will become porous, brittle and weak. The success of welding depends largely on the conditions of the surface to be joined before welding.

- **Methods of cleaning**

Chemical cleaning includes washing the joining surface with solvents of diluted hydrochloric acid to remove oil, grease, paint etc.

Mechanical cleaning includes wire brushing, grinding, filing, sand blasting, scraping, machining or rubbing with emery paper.

For cleaning ferrous metals a carbon steel wire brush is used. For cleaning stainless and non-ferrous metals, a stainless steel wire brush is used

Self check 3	Multiple choice

1. Mixed oxygen and acetylene pass through holes surrounding the center holes for _____

A. preheating flame B. Neutral C. flame D all

2._____ includes washing the joining surface with solvents of diluted hydrochloric acid to remove oil, grease,

A. chemical cleaning B. mechanical C. cleaning D .all

Operation Sheet 3	Preparing material

3.1. Prepare material for oxy-acetylene cutting operation

step 1- Identify cutting tips.

step 2- Select the required raw material for cutting purpose.

step 3- Making lay out on the selected materials.

step 4- assemble oxy-acetylene cutting accessories.

step 5- check the leakage of fitting.

MATERIALS

1/4-inch or 3/8-inch thick steel plate, approximately 4 in. x 10 in.

Cutting torch fitted with an Airco® #0 or #1 cutting tip or comparable equipment. See the above chart, Comparison of Cutting Tip Sizes.

Fig. Mild steel work piece for straight line cutting.

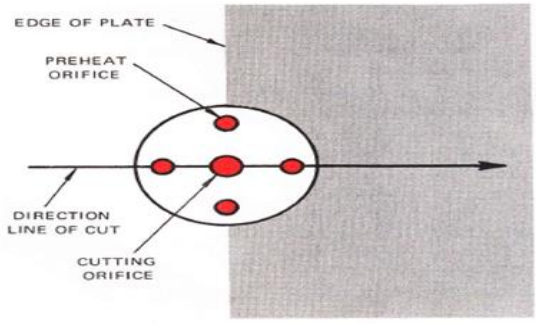


Fig 13. Tip alignment of square.

BASIC METAL WORK

Level-I

Learning Guide-46

Unit of Competence: Perform Cutting Using Oxyacetylene Process

Module Title: Performing Cutting Using Oxyacetylene Process

LG Code: IND BMW1 M14 LO2-LG 46

TTLM Code: IND BMW1 TTLM 1019V1

LO 2: Set up oxyacetylene cutting Outfit

Instruction Sheet	Learning Guide 46

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Interpreting instructions, symbols, specifications including bead size, bead placement, and reinforcement
- setting up cutting equipment

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to

- Interpret instructions, symbols, specifications including bead size, bead placement, and reinforcement
- set up cutting equipment

Learning Activities

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheet 3”.
3. Accomplish the “Self-check 3”
4. If you earned a satisfactory evaluation, proceed to “Operation Sheet 3”. However, if your rating is unsatisfactory, see your teacher for further instructions.
5. Read the “Operation Sheet 3” and try to understand the procedures discussed.

Information Sheet – 1	Interpreting instructions, symbols, specifications including bead size, bead placement, and reinforcement

1.1 Interpreting instructions, symbols, specifications including bead size, bead placement, and reinforcement.

1.1.1. Oxy- Acetylene Cutting Operating Instructions:

- **CONNECTING**

1. Attach regulators to the oxygen and fuel gas cylinders. Follow all instructions supplied with your regulators.
2. Attach oxygen and fuel gas hoses to the regulators and to the torch handle after Making sure all metal seating surfaces are clean. Tighten all connection nuts with a wrench.

3. Using Welding or Heating Head: Remove welding head connection nut from torch handle. Insert welding head into handle using slight back and forth twisting motion as you push.

Using Cutting Attachment: Set the welding head connection nut aside and insert the cutting attachment to the torch handle in the same manner as the welding head. Remove nozzle nut and insert cutting nozzle into the cutting attachment head. Slip nut over the nozzle and tighten with a wrench.

4. Check valve stem packing nuts for tightness.

- **ADJUSTING GAS PRESSURES**

Fuel Gas: With oxygen valve closed, open the fuel gas valve on the torch handle about one turn. Turn in the pressure adjusting screw on the fuel gas regulator until its delivery-pressure gauge indicates the desired pressure. Then immediately close the torch fuel gas valve.

Oxygen, Using Welding or Heating Head: Open the torch oxygen valve at least 1-1/2 turns. Adjust oxygen pressure at the regulator to the desired pressures. And then close the torch oxygen valve.

Oxygen, Using Cutting Attachment: Open the torch oxygen valve WIDE and leave the preheat oxygen valve on the cutting attachment closed. Depress the cutting oxygen valve lever on the cutting attachment. Adjust the oxygen pressure at the regulator to the desired pressure. Shut off the oxygen flow by releasing the cutting oxygen valve lever only.

- **TESTING FOR LEAKS**

Every welding and cutting outfit should be thoroughly tested for leaks after it is first hooked up, and at regular intervals thereafter. After all connections have been made, make sure both valves on the torch handle are closed. Then turn in the regulator pressure-adjusting screws clockwise until the oxygen delivery-pressure gauge registers 50 psi, the fuel gas delivery-pressure gauge registers 10 psi. Using Leak Test Solution suitable for oxygen service, such as P/N 998771 check for leaks at the cylinder valves, the cylinder-to-regulator connections, the regulator-to-hose connections, and the hose-to-torch connections. If bubbling at any point indicates leakage, tighten the connection. If this does not stop the leakage, close the appropriate cylinder valve, open the torch valve to remove all pressure from the line, and finally release the regulator pressure-adjusting screw by turning it counterclockwise. Then break the leaky connections, wipe metal seating surfaces with a clean, dry cloth, and examine them for nicks and scratches. Remake the connection(s) and retest. Do not try to light the torch until you are satisfied that all connections are gas tight.

- **LIGHTING & FLAME ADJUSTMENT**

CAUTION: Use friction lighter for lighting torch. Do NOT use a match. Use of a match can seriously burn your hand.

1. Open fuel gas valve about 1/2 turn and light the gas at the tip.
2. Slowly close the fuel gas valve until the yellow flame just starts to throw off smoke.
3. Open oxygen valve slowly until you have a neutral flame.
4. If harsher or softer flame is desired, readjust the two valves.

NOTE: When operating with a very soft flame, the welding head will tend to heat up and transfer some of this heat back to the torch handle. This may create some discomfort to the operator.

- **Cutting Attachment (Acetylene)**

1. Open the acetylene valve on the torch handle about 1/2 turn, and light the gas at the nozzle.

2. Slowly close the acetylene throttle valve until the yellow flame just starts to throw off black smoke.

3. Slowly open preheat oxygen valve on cutting attachment until neutral flames are obtained.

4. Finally, open the cutting oxygen valve by depressing lever and readjust the neutral flames by turning preheat oxygen valve.

The flame now has the proper strength for any cutting job. With this flame, acetylene is being consumed economically and the cutting attachment will be operating at best resistance to flashback. If greater preheat flame temperature is desired for faster starts or piercing, open the cutting oxygen valve and adjust the preheat oxygen valve until the flame inner cones shorten about 10 percent and become sharply pointed.

- **Cutting Attachment (Fuel Gases except Acetylene)**

1. Crack the fuel gas valve and light the gas at the nozzle.

2. Open the fuel gas valve until flame starts to leave the end of the nozzle.

3. Slowly open preheat oxygen valve on cutting attachment until flame stabilizes.

4. Depress lever to open cutting oxygen valve and then adjust preheat oxygen valve until preheat flames are at their shortest length.

5. If larger or smaller preheat flames are desired, depress cutting oxygen valve lever and alternately readjust fuel gas and preheat oxygen valve to obtain the final flame setting.

- **SHUTTING OFF**

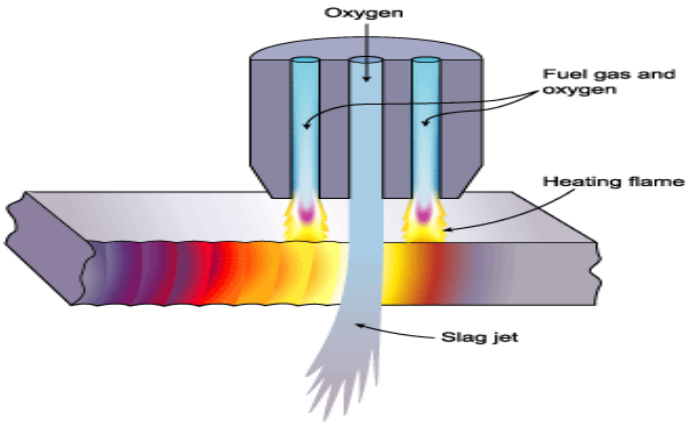
Close the fuel gas valve first, then the oxygen valve whether you are using a welding head or cutting attachment. However, if the cutting attachment is to be relighted

Within a half-hour, you may close the preheat oxygen valve on the attachment instead of the oxygen valve on the torch handle.

If operations are to be stopped for a half-hour or more, you should release all pressure from regulators. To do this, first close both cylinder valves. Then open the torch valves. Finally, back out the regulator pressure-adjusting screws until they turn freely.

- **The system operates in two stages:**

(1) The steel is heated at high temperature (900 ° c) with the flame produced by a fuel gas (contained in tanks with acetylene, propane, hydrogen or even gasoline) in the presence of oxygen (oxidizing gas that allows the focusing process). Their Goal is not to melt the metal, but take it to its ignition temperature.
An air-propane flame may reach 2000 ° c, while an oxygen-propane flame up to 2500 ° c and an oxygen-acetylene flame between 3200 ° c to 3500 ° c (although this is the combination of gas has a higher cost)
(2) An focused oxygen stream is injected (contained in high-pressure tanks) to provide the heat of flame. Because heat is released molecules combustion product has lower energy state that the molecules of fuel and oxygen.



Self check 1	Multiple choice

NAME_____ **DATE**_____

Multiple Choices

1._____Close the fuel gas valve first, then the oxygen valve whether you are using a welding head or cutting attachment.

A.cutting off B. shuting off C. Neutral D. none

2._____ with oxygen valve closed; open the fuel gas valve on the torch handle about one turn.

A. fuel gas B. oxy-acetylene gas C. propane D.all

Information Sheet – 2	Assembling and setting up cutting equipment

2.1 Proper Setup of Oxygen Acetylene Cutting Torch

The oxy-fuel cutting process is accomplished by bringing the base metal to a molten state, then introducing a high-pressure stream of cutting oxygen. This will ignite and burn the metal as well as carry away the slag or oxidizing residue. Oxy-fuel cutting can be applied to plain carbon steels, low-alloy streets and other ferrous metals. Nonferrous metals, stainless steels and cast iron are not usually cut using oxy-fuel equipment.

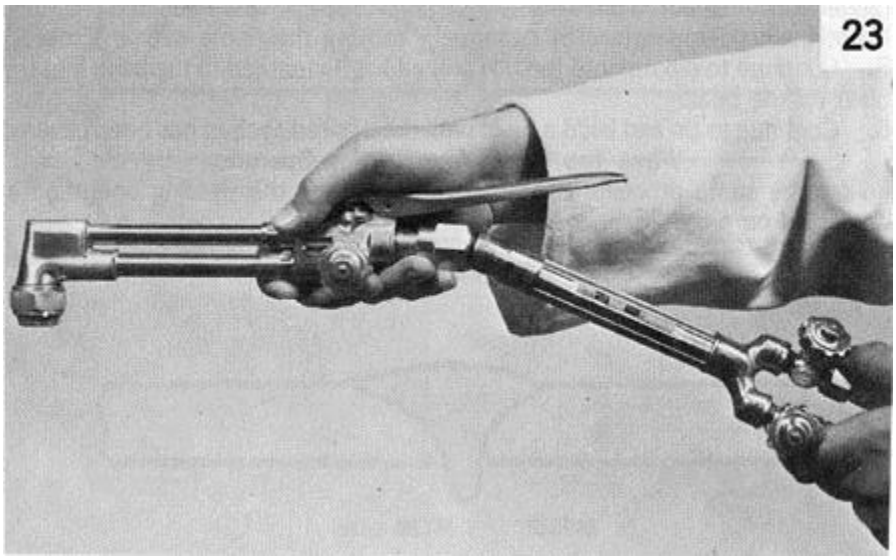
2.1.1 SETTING UP EQUIPMENT (CUTTING)

1. Inspect the cone end, coupling nut, and torch head for dirt, dust, oil, grease, or damaged parts. Dirt and dust can be removed with a clean cloth. CAUTION: If oil, grease or damaged parts are detected, contact your authorized service service repair station for cleaning or repairs.

2. Inspect the cutting attachment cone end for missing or damaged "O" rings. There must be two (2) "O" rings on the cone end. Damaged or missing "O" rings can allow gases to mix and will cause backfires or back flash. Severe damage can result.

3. Inspect the torch head. The tapered seating surfaces must be in good condition. If dents, burns or burned seats are present, the seat must be resurfaced. If the torch is used with poor seating surfaces, backfire or back flash may occur.

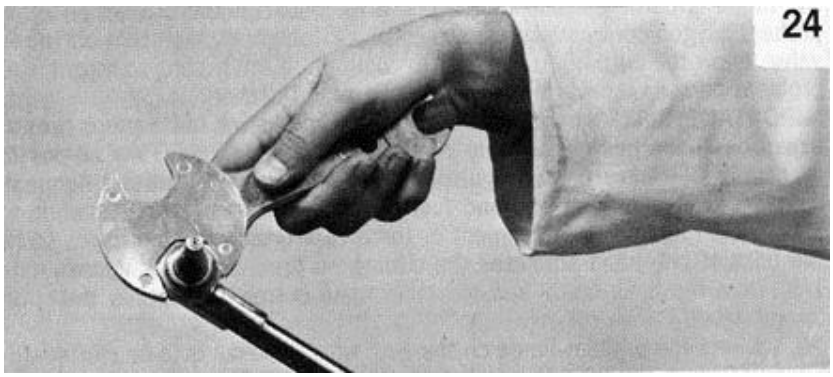
4. Connect the cutting attachment to the welding torch handle and tighten the coupling nut, using hand pressure only. Wrench tightening may damage "O" rings and create a faulty seal.



5. Select the required size and type of cutting tip. Inspect the tip seating surfaces for damage.

REMEMBER -- these seating surfaces prevent premature mixing of gases that can cause fires and explosions. IF the tapered seats on the tip are damaged, DON'T USE! Inspect the pre-heat and cutting oxygen holes. Splatter can stick on or in these holes. If holes are clogged or obstructed clean them out with proper size tip cleaner

6. Insert the tip in the cutting attachment head and tighten securely with wrench (15 to 20 pounds pressure).



(NOTE: If using a straight cutting torch as opposed to an attachment, disregard inapplicable parts of procedures 1 - 6)

7. Refer to cutting tip selection chart for correct cutting tip, regulator pressures, and travel speed.

8. Follow cylinder and regulator safety and operating procedures.

9. Open the oxygen valve on the welding torch completely.

10. Open the preheat oxygen control valve on the cutting attachment and adjust the oxygen regulator to the desired delivery pressure.

11. Close the preheat oxygen control valve.

12. Open the fuel valve on the welding torch handle and adjust the fuel regulator delivery range.

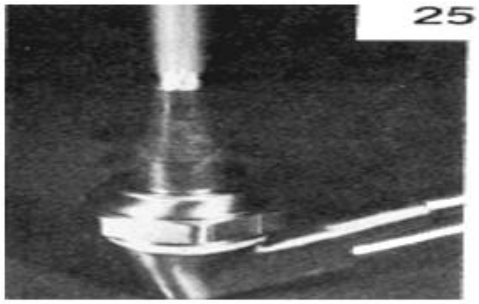
13. Close the fuel control valve on the torch handle.

14. Momentarily depress the cutting oxygen lever to purge the high pressure cutting oxygen passage.

15. Open the fuel valve on the torch handle approximately one-half turn and ignite with a spark lighter.

NOTE: Wear protective goggles to shield the eyes from bright light.

16. Continue to increase the fuel supply at the torch handle until the flame clears the end of the tip about 1/8", then reduce the supply slightly to return the flame to the tip



17. Slowly open the preheat oxygen control valve on the cutting attachment until the preheat flames establish a sharp inner cone. (See Fig 25) The configuration of the short inner cone is called the Neutral Flame.

18. Depress the cutting oxygen lever. Note that the preheat flame changes slightly to a carburizing flame. Continue to depress the cutting oxygen lever and incase the preheat oxygen at the cutting attachment until the preheat flames are again neutral.

- Secure the oxygen and acetylene tanks in the torch cart. This step is an important one for the safety of you and others in the vicinity so don't skip it. If you don't have a cart yet, secure the tanks to an upright beam or some other vertical solid object.
- Remove the covers protecting the tank valves and attach the regulators to the valves. Screw the fittings into the valves as far as you can by hand and then tighten securely with a wrench.
- Attach the hoses to the regulators. Connect the green hose to the oxygen regulator and the red hose to the acetylene regulator.
- Connect the other end of the hoses to the torch handle.
- Push the cutting torch in to the torch handle and hand-tighten the nut.
- Close the valves on the torch handle and the cutting torch.
- Turn the valve on the oxygen tank completely open. The valve has a seal on the shaft that works when the valve is fully open and helps prevent oxygen loss when the torch is in operation.

- Turn the adjusting screw on the oxygen regulator clockwise until the small gauge on the regulator registers somewhere in the 40 to 60 psi range.
- Turn the valve on the acetylene tank counterclockwise a quarter turn to open.
- Adjust the acetylene regulator until the small gauge on the regulator registers 10 psi.
- Open the oxygen valve on the torch handle completely by turning counterclockwise until it stops.
- Slightly open the oxygen valve on the cutting torch. Open just enough to start the flow of oxygen through the torch.
- Open the acetylene valve on the torch handle about 1/8 turn.
- Light the torch with a spark lighter and adjust the acetylene valve on the torch handle and the oxygen valve on the cutting torch until the flame has no yellow areas and the center is bright blue and well defined.
- heck the regulator gauges and adjust as necessary to maintain the proper pressure

Self Check	Multiple choice

Name: _____ Date: _____

1. The tapered seating surfaces must be in good condition.

A. inspect the torch head B. Inspect cylinder C .none

2. To connect the cutting attachment to the welding torch handle and tighten the coupling nut, using_____

A. cutting tool B. cylinder C. only hand pressure D. none

3. The regulator is _____when the adjusting screw is turned out.

A. Closed
B. Opened
C. Threaded
D. All of the above

Operation Sheet 1	Set up oxyacetylene cutting outfit

Procedures to Set up oxyacetylene cutting outfit

1) Secure the cylinders so they cannot be accidently knocked over. A good way do this is to either put them in a corner or next to a vertical column or then secure them with a piece of line. After securing the cylinders, remove protective caps.

2) Standing to one side, crack each cylinder valve slightly and then immediately close the valve again. This blows any dirt or other foreign matter out of the cylinder valve nozzle. Do not bleed fuel gas into a confined area because it may ignite. Ensure the valves are closed and wipe the connections with a clean cloth.

3) Connect the fuel-gas regulator to the fuel-gas cylinder and the oxygen regulator to the oxygen cylinder. Using a gang wrench, snug the connection nuts sufficiently to avoid leaks.

4) Back off the regulator screws to prevent damage to the regulators and gauges and open the cylinder valves slowly. Open the fuel-gas valve only one-half turn and the oxygen valve all the way. Some fuel-gas cylinders have a hand-wheel for opening the fuel-gas valve while others require the use of a gang wrench or T- handle wrench. Leave the wrench in place while the cylinder is in use so the fuel- gas bottle can be turned off quickly in an emergency. Read the high-pressure gauge to check the contents in each cylinder.

5) Connect the RED hose to the fuel-gas regulator and the GREEN hose to the oxygen regulator. Notice the left-hand threads on the fuel-gas connection.

7) Connect the hoses to the torch. The RED (fuel-gas) hose is connected to the connection gland with the needle valve marked "FUEL." The GREEN (oxygen) hose is connected to the connection gland with the needle valve marked "OXY."

8) With the torch valves closed, turn both regulator screws clockwise to test the hose connections for leaks. If none are found, turn the regulator screws
Counterclockwise and drain the hose by opening the torch valves.

9) Select the correct cutting tip and install it in the cutting torch head. Tighten the assembly by hand, and then tighten with your gang wrench.

10) Adjust the working pressures. The fuel-gas pressure is adjusted by opening the torch needle valve and turning the fuel-gas regulator screw clockwise. Adjust the regulator to the working pressure needed for the particular tip size, and then close the torch needle valve. To adjust acetylene gas, you should set the gauge pressure with the torch valves closed. To adjust the oxygen working pressure,
You should open the oxygen torch needle valve and proceed in the same manner as in adjusting the fuel-gas pressure.

11) In lighting the torch and adjusting the flame, always follow the manufacturer's directions for the particular model of torch being used. This is necessary because the procedure varies somewhat with different types of torches and, in some cases, even with different models made by the same manufacturer. In general, the procedure used for lighting a torch is to first open the torch oxygen needle valve a small amount and the torch fuel-gas needle valve slightly more, depending upon the type of torch. The mixture of oxygen and fuel gas coming from the torch tip is

then lighted by means of a spark igniter or stationary pilot flame. Adjust the preheating flame to neutral.

12) Hold the torch so that the cutting oxygen lever or trigger can be operated with one hand. Use the other hand to steady and maintain the position of the torch head to the work. Keep the flame at a 90 degree angle to work in the direction of travel. The inner cones of the preheating flames should be about 1/16 in. (1.6 mm) above the end of the line to be cut. Hold this position until the spot has been raised to a bright red heat, and then slowly open the cutting oxygen valve

6) To blow out the oxygen hose, turn the regulator screw in (clockwise) and adjust the pressure between 2 and 5 psig. After the hose has been purged, turn the screw back out again (counterclockwise) to shutoff the oxygen. Do the same for the fuel-gas hose, but do it ONLY in a well-ventilated place that is free from sparks, flames, or other possible sources of ignition.

13) Cutting is initiated by heating the edge or leading face (as in cutting shapes such as round rod) of the steel to the ignition temperature (approximately bright red heat) using the pre-heat jets only, then using the separate cutting oxygen valve to release the oxygen from the central jet. The oxygen chemically combines with the iron in the ferrous material to instantly oxidize the iron into molten iron oxide

Fig. Assembled oxy acetylene cutting out fit

LAP Test 1	Practical Demonstration

Name: _____ Date: ----------

Instructions: You are required to perform the following individually with the presence of your teacher.

1. Demonstrate on how to assemble the oxyacetylene cutting equipment's. Please take note of the given safety instructions while working. Let your teacher check the assembling before proceeding to the next instruction.

2. Demonstrate on how to set up the oxyacetylene cutting outfit. Please take note of the given safety instructions while working. Let your teacher check the set up before proceeding to the next instruction.

3. Demonstrate on how to adjust the oxyacetylene cutting equipment's. Please take note of the given safety instructions while working. Let your teacher check the adjustment.

BASIC METAL WORK

Level-I

Learning Guide-47

Unit of Competence: Perform Cutting Using Oxyacetylene Process

Module Title: Performing Cutting Using Oxyacetylene Process

LG Code: IND BMW1 M14 1019LO1-LG 47

TTLM Code: IND BMW1 TTLM 0919V1

LO 3: Cut materials

Instruction Sheet	Learning Guide 47

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- **Following Cutting procedures.**
- **Cutting materials in all positions**
- **Inspecting cut components quality and releasing**

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- **Follow Cutting procedures.**
- **Cut materials in all positions**
- **Inspect cut components**

Learning Activities

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheet 4”.
3. Accomplish the “Self-check 4”
4. If you earned a satisfactory evaluation, proceed to “Operation Sheet 4”. However, if your rating is unsatisfactory, see your teacher for further instructions.
5. Read the “Operation Sheet 4(a, b and c) and try to understand the procedures discussed.
6. Submit your accomplished Self-check 4. This will form part of your training portfolio
7. If you earned a satisfactory evaluation proceed to LAP 4 Test.
   However, if your rating is unsatisfactory, see your teacher for further instructions.
8. Do the “LAP test 4” (if you are ready) and show your output to your teacher

Information Sheet – 1	Following Cutting procedures.

3.1 cutting procedures of oxy-acetylenes

Oxyacetylene welding equipment must be set up frequently and it must be done efficiently. Since hazards are present, each step must be performed correctly. The proper sequence must be followed to insure maximum safety to personnel and equipment.

The cylinder caps are removed and put in their proper place. The cylinders should be fastened to a wall or other structure with chains, straps or bars, to prevent them from being tipped over. To use oxygen and acetylene cylinders and equipment without this safety precaution is to invite damage to the equipment and injury to the operator.

PROCEDURE

1. Aim the cylinder nozzle so it does not blow toward anyone. Crack the valve on each cylinder by opening the valve and closing it quickly. This blows any dust or other foreign material from the nozzle.
2. Attach the regulators to the cylinder nozzles.

Note: All oxygen regulators in commercial use have a standard *right-hand* thread and fit all standard oxygen cylinders. Acetylene regulators may have *right- or left-hand* threads and may have either a male or female connection, depending on the company supplying the gas. Adapters of various types may be needed to fit the existing regulators to different acetylene cylinders.

3. Attach the hoses to the regulators.

Note. All oxygen hose connections have *right-hand* threads. All acetylene hose connections have *left-hand* threads. The acetylene hose connection nuts are distinguished from the oxygen nuts by a *groove* machined around the center of the nut figure 8-1.

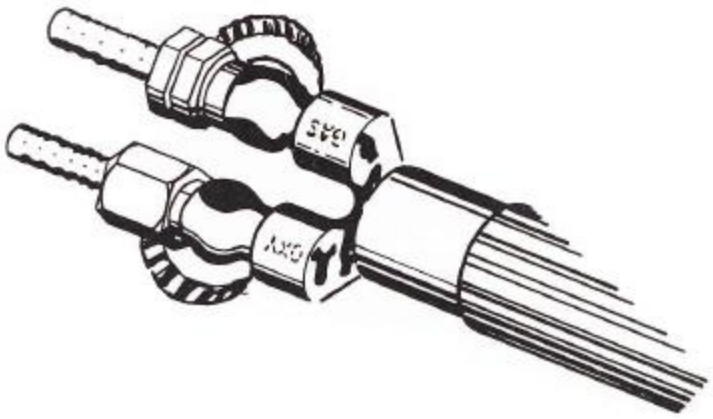


Fig. Oxygen and Acetylene Hose Connections

4. Attach the torch to the other end of the hoses noting that while the hose connections may be a different size at the torch than at the regulators, they still have right- and left-hand threads.

Note: Use only the wrenches provided for attaching hoses and regulators. These wrenches are designed to give the proper leverage to tighten the joints without putting undue strain on the equipment. If the joints cannot be properly tightened, something is wrong.

5. Select the proper tip and mixing head and attach it to the torch. Position the tip so that the needle valves are on the side or bottom of the torch when the tip is in the proper welding position.

6. Back off the regulator screws on both units until the screws turn freely. This is necessary to eliminate a sudden surge of excessive pressure on the working side of the regulator when the cylinder is turned on.

7. Be sure both torch needle valves are turned off (clockwise). This is an added safety precaution to make sure excessive pressure cannot be backed through the mixing head and into the opposite hose.

8. Open the acetylene cylinder valve *114* to 1/2 turn. Open the oxygen cylinder valve all the way.

9. Open the acetylene needle valve one full *turn.* Turn the adjusting screw on the acetylene regulator clockwise until gas comes from the tip. Light this gas with a spark lighter.

10. Adjust the regulator screw until there is a gap of about 1/4 inch between the tip and the flame. This is the proper pressure for the size of tip being used regardless of the gage pressure shown on the working pressure gage.

11. Open the oxygen needle valve on the torch one full turn. Turn the oxygen regulator adjusting screw clockwise until the flame changes appearance as oxygen is mixed with the acetylene.

12. Continue to turn the adjusting screw until the feather of acetylene just disappears into the end of the inner cone. This produces a neutral flame which is used in most welding.

This procedure for adjusting the oxyacetylene flame is the safest method of insuring the proper working pressures in both hoses and tip. Working pressure gages are delicate and easily get out of calibration. If this happens, excessive pressure can be built up in the hoses before it *is* discovered. However, if the pressures are adapted to the flame as indicated, there are equal pressures in both hoses which eliminates the possibility of backing gas from one hose to the other to form an explosive mixture. With the regulators properly adjusted, minor flame adjustments are made with the torch needle valves. When the cutting operation is finished, close the torch acetylene valve first, then the torch oxygen valve.

To shut down the equipment for an extended period of time, such as overnight, it should be purged. Use the following procedure:

1. Close the oxygen cylinder valve.
2. Open the torch oxygen valve to release all pressure from the hose and regulator.
3. Turn out the pressure adjusting screw of the oxygen regulator.
4. Close the torch oxygen valve.
5. Follow the same sequence for purging acetylene.

6 Weld joints to Standard or equivalent

3.2. RUNNING BEADS AND OBSERVING EFFECTS

The quality of the finished weld depends to a large extent on the correct adjustment and use of the flame. This unit provides an opportunity to weld with different kinds of flames and to compare the results. At the same time some actual welding skill is acquired.

MATER IALS

16- or 18-gage mild steel, 2 to 4 in. wide X 6 to 9 in. long

Airco® i2 welding tip or equivalent

PROC EEUR

1. Light the torch and adjust the flame to neutral.
2. Hold the tip of the inner cone of the flame about 1/8 inch above the work and pointed in the exact direction in which the weld is to proceed. The centerline of the flame should make an angle of 45 to 60 degrees with the work, figure 14-2.
3. Hold the flame in one spot until a puddle of metal 1/4 inch to 3/8 inch in diameter is formed.
4. Proceed with the weld, advancing the flame at a uniform speed in order to keep the molten puddle the same diameter at all times. This keeps the weld or *bead* the same width throughout its length. Start this bead 1/2 inch from the near edge of the plate being welded and proceed in a straight line parallel to this edge.

Note: The width of the bead is directly related to the thickness of the plate being welded. The accepted standard for welds in aircraft tubing and light sheet metal requires the weld to be six times as wide as the thickness of the metal.

5. After the weld has been completed, examine it for uniformity of width and smoothness of appearance. Turn the plate over and examine the bottom for uniformity of *penetration.*

3.3. STRAIGHT LINE CUTTING

Several things affect the speed, smoothness, and general quality of a cut made by an oxyacetylene flame. This unit provides practice in changing these variables to determine

the best methods for flame cutting.

The actual cutting process demonstrates the danger of personal burns and fires which might cause property damage.

MATERIALS

1/4-inch or 3/8-inch thick steel plate, approximately 4 in. x 10 in.

Cutting torch fitted with an Arco® #0 or #1 cutting tip or comparable equipment.

PROCEDURE

1. Draw a series of straight parallel lines about 2 inches apart on the plate. Use soapstone for marking so that the lines show up when the cutting goggles are being worn.

2. Light and adjust the preheating flame to neutral using the data supplied in chart 9-2, “Relation of Cutting Tip Size to Plate Thickness.”

3. Start the cut by holding the tip over the edge of the metal so that the vertical centerline of the tip is square with the work and in line with the edge of the plate. The tip is positioned in the torch as indicated in figure 10-1.

1. This is a correctly made Cut in 1 in, plate. The edge is square and the draglines are vertical and not too pronounced.

2. Preheat flames were too small for this cut with the result that the cutting speed was too slow, causing gouging at the bottom.

3. Preheat flames were too long with the result that the top surface has melted over, the cut edge is rough, and there *is* en excessive, amount of adhering slag.

4. Oxygen *pressure* was too low with the result that the top edge has melted over because of the too slow cutting speed.

S Oxygen pressure was too high and the nozzle lug too small with the result that the entire control of the cut has been lost.

6. Cutting speed was too slow with (ha result that the irregularities Of the draglines are emphasized,

7.Cuttlng speed was too high with the result that there Is a pronounced break to the dragline and the Cut edge is rough.

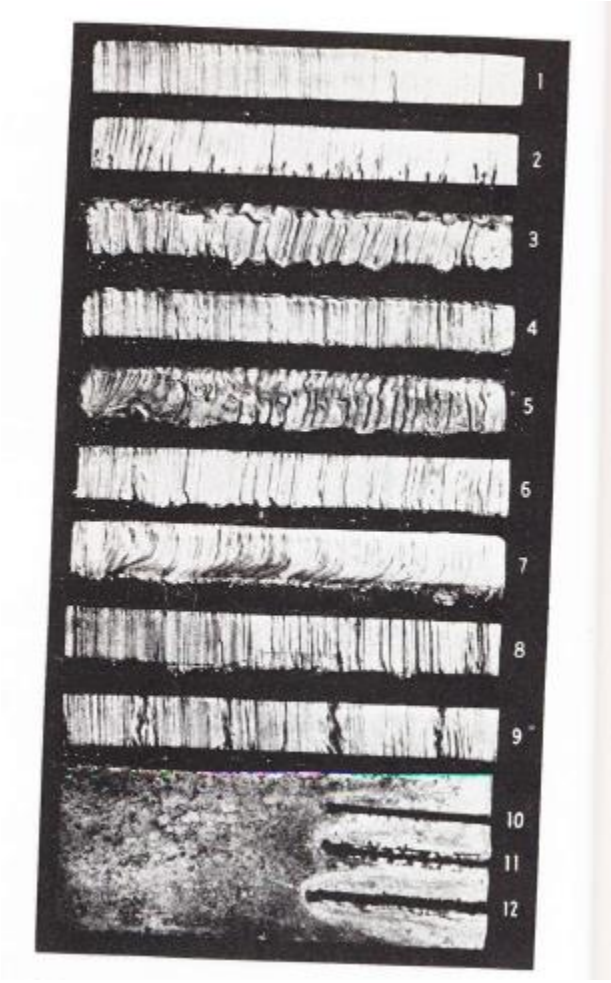
8. Torch travel was unsteady with the result that the cut edge is wavy end rough.

9. Cut was lost end not carefully restarted with the result that bad gouges were caused at the restarting point.

10. Correct procedure was used in making this cut.

11. Too much preheat was used and the nozzle was held too close to the plate with the result that a bad melting over of the top edge Occurred.

12. Too little preheat was used and the flames were held too far from the plate with the result that the heat spread opened up the kerfs at the top. The kerf is too wide at the top and tapers in.



Fig, Common faults that occur in hand cutting

4. When the edge of the work becomes bright red, turn the cutting oxygen on with the lever. Note that the oxygen makes a cut through the plate at the same angle that the centerline of the tip makes with the work.
5. Continue the cut, making sure that the tip is square with the work. Observe that when the rate of travel is right, the slag or iron oxide coming from the cut makes a sound like cloth being torn. The tearing sound serves as a guide to the correct rate of travel in most manual flame-cutting operations.
6. Finish the cut and check the flame-cut edge for smoothness, straightness, and amount of slag on the bottom edge of the cut surfaces.

7. Make more cuts but vary the amount of preheating by decreasing and increasing the acetylene pressure before each cut. Observe ‘the finished cut for smoothness, melting of the top edge of the plate, a- mount of slag on the bottom edge of the plate, and ease of removal of this slag. Compare the plates cut and determine which amount of preheat produces the best results.
8. Make more cuts but vary the rate of travel from very slow to normal to very fast. Ob serve these finished cuts and check the appearance

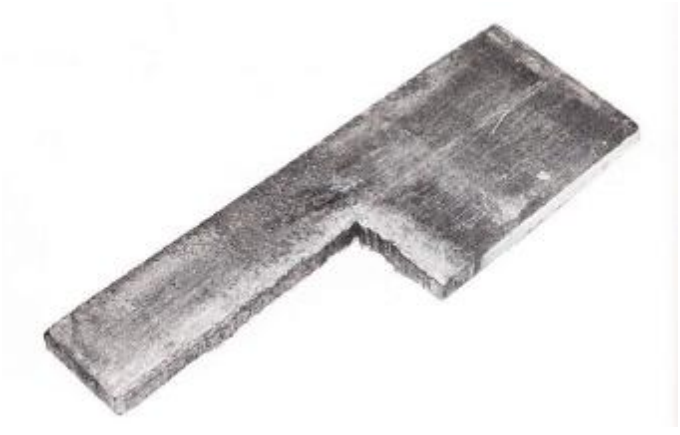


Fig. Straight cut

of the top and bottom of each plate, and also the ease of slag removal. Determine which rate of travel produces the best results.

9. Make more cuts but vary the amount of cutting oxygen pressure from low to normal to high and check the results as in step 8.

10. Make one or two cuts with the tip perpendicular to the work but move the torch so that the tip zigzags along the straight line drawn on the plate. Notice that the surface of the **Cut** edge follows the amount and direction the tip moves from the straight line.

Guidelines for Flame adjustment

- To get a neutral flame, always start with more acetylene, then increase oxygen until the acetylene feather disappears from the center cone
- excess oxygen causes molten metal to spark
- make sure regulators are set for the pressures recommended for the tip size

Harshest flame is when which jumps off the tip, you want just prior to jumping off the tip Typical startup procedures

- Verify that equipment visually appears safe IE:Hose condition, visibility of gauges
- Clean torch orifices with a “tip cleaners” (a small wire gauge file set used to clean slag and dirt form the torch tip)
- Crack (or open) cylinder valves slightly allowing pressure to enter the regulators slowly
- Opening the cylinder valve quickly will “Slam” the regulator and will cause failure. Never stand directly in the path of a regulator when opening the cylinder
- Check for leaks using by listening for “Hissing” or by using a soapy“ Bubble” solution
- Adjust the regulators to the correct operating pressure
- Slightly open and close the Oxygen and Acetylene valves at the torch head to purge any atmosphere from the system.

  Always use a flint and steel spark lighter to light the oxygen acetylene flame. Never use butane lighter to light the flame

Shutting down the unit

- Close the acetylene valve
- Close the oxygen valve
- Shut off the tanks
- Open the acetylene to purge the line
- When both gauges read zero, close the valve
- Open the oxygen valve
- When both gauges read zero, close the valve
- Release pressure by turning adjusting screw left (out)
- Coil hoses and put tools away

Self check 1	Multiple choice

1. This procedure for adjusting the oxyacetylene flame is the safest method of insuring the proper working pressures in both _____

A. hose and tip B. cylinder C. oxygen D.all

2. Shutting down the unit_____

A. Close the acetylene valve B. Open the oxygen valve C.shut off the tanks Dall

Information Sheet – 2	Cutting materials in all positions

2.1. Oxy-gas Cutting Operations

Before you begin a cutting operation with an oxy-gas cutting torch, make a thorough inspection of the area. Ensure that there are no combustible materials in the area that could be ignited by the sparks or slag produced by the cutting operation. If you are burning into a wall, inspect the opposite side of the wall, and post a fire watch as required.

EQUIPMENT SETUP

Setting up the oxy-gas equipment and preparing for cutting must be done carefully and systematically to avoid costly mistakes. To ensure your own safety, as well as the safety of your coworkers and equipment, make sure the following steps are taken before any attempt is made to light the torch.

Secure the cylinders so they cannot be accidentally knocked over. A good way to do this is to either put them in a corner or next to a vertical column and then secure them with a piece of line. After securing the cylinders, remove the protective caps. Cylinders should never be secured to a structural member of a building that is a current conductor.

- Standing to one side, crack each cylinder valve slightly and then immediately close the valve again. This blows any dirt or other foreign matter out of the cylinder valve nozzle. Do not bleed fuel gas into a confined area because it may ignite. Ensure the valves are closed and wipe the connections with a clean cloth.

- Connect the fuel-gas regulator to the fuel-gas cylinder and the oxygen regulator to the oxygen cylinder. Using a gang wrench, snug the connection nuts sufficiently to avoid leaks.
- Back off the regulator screws to prevent damage to the regulators and gauges and open the cylinder valves slowly.
- Open the fuel-gas valve only one-half turn and the oxygen valve all the way. Some fuel-gas cylinders have a hand wheel for opening the fuel-gas valve while others require the use of a gang wrench or T-handle wrench.
- Leave the wrench in place while the cylinder is in use so the fuel-gas bottle can be turned off quickly in an emergency. Read the high-pressure gauge to check the contents in each cylinder.
- Connect the ***RED*** hose to the fuel-gas regulator and the ***GREEN*** hose to the oxygen regulator. Notice the left-hand threads on the fuel-gas connection.
- To blow out the oxygen hose, turn the regulator screw in (clockwise) and adjust the pressure between 2 and 5 psig. After the hose has been purged, turn the screw back out again (counterclockwise) to shutoff the oxygen. Do the same for the fuel-gas hose, but do it ONLY in a well-ventilated place that is free from sparks, flames, or other possible sources of ignition.
- Connect the hoses to the torch. The RED (fuel-gas) hose is connected to the connection gland with the needle valve marked “FUEL.” The GREEN (oxygen) hose is connected to the connection gland with the needle valve marked “OXY.” with the torch valves closed, turn both regulator screws clockwise to test the hose connections for leaks. If none are found, turn the regulator screws counterclockwise and drain the hose by opening the torch valves.
- Select the correct cutting tip and install it in the cutting torch head. Tighten the assembly by hand, and then tighten with your gang wrench.
- Adjust the working pressures. The fuel-gas pressure is adjusted by opening the torch needle valve and turning the fuel-gas regulator screw clockwise.
- Adjust the regulator to the working pressure needed for the particular tip size, and then close the torch needle valve. To adjust MAPP gas, you should set the gauge

pressure with the torch valves closed. To adjust the oxygen working pressure, you should open the oxygen torch needle valve and proceed in the same manner as in adjusting the fuel-gas pressure.

In lighting the torch and adjusting the flame, always follow the manufacturer's directions for the particular model of torch being used. This is necessary because the procedure varies somewhat with different types of torches and, in some cases, even with different models made by the same manufacturer.

In general, the procedure used for lighting a torch is to first open the torch oxygen needle valve a small amount and the torch fuel-gas needle valve slightly more, depending upon the type of torch. The mixture of oxygen and fuel gas coming from the torch tip is then lighted by means of or stationary pilot flame.

CAUTION
NEVER use matches to light the torch; their length requires bringing the hand too close to the tip. Accumulated gas may envelop the hand and, upon igniting, result in a severe burn. Also, never light the torch from hot metal.

After checking the fuel-gas adjustment, you can adjust the oxy-gas flame to obtain the desired characteristics for the work at hand, by further manipulating the oxygen and fuel-gas needle valves according to the torch manufacturer's direction.

There are t**hree** types of gas flames commonly used for all oxy-gas processes.

They are

- carburizing,
- neutral, and
- Oxidizing.

To ensure proper flame adjustment, you should know the characteristics of each of these three types of flame.

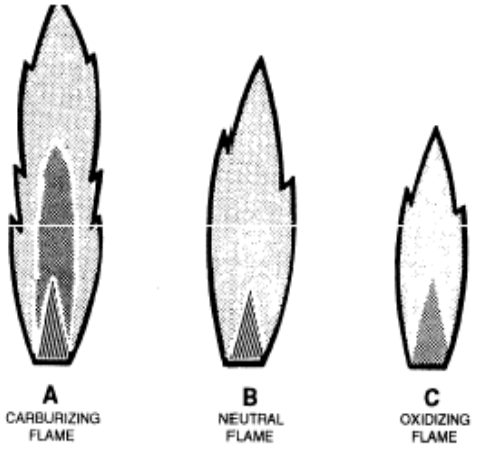


Fig .map gas flame

A pure fuel-gas flame is long and bushy and has a yellowish color. It takes the oxygen it needs for combustion from the surrounding air. The oxygen available is not sufficient enough to burn the fuel gas completely; therefore, the flame is Smokey and consists of soot.

This flame is not suitable for use. You need to increase the amount of oxygen by opening the oxygen needle valve until the flame takes on a bluish white color, with a bright inner cone surrounded by a flame envelope of a darker hue. It is the inner cone that develops the required operating temperature.

CARBURIZING FLAME.

The carburizing flame always shows distinct colors;

- the inner cone is bluish white, the intermediate cone is white,

- the outer envelope flame is light blue, and the feather at the tip of the inner cone is greenish. The length of the feather can be used as a basis for judging the degree of carburization.
- The highly carburizing flame is longer with yellow or white feathers on the inner cone,
- while the slightly carburizing flame has a shorter feather on the inner cone and becomes more white.
- The temperature of carburizing flames is about 5400°F.
- Strongly carburizing flames are not used in cutting low-carbon steels because the additional carbon they add causes embrittlement and hardness.
- These flames are ideal for cutting cast iron because the additional carbon poses no problems and the flame adds more heat to the metal because of its size.
- Slightly carburizing flames are ideal for cutting steels and other ferrous metals that produce a large amount of slag.
- Although a neutral flame is best for most cutting, a slightly carburizing flame is ideal for producing a lot of heat down inside the kerf.
- It makes fairly smooth cuts and reduces the amount of slag clinging to the bottom of the cut.

NEUTRAL FLAME.

- The most common preheat flame for oxy-gas cutting is the neutral flame.
- When you increase the oxygen, the carburizing flame becomes neutral. The feather will disappear from the inner flame cone and all that will be left is the dark blue inner flame and the lighter blue outer cone.
- The temperature is about 5600°F.
- The neutral flame will not oxidize or add carbon to the metal you are cutting.

OXIDIZING FLAME.

- When you add a little more oxygen to the preheat flame, it will quickly be-come shorter.
- The flame will start to neck down at the base, next to the flame ports.
- The inner flame cone changes from dark blue to light blue.
- Oxidizing flames are much easier to look at because they are less radiant than neutral flames. The temperature is about 6000°F.
- The oxidizing flame is rarely used for conventional cutting because it produces excessive slag and does not leave square-cut edges.
- Oxidizing flames are used in conjunction with cutting machines that have a high-low oxygen valve.
- The machine starts the cut with a oxidizing flame then automatically reverts to a neutral flame. The oxidizing flame gives you fast starts when using high-speed cutting machines and is ideal for piercing holes in plate.
- Highly oxidizing flames are only used in cutting metal underwater where the only source of oxygen for the torch is supplied from the surface.

Procedures when stopping work

When welding or cutting is to be stopped for considerable period of time the cylinder valve should be closed and all gas pressures released from the regulators.

- Close the oxygen cylinder valve
- Open the blow pipe oxygen valve to release all pressure from the hose and regulator.
- Close the blow pipe oxygen valve
- Close the acetylene cylinder valve
- Open the blow pipe acetylene valve to release all pressure from the hose and regulator.
- Turn out the pressure adjusting screw of the acetylene regulator

- Close the blow pipe acetylene valve close the acetylene cylinder valve and then opening the blow pipe valve relieves all pressures in the regulator and hose line
- After gauge readings (both gauges) have reached zero, the pressure adjusting screw should always be released since this must be done before the cylinder valve opened again.

CUTTING MILD-CARBON STEEL

- To cut mild-carbon steel with the oxy-gas cutting torch, you should adjust the preheating flames to neutral.

- Hold the torch perpendicular to the work, with the inner cones of the preheating flames about 1/16 inch above the end of the line to be cut (fig. 4-18).
- Hold the torch in this position until the spot you are heating is a bright red.
- Open the cutting oxygen valve slowly but steadily by pressing down on the cutting valve lever.

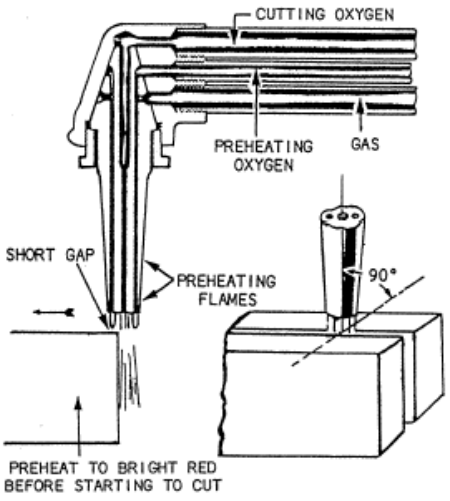


Fig position of torching tip for starting a cut.

- When the cut is started correctly, a shower of sparks will fall from the opposite side of the work, indicating that the flame has pierced the metal.

- Move the cutting torch forward along the line just fast enough for the flame to continue to penetrate the work completely.
- If you have made the cut properly, you will get a clean, narrow cut that looks almost like it was made by a saw.
- When cutting round bars or heavy sections, you can save preheating time by raising a small burr with a chisel where the cut is to begin. This small raised portion will heat quickly, allowing you to start cutting immediately.

Once you start the cut, you should move the torch slowly along the cutting mark or guide. As you move the torch along, watch the cut so you can tell how it is progressing. Adjust the torch as necessary. You must move the torch at the correct speed, not too fast and not too slow. If you go too slowly, the preheating flame melts the top edges along the cut and could weld them back together again. If you go too rapidly, the flame will not penetrate completely, as shown in figure 4-19. When this happens, sparks and slag will blow back towards you. If you have to restart the cut, make sure there is no slag on the opposite side.

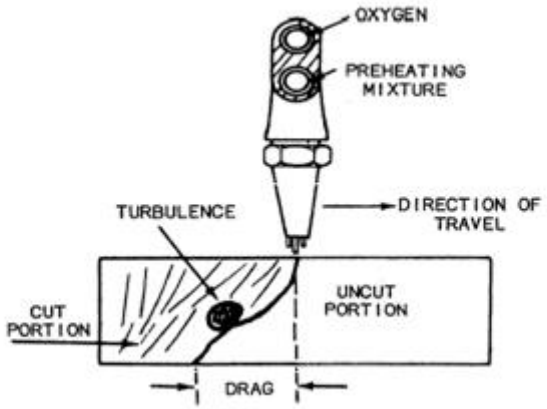


Fig the effect of moving a cutting torch too rapidly across the work

- **Cutting Thin Steel**
  When cutting steel 1/8 inch or less in thickness, use the smallest cutting tip available.
- In addition, point the tip in the direction the torch is traveling.

- By tilting the tip, you give the preheating flames a chance to heat the metal ahead of the oxygen jet, as shown in figure 4-20.
- If you hold the tip perpendicular to the surface, you decrease the amount of preheated metal

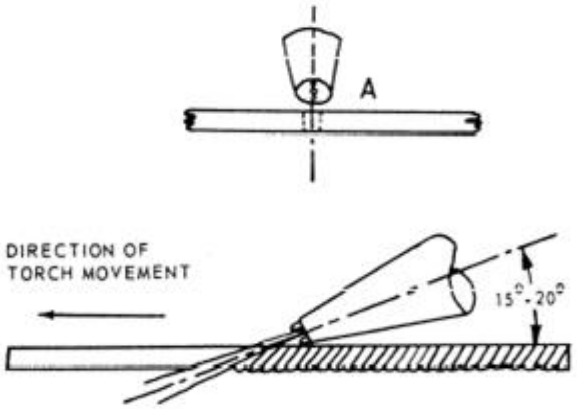


Fig. Torch position for cutting thin sheets

Cutting Thick Steel

Steel, that is greater than 1/8 inch thick, can be cut by holding the torch so the tip is almost vertical to the surface of the metal.

- If you are right-handed, one method to cut steel is to start at the edge of the plate and move from right to left.
- Left-handed people tend to cut left to right.
- Either direction is correct and you may cut in the direction that is most comfortable for you. Figure 4-21 shows the progress of a cut in thick steel.

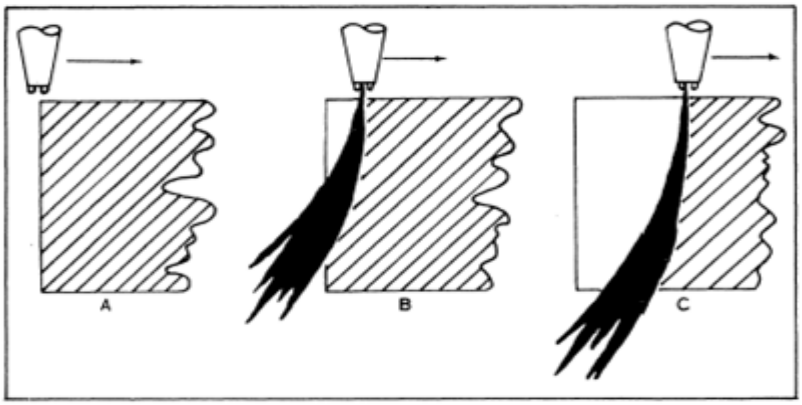


Fig. progress of a cut in thick steel. Preheat flame are 1/16 to 1/8inch from the metal surface.

- After heating the edge of the steel to a dull cherry red, open the oxygen jet all the way by pressing on the cutting lever.
- As soon as the cutting action starts, move the torch tip at a even rate. Avoid unsteady movement of the torch to prevent irregular cuts and premature stopping of the cutting action.
- To start a cut quicker in thick plate, you should start at the edge of the metal with the torch angled in the opposite direction of travel.
- When the edge starts to cut, bring the torch to a vertical position to complete the cut through the total thickness of the metal.
- As soon as the cut is through the metal, start moving the torch in the direction of travel.
- Two other methods for starting cuts are used. In the first method, you nick the edge of the metal with a cold chisel at the point where the cut is to start. The sharp edges of the metal upset by the chisel will preheat and oxidize rapidly under the cutting torch, allowing you to start the cut without preheating the entire edge of the plate.
- In the second method, you place an iron filler rod at the edge of a thick plate.
- As you apply the preheat flames to the edge of the plate, the filler rod rapidly reaches the cherry red temperature.
- At this point, turn the cutting oxygen on and the rod will oxidize and cause the thicker

- plate to start oxidizing.

CUTTING CAST IRON

- It is more difficult to cut cast iron than steel because the iron oxides in cast iron melt at a higher temperature than the cast iron itself.
- Before you cut cast iron, it is best to preheat the whole casting to prevent stress fractures.
- Do not heat the casting to a temperature that is too high, as this will oxidize the surface and make cutting more difficult.
- A preheat temperature of about 500°F is normally satisfactory.
- When cutting cast iron, adjust the preheating flame of the torch to a carburizing flame.
- This prevents the formation of oxides on the surface and provides better preheat.

Settings For Oxy/Acetylene Cutting With Type 3 or NM Cutting Torches

Mild Steel Thickness			Operating pressure				Gas consumption						Cutting Speeds	
			Oxygen		Acetylene		Cutting Oxygen		Heating Oxygen		Acetylene			
mm	In	Size	bar	psi	bar	psi	l/h	ft3/h	l/h	ft3/h	l/h	ft3/h	mm.m	in.m
Sheet		Asnm	1.5	20	0.14	2	800	28	85	3	85	3	-	-
6	¼	1/32	1.8	25	0.14	2	800	28	480	15	400	14	510	20
13	½	3/64	2.1	30	0.21	3	1900	67	570	20	510	18	480	19
25	1	1/16	2.8	40	0.14	2	4000	140	540	19	470	17	400	16
50	2	1/16	3.2/3.5	45/50	0.14	2	4500	160	620	22	560	19	300	12
75	3	1/16	3.5/4.2	50/60	0.14	2	4800	170	680	24	620	22	205	8
100	4	5/64	3.2/4.8	45/70	0.14	2	6800	240	850	30	790	27	150	6
150	6	3/32	3.2/5.5	45/80	0.21	3	9400	330	960	34	850	30	125	5
200	8	1/8	4.2	60	0.28	4	14800	510	1380	48	1250	44	100	4
250	10	1/8	5.3	75	0.28	4	21500	760	1560	55	1420	50	75	3
300	12	1/8	6.3	90	0.28	4	25000	880	1560	55	1420	50	50	2

table.1.

Settings For Oxy/Acetylene Gouging With Type 3 or NM Cutting Torches

Material Thickness		Operating pressure		Gas consumption			Cutting Speeds
		Oxygen	Acetylene	Cutting Oxygen	Heating Oxygen	Acetylene	

mm	in		bar	psi	bar	psi	l/h	ft3/h	l/h	ft3/h	l/h	ft3/h	mm.m	in.m
8	5/16	13	4.0	60	0.5	7	3680	130	990	35	905	32	610	24
11	7/16	19	5.0	75	0.5	7	9340	330	1870	66	1700	60	1070	42
12	1/2	25	5.5	85	0.55	8	16270	575	2290	81	2100	74	1220	48

Self check 2	Multiple choice

1. The inner cone is bluish white, the intermediate cone is white?

A. cutting cast iron B .oxidizing flame**.** C. carburizing flame**.** D **.**all

2. _____flame is long and bushy and has a yellowish color.

A. A pure fuel-gas B. Oxygen C. carbon D.none

Information Sheet – 3	**Inspecting cut components quality and releasing**

3.1 Inspecting cut components quality and releasing

3.1.1 INTRODUCTION

Although oxy-fuel cutting is generally viewed as a mature uncomplicated process, those who work with it realize all too well that making it perform properly is no simple matter. Experienced operators can achieve a level of cut quality that rivals a machined surface, and do it in a fraction of the time cost of hard tooling. Consistently reaching that quality, however, requires an understanding of the many factors that are at work, their direct effect on quality, and their interaction with each other. For many operators, that can only be achieved through years of hands-on experience.

The information presented in this booklet is intended to reduce the learning time

for less experienced operators by providing an understanding of the "how's" and "why's" of oxy-fuel cutting. However, even the most experienced operators will benefit by learning how some die-hard habits, viewed by some to improve cut quality and performance, can actually do more harm than good.

This booklet has divided the oxy-fuel cutting process into several key elements, their effect on quality and their interaction with each other. By understanding these fundamental relationships, all operators can reason the causes of various defects and then take corrective action to prevent them.

- **What is top Quality in Oxy-fuel cutting?**
  1. Square top corner (with minimum radius),
  2. Cut face flat top to bottom (no undercut),
  3. Cut face square with respect to top surface,
  4. Clean smooth surface with near vertical drag lines, and
  5. Little to no slag on bottom edge (easily removed by scraping)
- **Elements Of Oxy-fuel cutting**

  Preheat Flame

  Oxygen Stream

  Torch and Cutting Nozzle

  Cutting Speed

  Material Being Cut
- **Adjusting for Maximum flame temperature**
  1. Light the torch and adjust to any desired flame setting.
  2. Leaving torch fuel gas valve undisturbed, slowly close preheat oxygen valve until inner preheat cones become long and non-uniform in shape.
3. Slowly open preheat valve while paying close attention to the change in the inner cone length.
4. They will shorten, remain the same length for a while, and then will begin to lengthen again as you continue to add oxygen.

. Repeat steps 2 and 3 but this time stop opening the oxygen valve when the inner cones first become their shortest length. It is at this point that flame temperature and flame intensity are maximum

- **effect Of preheat On cut Quality**

Characteristics of proper preheat:

1. Top edge quite square less than 1/1 melt over (top rounding).
2. Face of cut contains an easily removable thin layer of slag which covers a clean surface with well defined drag lines from top to bottom.
3. Little to no easily removable slag on the bottom edge.

Characteristics of too much preheat:

1. Heavy roll over and occasional protrusion at top edge.
2. Black heavily crusted slag on face can be more difficult to clean to base metal.
3. Upper portion of cut has little to no drag lines and detail because of melting.

Characteristics of too little preheat:

1. Top edge is almost perfectly square.
2. Torch is constantly on the verge of losing cut.
3. Some difficulty is experienced in getting through heavy plate (over ").

General comments / recommendations about fuel gas:

1.Ifusingcylinderoxygen,trytouseafuelwiththelowestoxygenfactortominimizecost, cylinder handling and rental charges.

2. For very thin plate cutting (less than or equal to 1/ "), acetylene provides minimum plate distortion and cleanest cut because of high inner BTU and low total BTU.

3. All fuels produce the same quality of cut if adjusted properly on plates between 1/" and 2" thick.

Operating costs will vary however.

4. Acetylene becomes more difficult to use above 2" because of tendency to backfire and flashback during piercing.

5. As thickness increases, fuels with lower inner BTU content are preferred because they tend not to burn and round top edge of plate.

6. Five regulator preheat controllers should be on every steel service center machine.

These permit intense flame adjustment during preheat/pierce and softer settings during cutting to maintain maximum quality and efficiency and to minimize cost.

7. Natural gas is the preferred fuel gas in areas where it is available. Low unit cost and good quality in all but very thin pieces. **Cautions**: Must have bulk oxygen, and natural gas supply pressure of 10 psi minimum. If lower, booster pumps should be installed. Good injector torches can improve performances below 10 psi.

8.Do not arbitrarily change fuel gas type without consulting present supplier to be sure correct torch and nozzles are being used. .

9.Be skeptical of claims made by proprietary fuel gas suppliers for hotter flame temperature, faster cutting speed or better cut quality. Cutting speed on a thin plate (less than or equal to 1/2") is controlled by preheat intensity (flame temperature) and in heavier plate cutting by oxygen stream shape and quality, not the fuel type. Quality of cut is a function of oxygen stream and cutting speed.

Self check 3	Multiple choice

1. Which of the following Elements Of Oxy-fuel cutting?

A. free heat flame B. oxygen stream C.A and B D. none

2. What is top Quality in Oxy-fuel cutting?

A. Square top corner B. Connect C. cut face D.A and C

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