California Vocational Agriculture Curriculum Guidelines Instructional Unit

OXY-ACETYLENE WELDING

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Introduction to Agriculture

OXY-ACETYLENE WELDING

Unit Goals

To assist the student in developing knowledge and skills involved in the oxy acetylene welding process.

Unit Objectives

Upon completion of this unit the student will be able to:

1. Identify oxy-acetylene welding apparatus.
2. Properly set up, use, shut off, and store an oxy-acetylene welder.
3. Use the oxyacetylene equipment to weld and braze mild steel.

Teaching Outline

I. Safety

It is necessary that proper safety and operating procedures be understood prior to use of the oxy-acetylene welding and cutting apparatus. A thorough understanding of the proper safety and operating procedures will serve to minimize the hazards.

A. Work area

1. Must have fireproof floor
2. Adequate ventilation
3. Free from oil and grease
4. Fireproof work benches
5. Cylinders chained or secured

B. Operator apparel

1. Goggles: tempered lenses, shade #5 Standard
2. Protection against sparks, flying slag and flame brilliance
3. Clothing free from oil and grease

C. Fire prevention

1. Never use oil or grease on apparatus.
2. Keep flame and sparks away from hoses, and cylinder
3. Have fire extinguisher in area
4. Check for leaks with soapy water... regularly

II. Equipment and Accessories

These should be kept clean -- oil, grease, or pipedope can become a fuel for fire or explosion if exposed to oxygen at high pressure. The internal working parts are precision units and should be serviced by trained personnel only., External fittings can be sealed to prevent leaks with teflon tape. However, it should be noted that teflon tape when coming into contact with a flame produces an immediate and deadly gas.

A. Oxygen

1. Is not flammable or hannful. TM 1
2. The presence of pure oxygen will drastically increase the speed of burning
3. Common size of cylinder, contains 244 cubic feet at 2,000 to 2,600 lbs. per square inch pressure.
4. Cylinders handled with great care
5. Cylinders can explode violently if dropped, or hit with an object.
6. The jet effect of a full cylinder is so great that if a cylinder were pointed upwards and stabilized with fins, then the cylinder valve broken off the cylinder would be propelled many miles. This is why cylinders must be secured to prevent falling and damaging valves.

SUGGESTED LEARNING ACTIVITIES		SUGGESTED RESOURCE MATERIALS
I.	1. Demonstrate proper and safe use of oxygen and acetylene equipment.	1. Equipment and accessories in local shop.
	2. Give all students written and operational safety test.	2. Instructor composed test.
II.	3. Use transparencies or wall chart showing the working parts of equipment.	3. Use your own contact -- welding equipment dealer.

II. B. Acetylene

1. Compound of carbon and hydrogen, C_2H_2

2. An unstable gas when compressed above 15 psi.

3. Acetylene can be transported in cylinders at high pressure because the cylinder is first filled with a porous form of concrete and then the air spaces are filled with acetone (all air is removed). The acetylene then is added and combines with acetone under pressure. In this form the acetylene is stable at the 250 psi cylinder pressure.

4. Acetylene cylinders must be upright for 8 hours before and during use -- to prevent the loss of acetone.

5. Large size cylinders contain 275 cubic feet at 250 lbs. per square inch

6. Acetylene mixed with air forms a highly explosive mixture.

7. Acetylene may be withdrawn too rapidly, removing all of the available acetylene. Gauge will show empty. After it is allowed to sit awhile more acetylene will come out of solution and may be used again.

C. Regulator -- TM 2

The functions of regulators are to reduce high cylinder pressures to suitable low working pressures for cutting and welding applications and maintain these pressures

1. Parts of Regulators:

   a. inlet
   b. pressure adjusting screw
   c. high pressure gauge
   d. low (working) pressure gauge
   e. outlet

2. Oxygen and acetylene regulators are <u>not</u> <u>interchangab1e</u>

3. Oxygen inlet connections have right hand threads

4. Acetylene inlet connections have left hand threads

5. Pressure adjusting screw is adjusted clockwise

6. High pressure gauge indicates the cylinder pressure

7. Low working gauge indicates pressure delivered to the hose and torch.

8. Welding hoses are connected to the outlet.

9. All oxygen outlets are right-hand threads.

10. All acetylene outlets are left-hand threads.

D. Welding Hose: The hoses transport low-pressure gases from the regulators to the torch handle or butt.

1. Oxygen hose is always green.

2. Acetylene hose is always red.

3. Hose is flame retardant.

4. Keep hose away from open flame, slag and sparks.

SUGGESTED LEARNING ACTIVITIES	SUGGESTED RESOURCE MATERIALS
II. 1. Have each student turn on light and shut off oxyacetylene torch properly.	1. Equipment in shop.

II. E. Torch Handle (TM 3): The function of torch handle is as a means to control the gas supply with two control valves, oxygen and acetylene. The elements are:

1- Two control valves

2. Barrel

3. Torch head

F. Welding Tips and Torches

The purpose of welding tips is to provide a safe, convenient method of varying the amount of heat. The cutting torch may be attached to torch handle to act as a means of cutting metal.

1. Tips and torches come in various sizes.

2. Varying pressures are used for different sizes.

3. All tips are made of copper and may be damaged by careless handling.

III. Setting Up and Adjusting Equipment

The setting up of welding equipent is an operation which must be done frequently and efficiently. To avoid hazards each step must be performed correctly.

A. Setting Up

1. Chain cylinders in vertical position

2. Remove protective caps and blowout any dust or foreign material from the cylinder valve opening. Crack the tank.

3. Attach regulators to proper cylinder.

4. Attach hoses to proper regulators.

5. Attach torch handle to other end of hoses. Right and left threads on hose ends will prevent you from attaching to the wrong part of torch valves.

6. Select proper tip or attachment and attach to torch handle.

B. Adjusting and Lighting the Torch

1. Back off regulator screws, turn counter clockwise. until screws turn freely

2. Close both needle valves on torch handle. clockwise -- snug, not tight

3. Stand to one side, slowly open acetylene cylinder valve 1/4 turn, oxygen cylinder valve all the way as it sears either open or closed

4. Turn the adjusting screws on regulator clockwise to proper pressures

   a. Acetylene 5-8 lbs.
   b. Oxygen 10-30 lbs. depending on nature of job to be done

5. Check all connections for leaks

   a. smell acetylene
   b. listen for oxygen

6. Wear protective goggles

7. Hold torch in one hand, spark lighter in the other -- TM 4, 5

SUGGESTED LEARNING ACTIVITIES		SUGGESTED RESOURCE MATERIALS
III.	1. Have each student practice adjusting valves to obtain a neutral flame.	1. Equipment in shop.
	2. Have each student examine their joints for uniformity and strength.	2. Equipment in shop.

III. B. 8. Ooen acetylene needle valve on torch approximately 1/4 turn MAX.

9. Ignite gas

10. Point flame away from others and yourself, and cylinder

11. Continue ooening acetylene valve until flame stops smoking

12. Open oxygen needle valve slowly until a bright neutral flame is reached, TM 5

13. Re-adjust pressures if necessary

C. Shut Down

1. Turn off acetylene needle valve first

2. Turn off oxygen needle valve second

3. Turn off valves at the cylinders

4. Open actylene needle valve to relieve pressures, leave open until gauges read, zero; then turn off before opening oxygen valve

5. Open oxygen needle valve to relieve pressure, leave open until gauges read, zero; then close

6. Back-off adjusting screws until they turn freely, counter-clockwise.

7. Coil-up hoses and torch handle, out of the way.

8. Leave a tip on the torch handle, return all other apparatus to proper storage area, TM 7 &8

IV. Joining Metals -- TM 6

In the oxyacetylene welding process two metals are joined by melting or fusing their adjoining surfaces. This is accomplished by directing an oxyacetylene flame over the metals until a molten puddle of metal is formed. To help the metals form together filler rod may be added to the molten puddle.

A. Beads Procedure

1. Select mild steel and corresponding tip size

2. Light torch

3. Hold tip of inner cone of the flame about 1/16" above surface

4. Hold flame in same spot until a molten puddle is formed

5. Hold flame pointing in the direction of weld, forming about 45' - 60' degree angle with surface

6. Rotate flame in small circles and slowly move in the direction of the weld

7. Keep the puddle size the same, as the torch is moved across the metal

8. Inspect weld for uniformity and penetration

B. Fusion or Outside Corner Welds

1. Select mild steel and tip

2. Set-up and tack plates every 2" starting at right-hand end

SUGGESTED LEARNING ACTIVITIES		SUGGESTED RESOURCE MATERIALS
III.	1. Demonstrate each of the welding joints and have each student oractice each joint.	**1.** Equipment in shop.
	2. Have each student clean up and put away accessories prooerly.	2. Equipment in shop.

IV. B. 3. Proceed with weld as stated for bead

4. The metal should split the flame

5. Make the weld, leaving a smooth uniform bead

6. Examine the finished weld for uniformity and penetration

C. Butt Welds

1. Select mild steel and tip

2. Place plates flat and tack every 2", starting from right end

3. Depending on thickness of plates to how close plates are tacked together

4. Make weld much the same way as for beads

5. Examine finished weld for uniformity and penetration

D. Tee or Fillet Welds

1. Select mild steel and tip

2. Place one plate vertically on top of a flat plate

3. Tack plates into position every 2" apart

4. Proceed with the bead, paying particular attention to:

a. flame angle 45' degrees or less with bottom plate
b. flame angle 60' - 80' degrees toward weld direction
c. puddle should be equal on both plates

5. Examine finished weld for uniformity

E. Cap Weld s

1. Select mild steel and tip

2. Lay both plates flat with one, halfway on top of the other

3. Weld the plates

a. hold flame 75'degrees pointing toward lower plate
b. hold flame 60' degrees in the direction of the weld

4. Examine weld for uniformity

F. Brazing

1. Select metal, tip and proper bronze rod, either flux coated or plain and a can of flux

2. Clean metal with wire brush

3. Adjust flame properly for metal to braze

4. Heat tip of rod and dip into flux

5. Preheat metal only to a dull red color

6. Bring the rod and flame in contact with work in a downswing

7. Drag rod in direction of the brazing before removing it in an upswing

SUGGESTED LEARNING ACTIVITIES

SUGGESTED RESOURCE MATERIALS

IV. F. 8. Continue to dip rod into flux and add sufficient rod to metal to form a bead

9. Inspect finished bead for uniformity of width. height and ripples

SUGGESTED LEARNING ACTIVITIES

SUGGESTED RESOURCE MATERIALS

Student Evaluation

1. List two ways to differentiate between oxygen and acetylene cylinders:

   a.

   b.

2. What is the difference between tank or cylinder pressure, and delivery or working pressure?

3. Normally the hose nuts for acetylene are .___ hand threads, while oxygen fixtures are always _____

4. What are two functions of oxygen gas and two for acetylene gas?

Oxygen:	Acetylene:
a.	a.
b.	b.

5. List two precautions to consider before attaching regulators to cylinders.

   a.

   b.

Student Evaluation

Given a set of oxy-acetylene equipment, you will be able to:

1. Identify oxygen and acetylene cylinders.
2. Differentiate between tank pressure and working pressure gauges.
3. Identify hose nuts with regular threads and left-hand threads.
4. Identify at least 20 of 25 given parts of oxyacetylene equipment, LABELED by instructor or designated student.
5. Select correct sizes of welding tips.
6. List the purposes of oxygen and acetylene gases.
7. List two precautions to consider before attaching regulators to cylinders.

Student Evaluation

BRAZING, WELDING & CUTTING

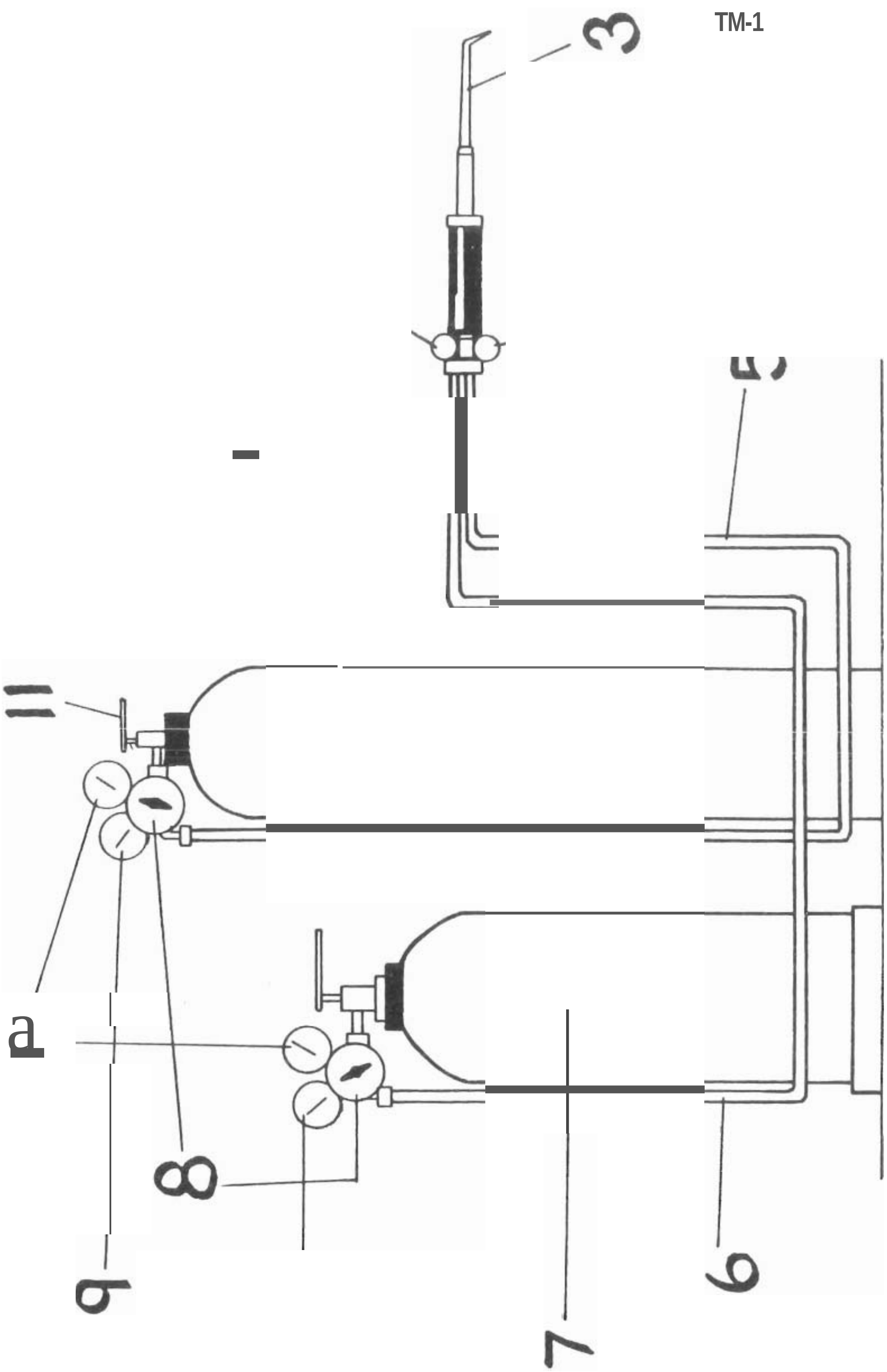
Given adequate reference material the student **will** be able to:

1. Explain (to the satisfaction of the instructor) the difference in fuse welding with steel rod and brazing.
2. Differentiate by explanation or demonstration between a neutral, oxidizing and carburizing flame.
3. Relate to the instructor, orally or in writing, the approximate delivery pressure per square inch for oxygen and acetylene gases.
4. Sketch an example of a butt weld, corner weld and fillet weld.

Given a set of oxy-acetylene equipment and supplies, the student will be able to:

5. Carry a puddle on 16 gauge stock with and without filler rod scoring at least 7 out of 10 points.
6. Make a butt weld, edge weld, lap weld and fillet weld on 16 gauge stock with and without filler rod, scoring at least 7 out of 10 points.
7. Cut flat steel, angle iron and round pipe with cutting attachment scoring at least 7 out of 10 points.
8. Cut a 45 degree angle, and cut a hole from 12 gauge steel plate scoring at least 7 out of 10 points.

OXYACETYLENE EQUIPMENT



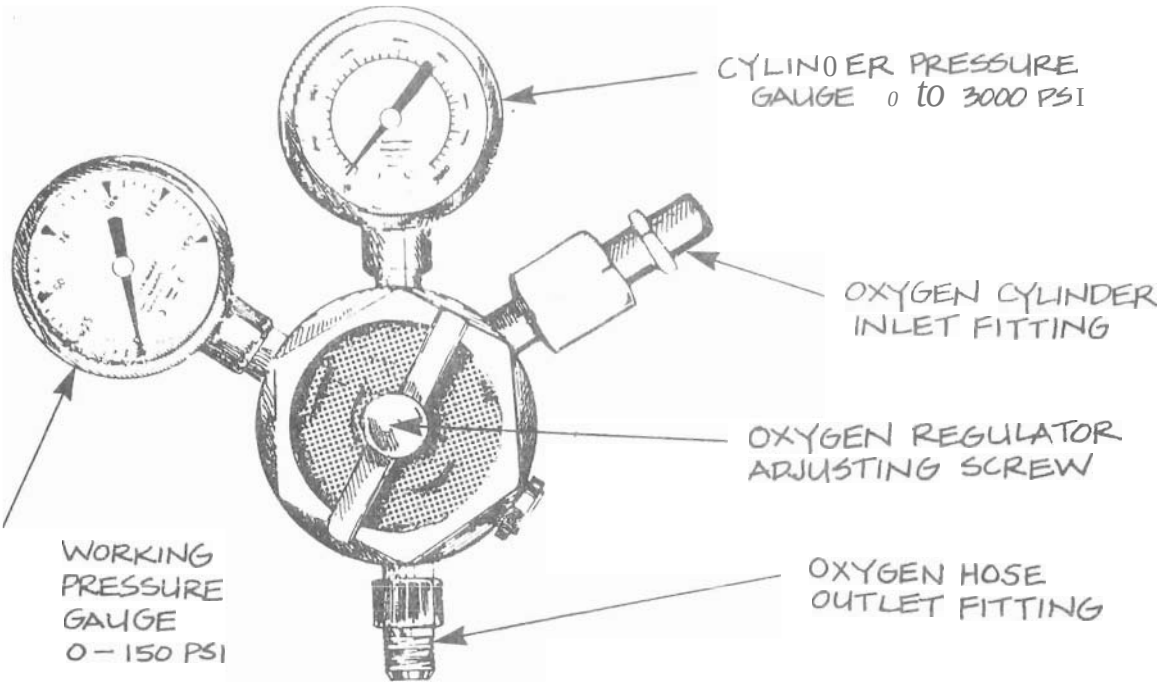
OXY-ACETYLENE EQUIPMENT

TM-1A

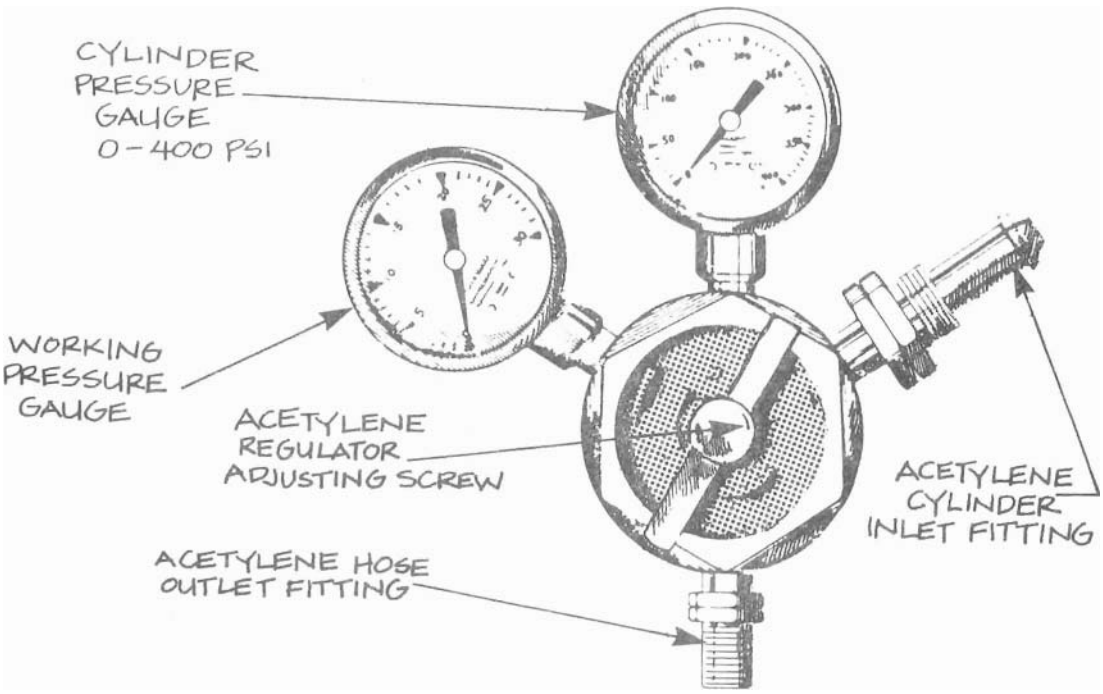
1. Oxygen Cylinder
2. Acetylene Torch Valve
3. TIP
4. Oxygen Torch Valve
5. Oxygen Hose
6. Acetylene Hose
7. Acetylene Cylinder
8. Pressure Regulator
9. Regulator Outlet Gauge
10. Cylinder PressureGauge
11. Oxygen Cylinder Valve

WELDING REGULATORS

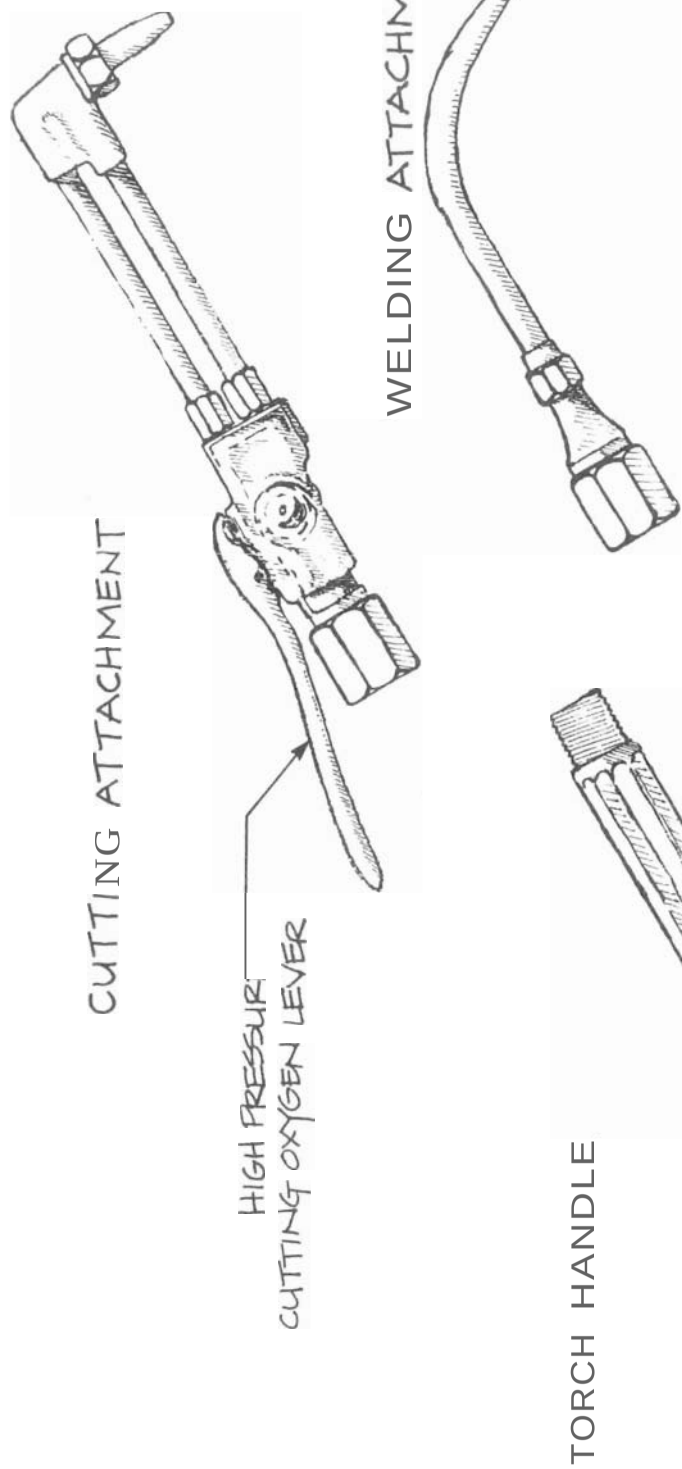
OXYGEN REGULATOR



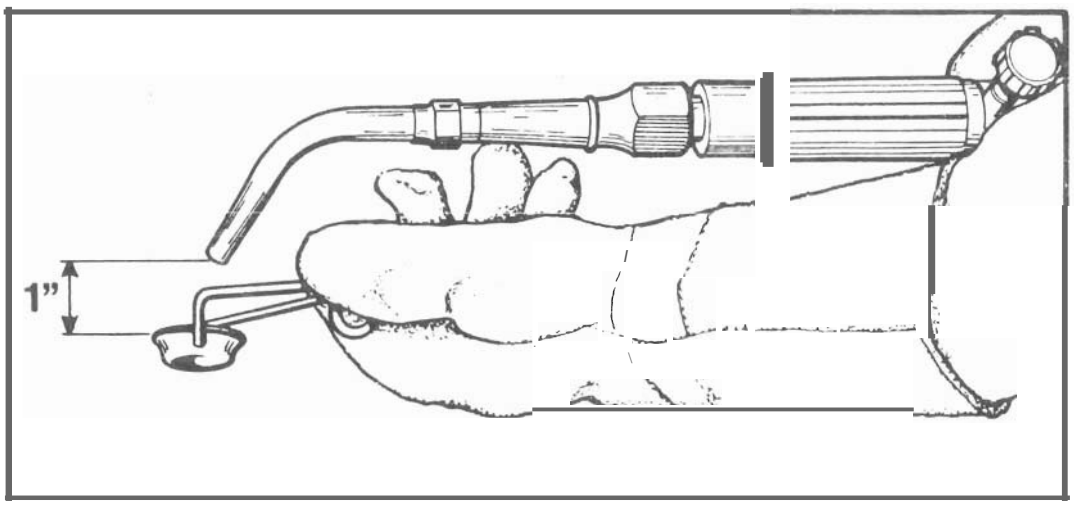
ACETYLENE REGULATOR



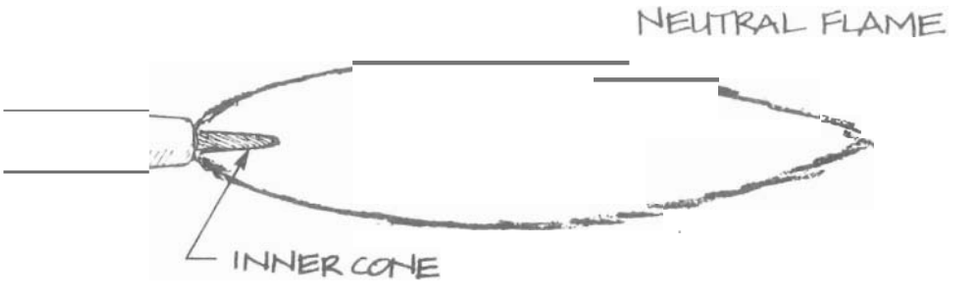
OXYACETYLENE TORCHES

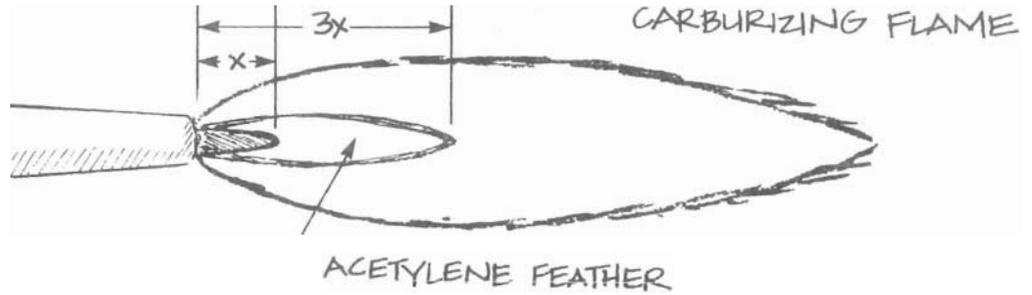


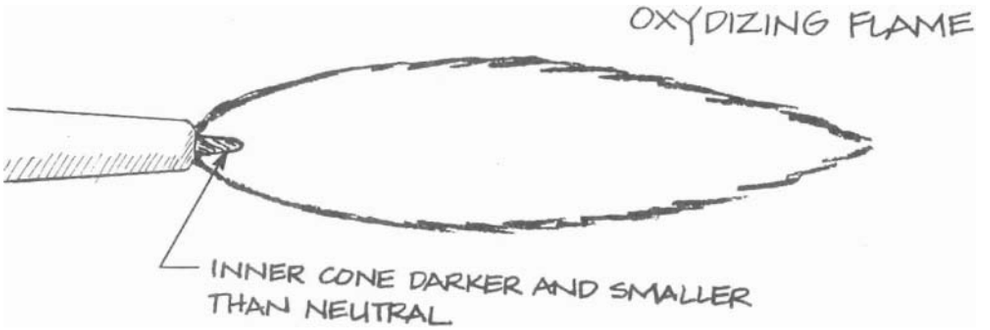
USING FRICTION LIGHTER

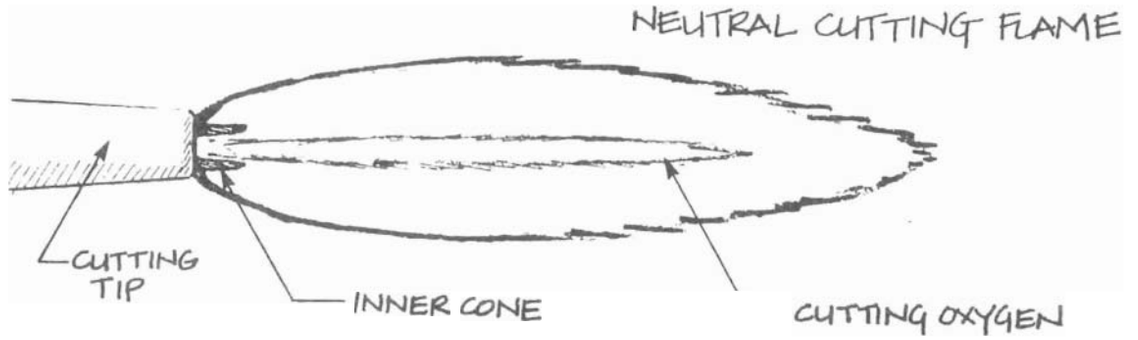


OXYACETYLENE FLAMES









THE FIVE KEYS TO WELDING

This is a comparison of the five keys to Arc Welding to their equivalent factor in gas welding. Let it be noted here and now that every factor is more critical in its need for fine adjustment and control in gas welding than it is ln arc welding.

1. Machine Setting -- Heat

A. Correct size tip for thickness of metal
R. Correct pressure adjustment for tip size
C. Correct flame adjustment for tip (neutral flame).
D. Quantity and quality.

2. Arc Length

A. Distance flame tip is away from molten pool. Tip of flame should be 1/16" to 1/8" away from metal.

B. Control of flame: use a slow circular motion bringing the flame slightly lower at the leading edge of the molten pool.

3. Speed of Travel

This will depend almost entirely on your ability. Go slow at first. The molten pool must be maintained and flowed evenly. As your skill develops speed will increase. By slightly increasing flame adjustment speed can be increased.

4. Lead Angle

A. Tip angle to the work in the direction of weld. It's about the same as for arc welding

B. Down hand welding -- most used -- flame goes ahead of you.

C. Back hand welding -- for light easy to burn through material -- flame plays back over the finished weld.

5. Position Angle

Across the direction of weld follows the same general characteristics as for arc welding -- generally 1/2 the angle.

In gas welding we are separating the two functions of (heating and making base metal molten) from the adding of the filler material to the molten pool. These two functions must be kept separate and each hand trained to perform independently of the other.

You must first practice making and running the molten pool without losing it or letting it freeze. After some skill is developed try to add metal from the filler rod to the molten pool without interrupting its uniform steady progression. Don't cut and melt the filler rod with the flame. But develop the skill to fill and flow without losing the molten pool. At first you will experience some difficulty in adding the filler rod to the pool without getting it stuck to the plate. Don't be discouraged, but watch to see that it is molten on the end before you try to drop it onto the leading edge of the pool. If it does occasionally get stuck don't leave the molten pool to move over and melt it free, but flow the pool over to where the rod is.

INFORMATION SHEET ON OXY ACETYLENE WELDING

1. Oxygen does not burn -- it only supports combustion. It makes things that burn, burn faster and hotter.
2. Oxygen is secured from air (20% or 1/5) by compressing air -- and liquifying it then distilling.
3. Acetylene gas -- is made from coke (coal) into carbide. by adding water -- carbide gas or acetylene is given off. It is a fuel -- it burns.
4. Acetylene gas is dangerous at pressures above 15 psi.
5. Acetone will dissolve 10 times its volume of actylene (this permits higher tank pressures).
6. Each acetylene cylinder has several gallons of acetone in it. It also has a very porous form of concrete in it to act as a sponge and strainer to keep the acetone in and let the gas come out of the solution free of any acetone.
7. For the above reasons of construction. acetylene cylinders must not be laid on their sides before using. Must be standing erect 8 hours before using, or acetone is lost and welding is not possible.
8. Acetylene hose -- regulator and tank fittings are left-hand threaded. Hoses red or black.
9. Oxygen fittings are right-hand threaded and hoses green.
10. Oxygen and oil form a compound similar to dynamite -- use no oil is the rule around oxyacetylene equipment.
11. Safety caps must be on cylinders when not hooked into a welding system.
12. Oxygen cylinders when full have about 2.000 1bs. psi.
13. Acetylene cylinders when full have about 350 lbs. psi.
14. Never cut or weld on a sealed or closed container or any vessel that may have held combustable material at any time in its past history.
15. Empty tanks should be marked MT with chalk.
16. Both cylinder valves should be cracked before installing regulators -- blows out dust to keep it from going into regulator.
17. Acetylene cylinder is opened only 1/4 turn.

18. Oxygen cylinder valve is double seating to prevent leaking around the stem. Open all the way.
19. The neutral flame for welding is secured when equal parts of oxygen and acetylene are burned together. 6,000 degrees F.
20. Too much acetylene gives a feathered flame carburizing flame.
21. Too much oxygen gives a harsh flame oxidizing -- or burning -- flame. Scales the metal.
22. Backfiring is caused by the tip getting too hot.
    a. from not enough flame size to allow the gases to cool the top
    b. getting tip too close to hot metal
    c. angle of tip not correct, too much flame bounces back over tip.
23. Blowout is caused by too large a flame adjustment for size of tip.
24. The regulators STEP down the high pressures in the cylinders. To an evenly controlled low pressure at the torches.
25. One gauge shows pressure in cylinder. Other gauge shows torch pressure if it is set with torch valve open.
26. Regulators must be backed off "closed" before opening cylinder valves.
27. Tank or cylinder valves are closed first.
28. Lines and regulators "purged" (all pressure released).
29. Regulators must be backed off before leaving the eguipment. Gauges all at zero.
30. Keep hoses out of the way -- hot flame or sparks will burn the hoses, as will hot metal.
31. Compressed gasses expand when heated so keep them away from direct sunlight and torch flame or any other sources of direct heat.

OXY ACETYLENE EQUIPMENT SAFETY

1. Be certain hoses are out of the way of torch flame and droppings, especially when cutting.
2. Keep area free of grease, gasoline, paper, wood and other combustable material.
3. Do not play with fire. Leave experimenting to the scientists.
4. Wear protective goggles at all times when cutting or welding or brazing.
5. DO NOT WELD, CUT, SOLDER OR BRAZE on closed containers.
6. Check your equipment for leaks before starting to work.
7. Get your tools and equipment and make all preparations before you light the torch.
8. Don't lay lighted torch down to go and get something.
9. When welding or cutting keep flame and slag from contacting cement floors. Cement explodes when overheated.
10. Popping and backfiring is caused by tips becoming too hot. Solution is to adjust for larger flame for tip you are using or select larger tips or keep proper distance between tip and work.
11. Use no oil on oxyacetylene equipment.
12. Use extreme caution in cleaning tips not to break cleaners off in tips.
13. Do not breathe fumes from brazing or cutting on galvanised material. Serious sickness can result.
14. Oxyacetylene flame is 6,300 degrees F, it is HOT, be careful.

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