Fuel Gas(oxy-acetylene) welding safety

- Use aprons and gloves.
- Do not point the flame towards the regulators and another person.
- When finished welding shut off the main valves , bleed the lines and loosen the regulator adjusting screws.
- Wind up the hoses when finished shutting everything off.

- Do not turn acetylene valve more than 1 ½ turns.
- Never use oil near oxygen equipment
- Threads used for acetylene are LEFT-

Cont....

- Welding goggles must be worn at all times in work areas.
- Long and loose hair must be contained.
- Appropriate footwear with substantial uppers must be worn.
- Close fitting/protective clothing must be worn.
- Rings and jeweler must not be worn.
- Oil free leather gloves must be worn when welding.

PRE-OPERATIONAL SAFETY CHECKS

- ✓ Ensure no slip/trip hazards are present in workspaces and walkways.
- ✓ Keep area clean and free of grease, oil and other flammable material.
- ✓ Gas hoses must be in good condition
- ✓ Before lighting up make a visual inspection of all equipment for damage.
- ✓ Check that the area is well ventilated and fume extraction unit is on.
- ✓ Faulty equipment must not be used

PRESSURE SETTING

- Check that the oxygen and acetylene regulator adjusting knobs are loose.
- Check that both blowpipe valves are closed.
- Slowly open the cylinder valves on each cylinder for half a turn only.
- Purge and check for constant oxygen gas flow.
- Open the oxygen blowpipe for 2 seconds valve and check the delivery gauge.
- Close the oxygen blowpipe valve.

LIGHTING UP

- Open the acetylene blowpipe valve slightly and light the blowpipe with a flint lighter.
- Continue to slowly open the acetylene valve until the flame no longer produces soot.
- Slowly open the oxygen blowpipe valve until a neutral flame is produced.

SHUTTING OFF BLOWPIPE

1. Close the acetylene blowpipe valve first.
2. Then close the oxygen blowpipe valve

CLOSING DOWN

- Close down both cylinder valves.
- Open oxygen blowpipe valve to allow the gas to drain out.
- When oxygen gauges read zero, unscrew regulator-adjusting knob.
- Close oxygen blowpipe valve.
- Turn off acetylene cylinder valve.
- Open acetylene blowpipe valve and release gas.
- When acetylene gauges read zero, release regulator adjusting knob.
- Close acetylene blowpipe valve.

Identification, Care and Storage of Gas Cylinders

- To prevent the interchange of fittings between cylinders containing acetylene and oxygen gases, the valve outlets on acetylene gas cylinders are screwed left handed

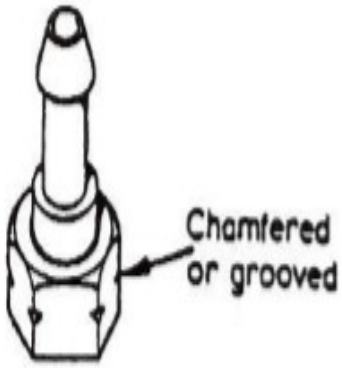


Figure 1 - Left-Hand Thread Combustible Gas i.e. Acetylene

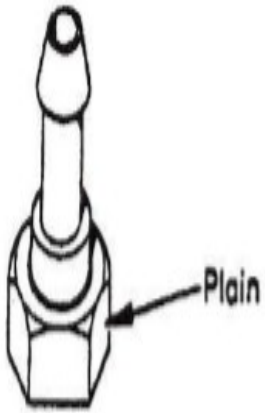


Figure 2 - Right-Hand Thread Non-Combustible Gas i.e. Oxygen

Definition of oxy- acetylene

- **Ox fuel welding is a welding process where the heat for fusion is supplied by a torch using oxygen and a fuel gas**
- The heat from the torch allows for the melting and mixing of the base metal and filler metal to form a solid weld.

Cont....

- Join metal by heating surfaces to be joined to melting point with gas flame
- Fusing metal into homogeneous mass
- Letting it solidify into a single unit
- Flame in cone reaches temperatures as high as 5800º to 6300ºF
- Filler rod may or may not be

Cont....

- Oxyacetylene welding is limited to thin metal sections or when portability is important(0.5-6mm)
- Today almost exclusively used on thin metal
- An electric arc welding processes is usually used for welding thicker metal

Cont……

- Welds with 100% integrity possible
- Secondary flame shields the molten weld pool from the air
- Atmospheric oxygen combines with carbon monoxide to produce carbon dioxide
- Carbon dioxide forces surrounding atmosphere away from the weld

Advantages and Disadvantages

- The main advantage of the oxyacetylene welding process is that the equipment is simple, portable, and inexpensive.
- It is convenient for main- tenancy and repair applications.

Cont....

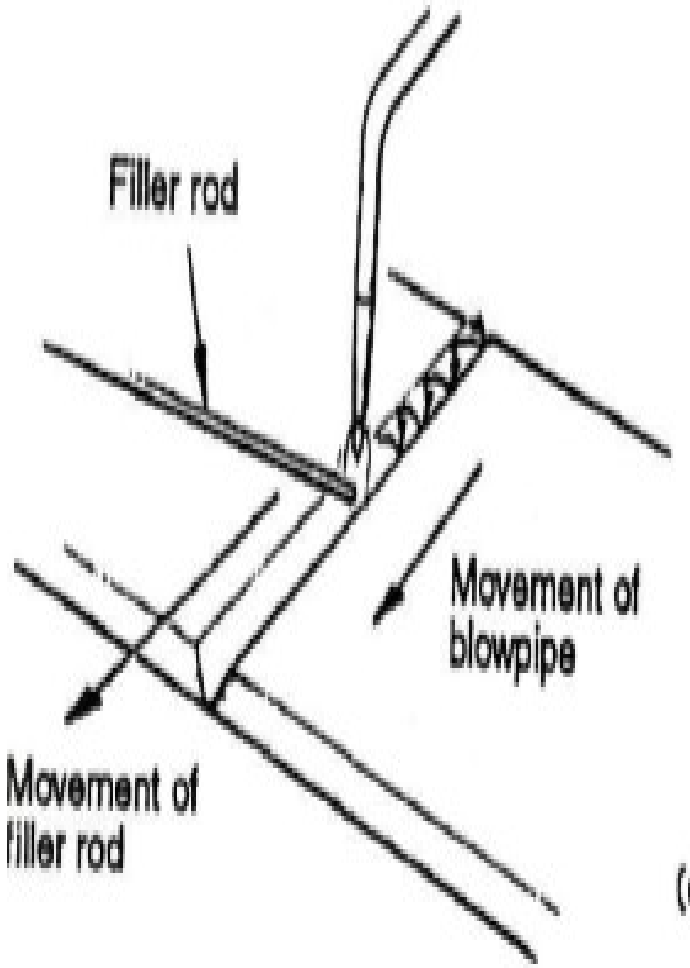
- Due to its limited power density, the welding speed is very low and the total heat input per unit length of the weld is rather high, resulting in large heat-affected zones and severe distortion.
- The oxyacetylene welding process is not recommended for welding reactive metals such as titanium and zirconium because of its limited protection power.

Welding Techniques

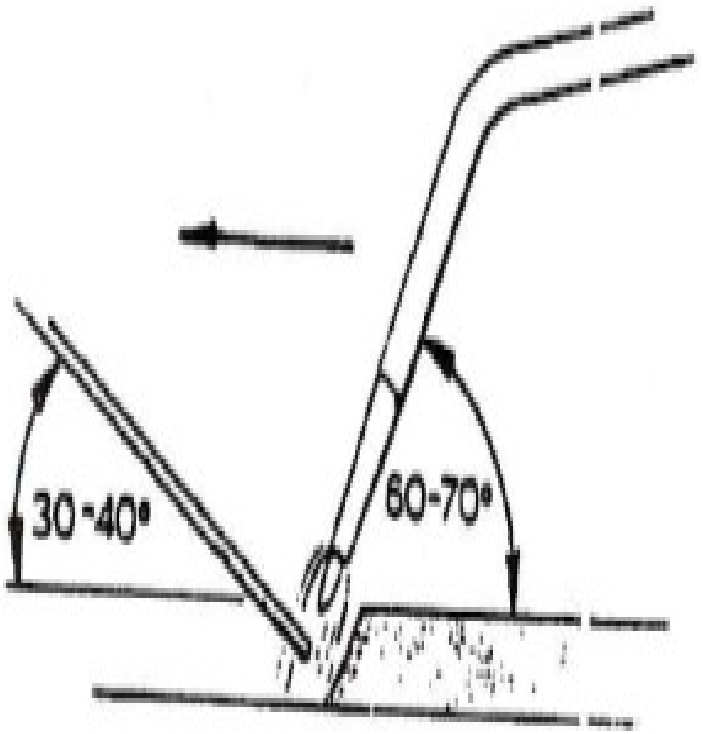
Leftward Welding

- The weld is commenced on the right-hand side of the seam; working towards the left-hand side.
- The blowpipe is moved forwards with the filler rod being held in front of the flame.

Cont.....


Filler rod
Movement of blowpipe
Movement of filler rod

(a)


30-40°
60-70°

(b)

Cont.....

Leftward Technique

Thickness of Plate (mm)	(in)	Power of Blowpipe (gas consumption) (l/h)	(ft³ h)	Diameter of Filler Rod (mm)	(in)	Rate of Welding (m.h)	(ft.h)	Distance between edges (mm)	(in)	Welding Rod used per metre (m)	per foot (ft)	Edge preparation
0·9	1/32	28-57	1-12	1·6	1/16	6-7·6	20-25	—	—	0·3	1	square
1·6	1/16	57-86	2-3	1·6	1/16	7·6-9	25-30	1·6	1/16	0·53	1·75	square
2·4	3/32	86-140	3-5	1·6	1/16	6-7·76	20-25	2·4	3/32	8·84	2·75	square
3·2	1/8	140-200	5-7	3·2	1/8	5·4-6	18-20	3·2	1/8	0·50	1·65	square
4·0	5/32	200-280	7-10	3·2	1/8	4·6-5·4	15-18	3·2	1/8	0·64	2·1	80° vee
5·0	3/16	280-370	10-13	3·2	1/8	3·6-4·6	12-15	3·2	1/8	1·40	4·8	80° vee

Table 3 - Leftward Technique

Rightward Welding

The welding is commenced on the left-hand side of the seam, working towards the right-hand side.

The filler rod is held at an angle of 30/40°

Cont.....

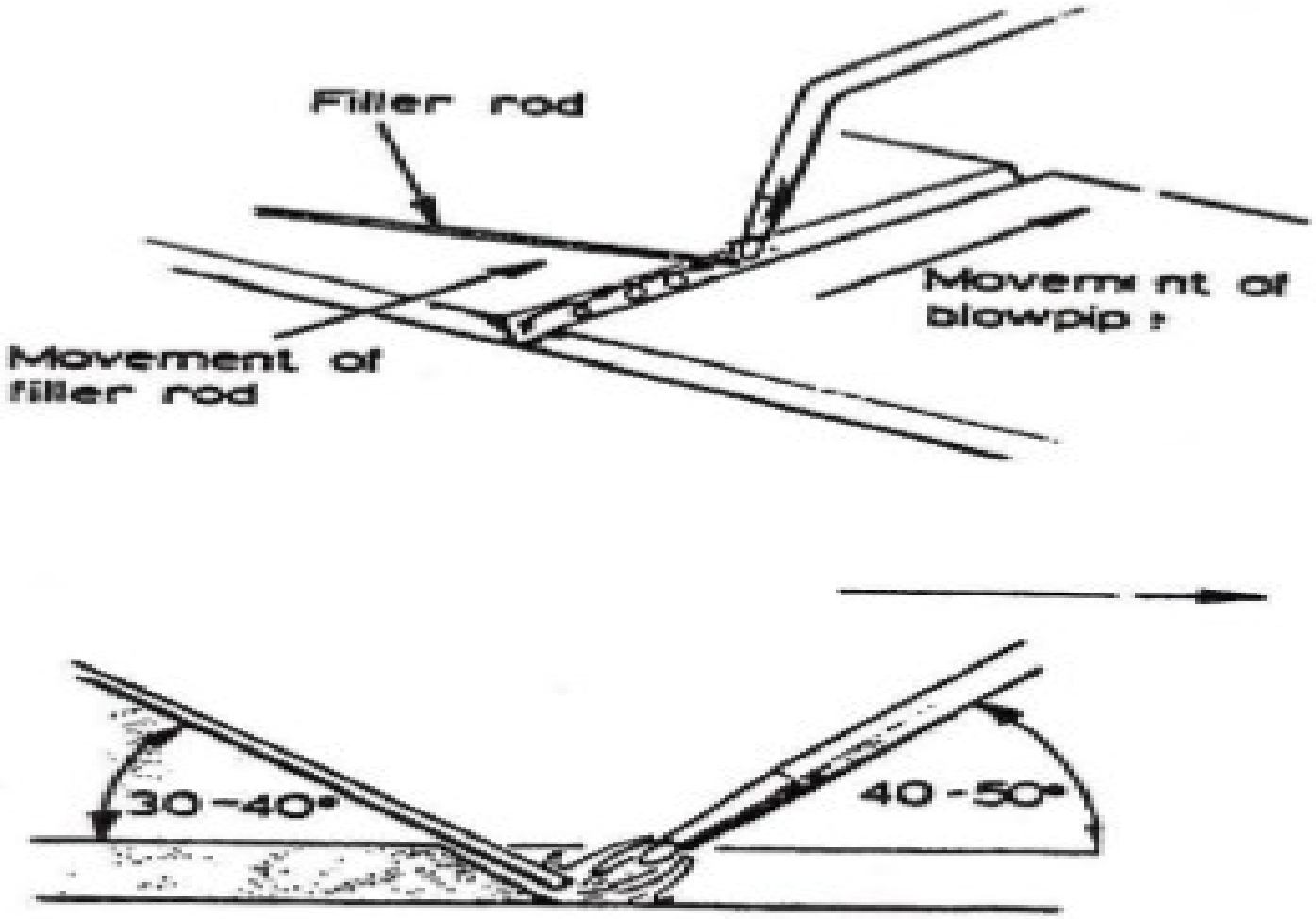


Figure 8 – Rightward Welding

Cont.....

- It is more common to use the rightward technique, in preference to the leftward, on **mild steel plate over 3/18 in**, because:

(a)Less filler rod is used

(b) Welding speed is greater

(c) Gas consumption is less

(d) The Better mechanical properties

(e) Less risk of oxidation

Cont.....

Rightward Technique

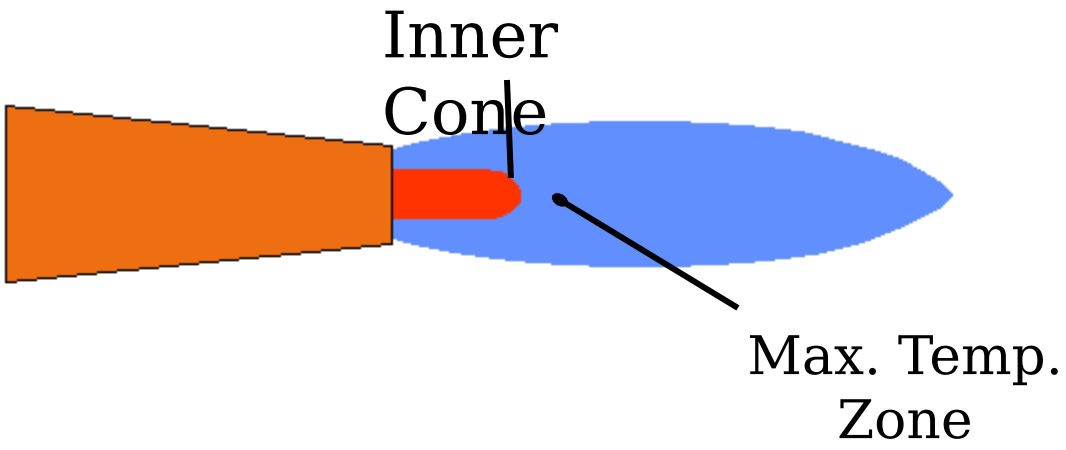
Thickness of Plate (mm)	Thickness of Plate (in)	Power of Blowpipe (gas consumption) (l/h)	Power of Blowpipe (gas consumption) (ft³ h)	Diameter of Filler Rod (mm)	Diameter of Filler Rod (in)	Rate of Welding (m.h)	Rate of Welding (ft.h)	Distance between edges (mm)	Distance between edges (in)	Welding Rod used per metre (m)	Welding Rod used per foot (ft)	Edge preparation
5·0	3/16	370-520	13-18	2·4	3/32	3·6-4·6	12-15	2·4	3/32	1·03	3·4	no vee
6·5	1/4	520-570	18-20	3·2	1/8	3·0-3·6	10-12	3·2	1/8	1·03	3·4	no vee
8·2	5/16	710-816	25-30	4·0	5/32	2·1-2·4	7-8	4·0	5/32	1·03	3·4	no vee
10·0	3/8	1000-1300	35-45	5·0	3/16	1·8-2·1	6-7	3·2	1/8	1·22	4·0	60° vee
13·0	1/2	1300-1400	45-50	6·5	1/4	1·3-1·5	4·5-5	3·2	1/8	1·69	4·75	60° vee
16·2	5/8	1600-1700	55-60	6·5	1/4	1·1-1·3	3·75-4·25	3·2	1/8	2·05	6·75	60° vee
19	3/4	1700-2000	60-70	6·5	1/4	0·9-1·0	3-3·25	3·2	1/8	2·96	9·75	60° top, 80° bottom vee
25	1	2000-2500	70-90	6·5	1/4	0·6-0·7	2-2·25	3·2	1/8	5·08	16·75	60° vee 80° bottom vee

Table 4 - Rightward Technique

Factors Affecting the Weld

- ✓The torch tip size
- ✓Torch angle
- ✓Welding rod size
- ✓Torch manipulation

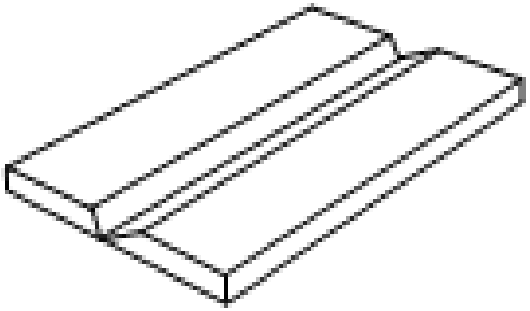
- **Reducing or Carburizing** Excess acetylene (Alloy steels and aluminium alloys)



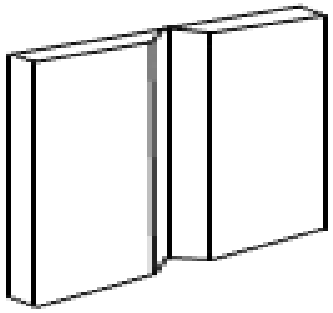
Reducing Flame cont.....

- The combustion of acetylene is incomplete. As a result, a greenish acetylene feather between the inert cone and the outer envelope characterizes a reducing flame.
- This flame is reducing in nature and is desirable for welding aluminum alloys because aluminum oxidizes easily. It is also good for welding high-carbon steels (also called carburizing flame in this case) because excess oxygen can oxidize carbon and form CO gas porosity in the weld metal.

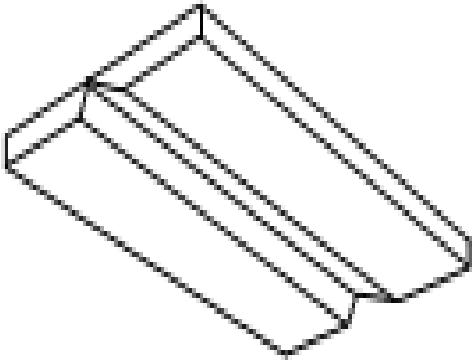
Reducing Flame cont.....



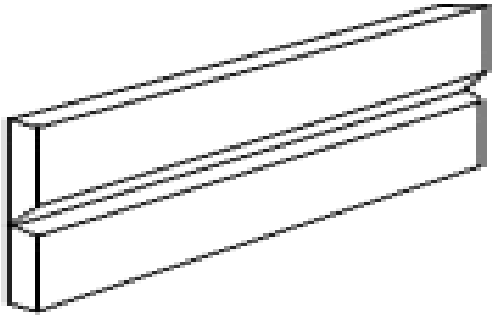
(a) flat



(c) Vertical



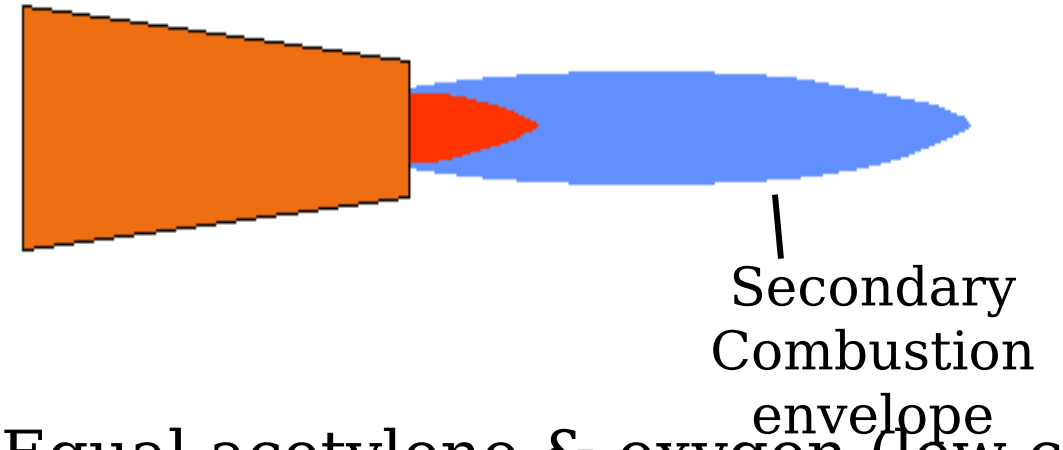
(d) overhead



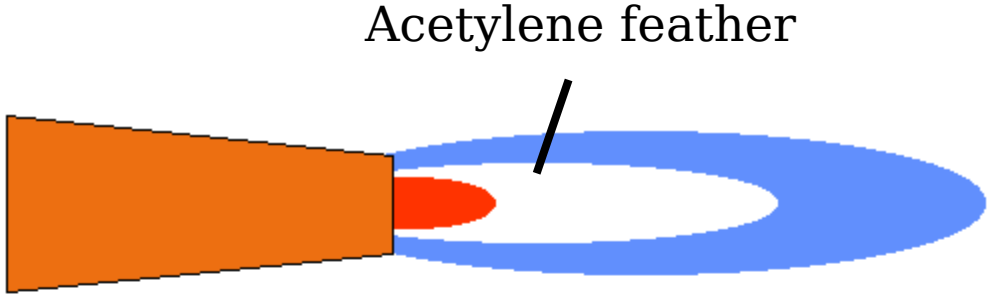
b) horizontal

Oxidizing Flame

- Excess oxygen (Brasses, Bronzes, copper)

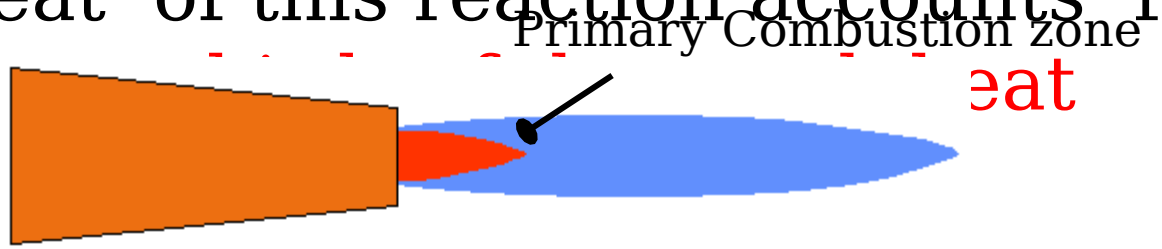


Neutral: Equal acetylene & oxygen (low carbon steel, mild steels).



Cont.....

- The oxy-acetylene flame has two distinct zones.
- The inner zone (Primary combustion Zone) is the hottest part of the flame.
- The welding should be performed so as the point of the inner zone should be just above the joint edges
- The heat of this reaction accounts for about eat genera



$C_2H_2 + O_2$ $2CO + H_2$

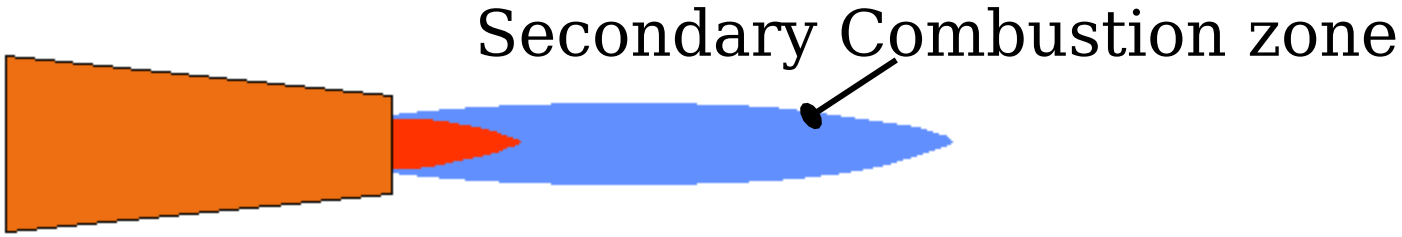
Cont……

- Secondary combustion, which accounts for about one-third of the total heat generated
- The outer zone the secondary combustion envelope performs two functions

➢ ***Preheats the joint edges***

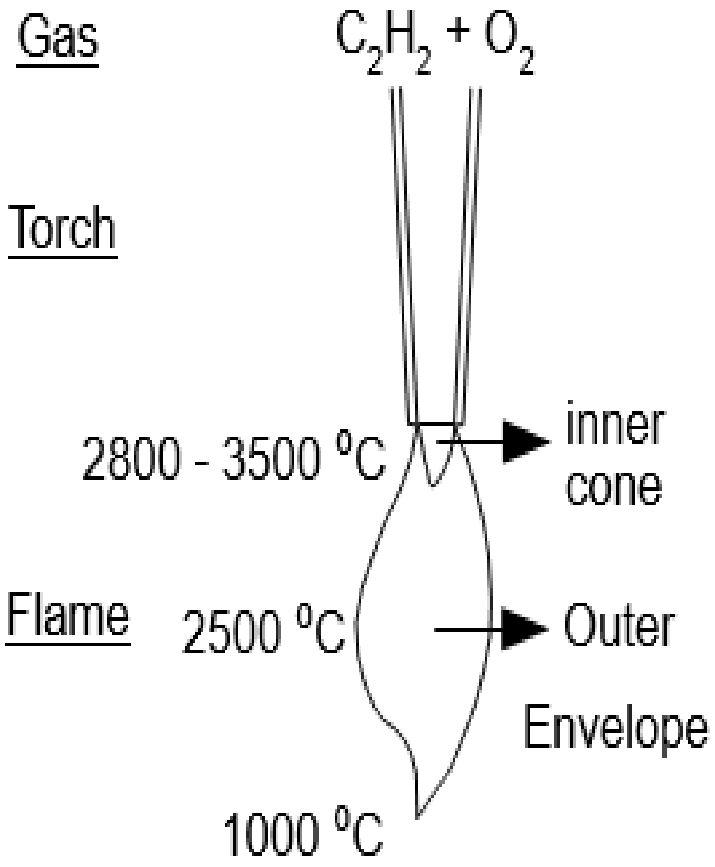
➢ ***Prevents oxidation***

$CO + H_2 + O_2 \qquad CO_2 + H_2O$



Cont....

Three types of flames in oxyacetylene welding. Modified from Welding *Journal* (4). Courtesy of American Welding Society.



Primary combustion in inner cone (2/3 total heat):

$2C_2H_2 + 2O_2$ (from cylinder) $\rightarrow 4CO + 2H_2$

Secondary combustion in outer envelope (1/3 total heat):

$4CO + 2O_2$ (from air) $\rightarrow 4CO_2$

$2H_2 + O_2$ (From air) $\rightarrow 2H_2O$

Flame definition

- The **neutral** flame is produced when the ratio of oxygen to acetylene, in the mixture leaving the torch, is almost exactly one-to-one. It’s termed ”neutral” because it will usually have no chemical effect on the metal being welded. It will not oxidize the weld metal; it will not cause an increase in the carbon content of the weld metal.

Cont....

- The excess acetylene flame is created when the proportion of acetylene in the mixture is higher than that required to produce the neutral flame.
- Used on steel, it will cause an increase in the carbon content of the weld metal.

- Oxidizing Flame When excess oxygen is used, the flame becomes oxidizing because of the presence of unconsumed oxygen. A short white inner cone characterizes an oxidizing flame This flame is preferred when welding brass because copper oxide covers the weld pool and thus prevents zinc from evaporating from the weld pool.

Cont….

- The oxidizing flame results from burning a mixture which contains more oxygen than required for a neutral flame. It will oxidize or ”burn” some of the metal being welded.

Cont.....

Carburizing flame



Neutral



Oxidizing



Fuel Gasses

- **Fuel Gasses**
  - **Propane (Liquid Petroleum Gas)(LPG)**
  - **Natural Gas**
  - **Acetylene**
  - **MAPP(methyl acetylene-propadiene propane)**
  - **Hydrogen**

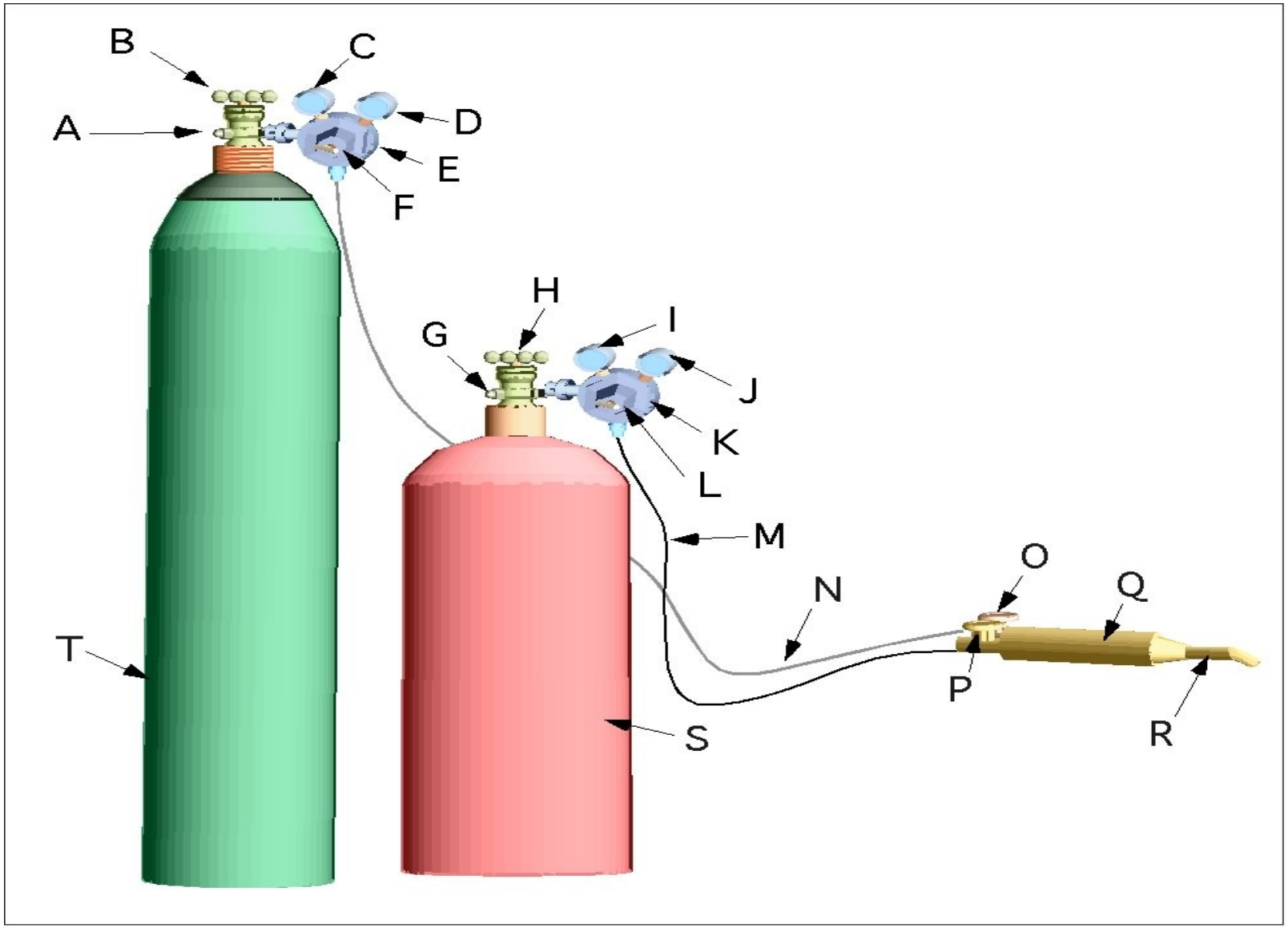
Acetylene G

- Virtually all the acetylene distributed for welding and cutting use is created by allowing calcium carbide (a man made product) to react with water.
- Calcium carbide method of producing acetylene is that it can be done on almost any scale desired. Placed in tightly-sealed cans, calcium carbide keeps indefinitely. For years, miners' lamps produced acetylene by adding water, a drop at a time, to lumps of carbide.

uses

- **Traditionally ox fuel equipment was used for:**
  - **Brazing**
  - **Fusion welding**
  - **Flame hardening**
  - **Metalizing**
  - **Soldering**
  - **Stress relieving**
  - **Cutting**
  - **Bending**

Name of the cylinders parts



Cont……

A.Oxygen safety disc
B.Oxygen cylinder valve
C.Oxygen cylinder pressure gauge
D.Oxygen working pressure gauge
E.Oxygen regulator
F.Oxygen regulator adjusting screw
G. Acetylene cylinder safety disc
H. Acetylene cylinder valve
I. Acetylene cylinder pressure gauge

Cont……

J. Acetylene working pressure gauge

K. Acetylene regulator

L. Acetylene regulator adjusting screw

M. Acetylene hose

N. Oxygen hose

O. Oxygen torch valve

P. Acetylene torch valve

Q. Torch

R. Welding tip

S. Acetylene cylinder

T. Oxygen cylinder

Type of cylinders

Oxygen Cylinder

- One piece, seamless construction.
- Each cylinder has unique serial number and number is recorded in national registry.
- Scheduled inspection required.
- Must not be dropped.
- Should not be used as a roller.
- Never use any lubricates on threads or any part of the cylinder.
- Three common sizes are 244, 150 & 80 cubic feet.
- The valve should never be left exposed.

Cont…….

- Oxygen is stored within cylinders of various sizes and pressures ranging from 2000- 2640 PSI. (Pounds Per square inch)

- Oxygen cylinders are forged from solid armor plate steel. No part of the cylinder may be less than 1/4” thick.
- Cylinders are then tested to over 3,300 PSI using a (NDE) hydrostatic pressure test.

Cont…….

- Cylinders are regularly chemically cleaned and annealed to relieve “jobsite” stresses created by handling
- Never transport cylinders without the safety caps in place
- Never transport with the regulators in place
- Never allow bottles to stand freely.

Cont.....

- Oxygen cylinders incorporate a thin metal *“pressure safety disk”* made from stainless steel and are designed to rupture prior to the cylinder becoming damaged by pressure.
- The cylinder valve should always be handled carefully

Acetylene Cylinder

- **Special cylinder because acetylene is unstable above 15 psi.**
- **Acetylene is shock sensitive.**
- ***Acetylene cylinders are filled entirely with a porous materials which must be able to stop the propagation of an acetylene decomposition within the cylinder initiated by a backfire or an external heating of the acetylene cylinder.***

Cont....

- **250 psi when filled.**
- **Protected by fuse plugs that melt at 212 oF.**
- **The cylinder should be opened only 1/2 to 3/4 of a turn when in use.**
- **The withdrawal rate in cubic feet per hour should never exceed 1/7 times the cylinder capacity.**
- **Common sizes are 300, 120 and 75 cubic feet**

Cont.....

- The acetylene cylinder is made of steel with a concave bottom, Under pressure, dissolved acetylene is safe, but free acetylene over 15 psi pressure is unsafe.
- For safety, then, it becomes necessary to dissolve the acetylene.

Cont.....

- Acetone initially dissolves about 25 times its own volume, About 40% of the cylinder volume is filled with acetone, and, as the cylinder is charged with acetylene, the acetone absorbs the acetylene and swells up in the porous material.

- In each cylinder are fuse plugs, consisting of steel bolts tapped into the cylinders. These are drilled and filled with a low melting alloy that melts between 203° and 207°F. In case of fire, the gas escapes through the melted fuse plugs, so a torch flame should be kept away from all cylinders. Most fuse plugs are on the top and/or bottom of the cylinder..

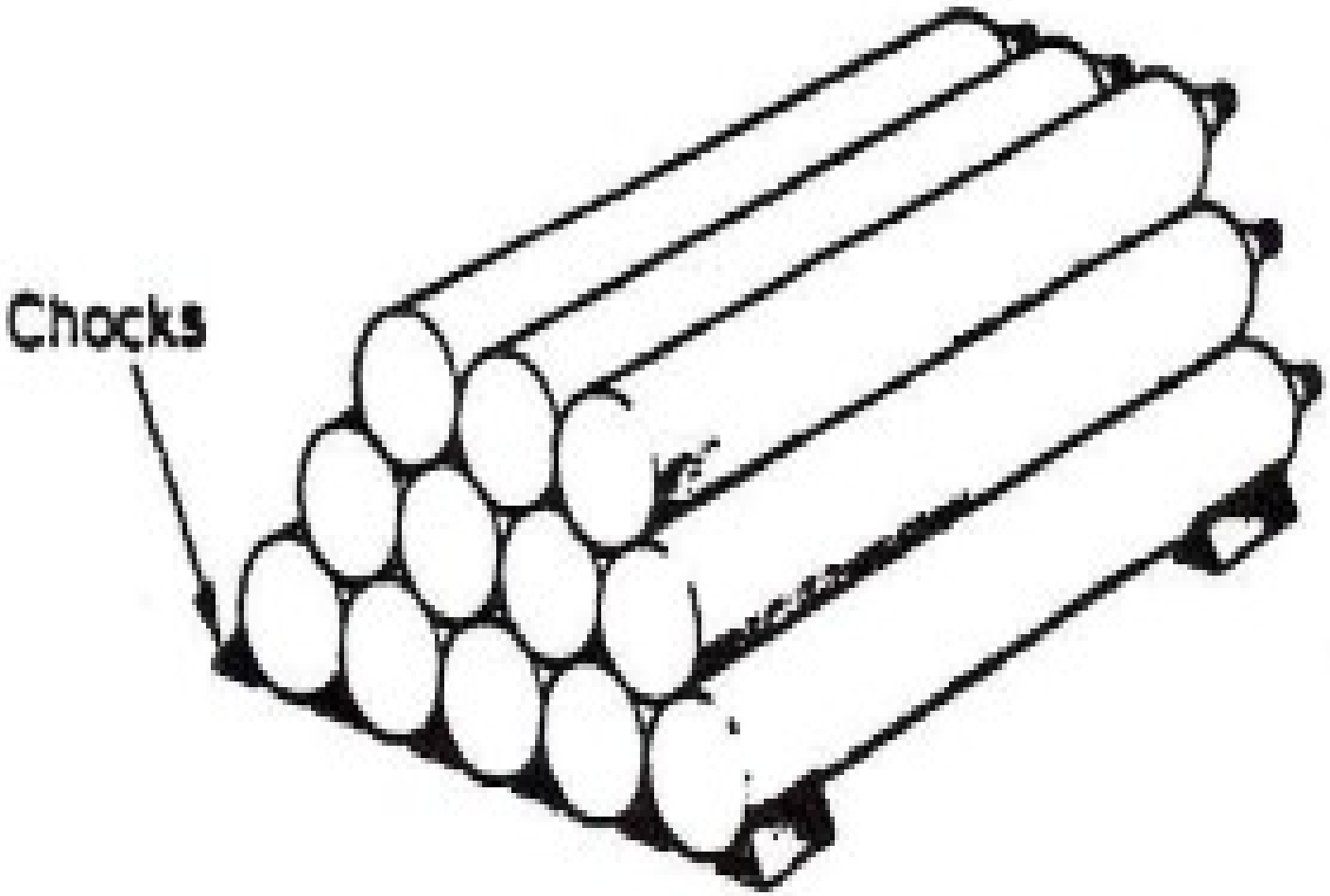
Cont…..

- Oxygen and acetylene cylinders should never be stored together. They should be stacked as in the diagram, with the bottom layer well chocked to prevent rolling, or stored upright with a securing chain to prevent them falling over. The full cylinders should be stored separately from empty ones and used up in rotation as received.

Cont.....

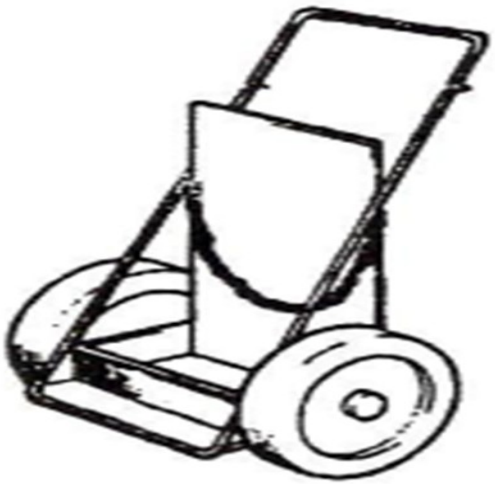
- The storage area should be cool and dry, protected from direct sunlight, frost, rain and corrosive conditions.
- There should be prominent signs indicating the presence of fire risk and No Smoking signs should be strictly observed

Cont.....

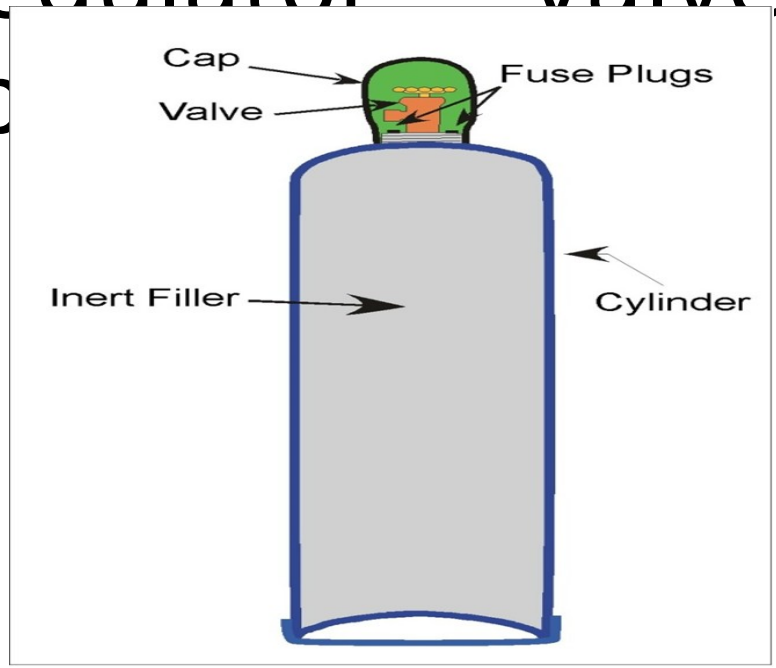


Cont.....

- When using cranes, etc., to lift cylinders, a protective mat or cradle should be used. When moving cylinders that are in use and have regulator valves

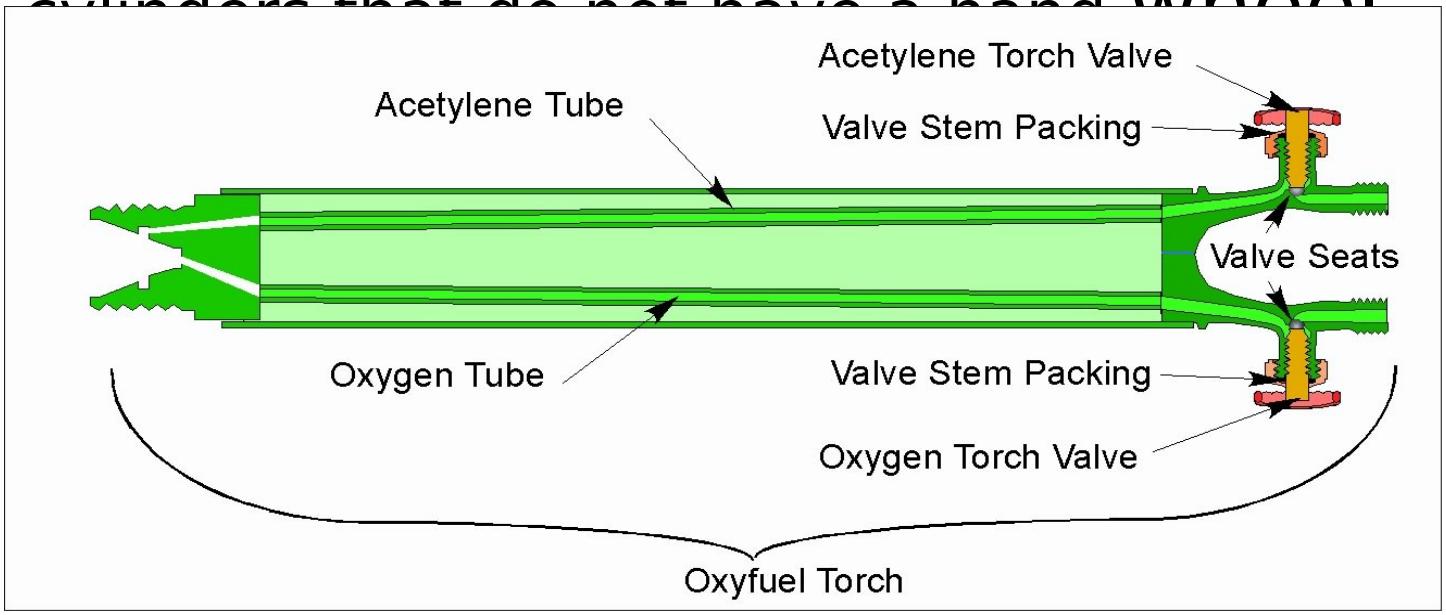


Portable Welding Trolley



Valves

- Acetylene cylinder shut off valves should only be opened 1/4 to 1/2 turn
- This will allow the cylinder to be closed quickly in case of fire.
- Cylinder valve wrenches should be left in place on cylinders that do not have a hand wheel



Gauges

- The pressure of the gases obtained from cylinders is much higher than the gas pressure used to operate the welding torch. Since the pressure of the gases must be reduced between the cylinder and the welding torch, special reducing valves called **regulators** are required.

CONT.....

- Most regulators are constructed with two gauges. One gauge shows the pressure (amount) of gas in the cylinder and the other indicates the working pressure of the gas being delivered to the torch.
- The pressure (amount) of gas in an oxygen cylinder is 1980 lb/in² and the pressure (amount) of gas in an acetylene cylinder is 225 lb/in².
- Pressure readings on gauges are up to: oxygen 30 lb/in² acetylene 15 lb/in²

Oxygen gauges

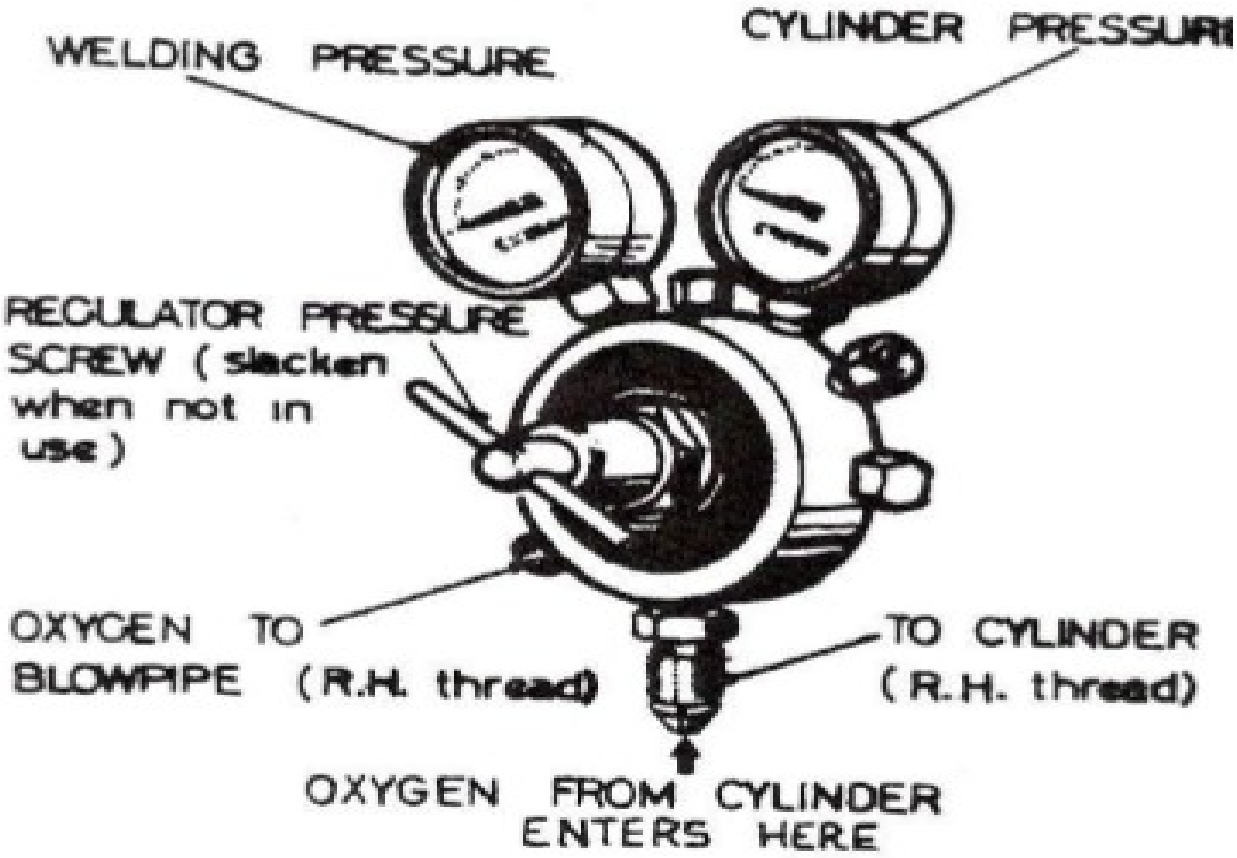


Figure 4 - Oxygen Gauges

Acetylene gauges

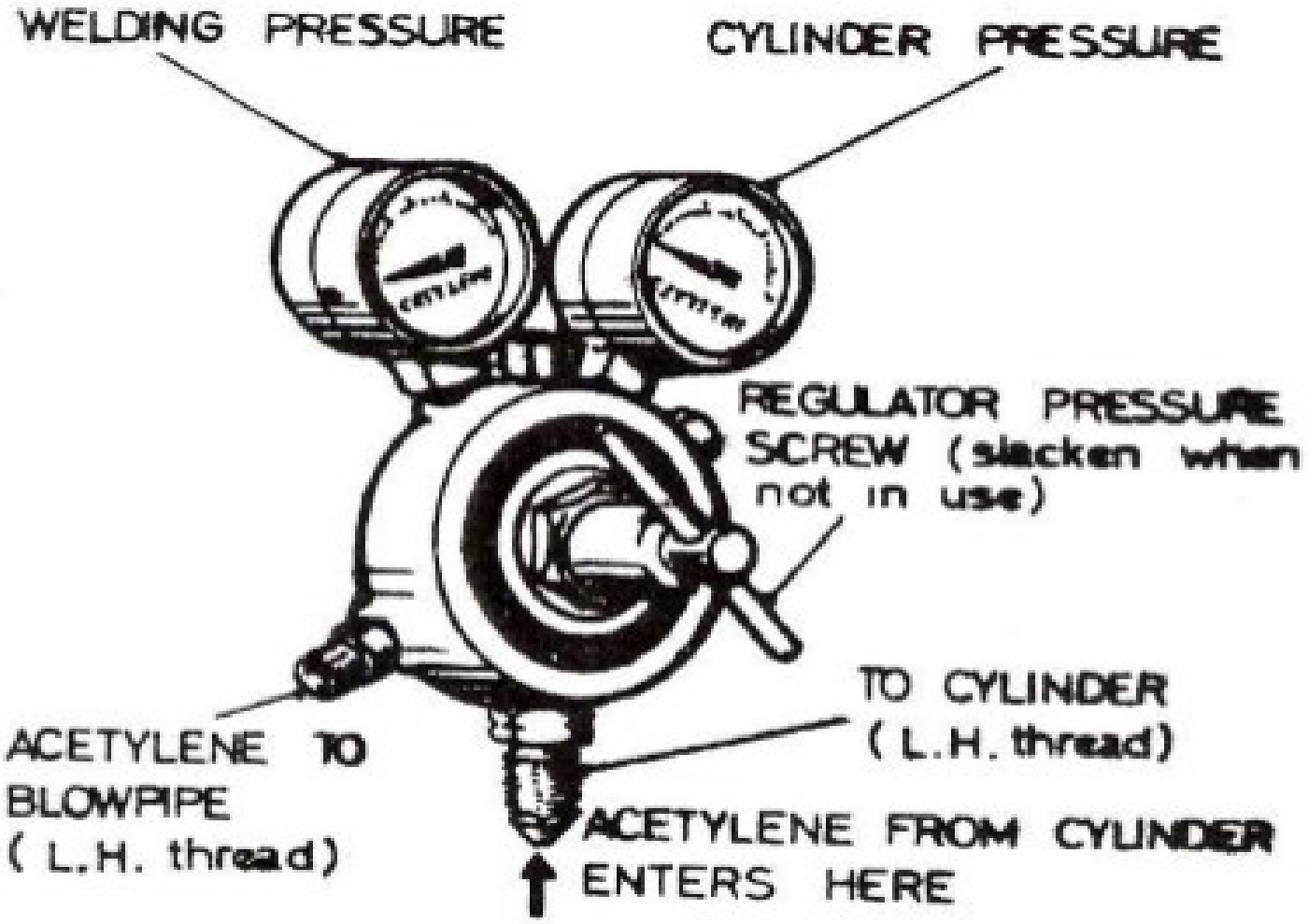


Figure 5 - Acetylene Gauges

Pressure Regulators

- ✓ **Gas systems must have a pressure regulator to reduce the pressure from the high pressure in the cylinder down to the working pressure.**
- ✓ **Many different designs are used.**
- ✓ **They range from simple fixed output, commonly used for gas grills and camping stoves**

Cont.....

- Most regulators have a gauge for cylinder pressure and working pressure Regulators are shut off when the adjusting screw is turn out completely.
- Regulators maintain a constant torch pressure although cylinder pressure may vary
- Regulator diaphragms are made of stainless steel

Cont.....



http://www.smithequipment.com/products/regul/images/twinfuel.jpg



http://www.aquaknect.com.au/Hi/GA11.jpg

- Connect the regulator to the cylinder valve (left hand for acetylene and other combustible gases, right hand for oxygen and other non-combustible gases), using the correct spanner and ensure a gas tight seal.
- Check that the pressure adjusting screw of the regulator is fully released (turned fully anticlockwise).

Commencing Operation

- Connect the downstream equipment and open the cylinder valve slowly.
- Check all joints for leaks using a 0.5% Tee pol in water solution.
- When gas is flowing, there maybe a reduction in pressure, and adjustments should be made.
- Purge the gas line before lighting the equipment.

Finish of Operation

- When work has stopped, close the cylinder valve, vent gas from the system and unscrew the pressure adjusting knob.

Working Pressure

- ✓ **Oxygen and fuel gas working pressure should be set according to manufactures recommendations for the job being performed.**
- ✓ **Potential problems with excessive pressure.**
  - **Harsh flame**
  - **Damaged equipment**
  - **Increased potential of flashback.**
- ✓ **Potential problems of insufficient pressure.**
  - **Insufficient heat**

Cont.....

- One gauge indicates the pressure of the cylinder and the other indicates the pressure in the supply pipe to the torch.

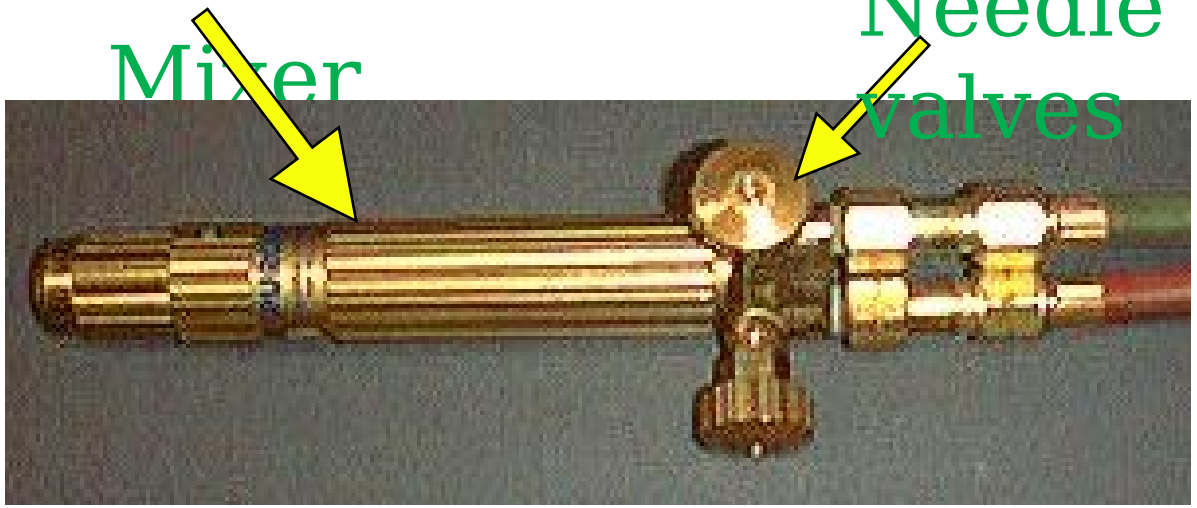


Ox fuel Torch

- **The ox fuel torch is the handle for holding and controlling the system.**
- **It the controls the flow rate of the gasses and delivers them to the welding tip, or cutting attachment.**

Cont.....

- Oxygen and acetylene are delivered to the torch by separate hoses. Each gas is controlled by a valve on the torch. The two gases mix in the torch and after they are ignited burn at the nozzle



Typical torch styles



- A small welding torch, with throttle valves located at the front end of the handle. Ideally suited to sheet metal welding. Can be fitted with cutting attachment in place of the welding head shown. Welding torches of this general design are by far the most widely used. They will handle any oxyacetylene welding job, can be fitted with multi flame (Rosebud) heads for heating applications, and accommodate cutting attachments that will cut steel 6 in. thick.

A full-size oxygen cutting torch which has all valves located in its rear body. Another style of cutting torch, with oxygen valves located at the front end of its handle.

Flashback Arrestors

- These are positioned on both the fuel gas and oxygen supply between the hose and the regulator. Their purpose is to prevent the return of a flame through the hose into the regula

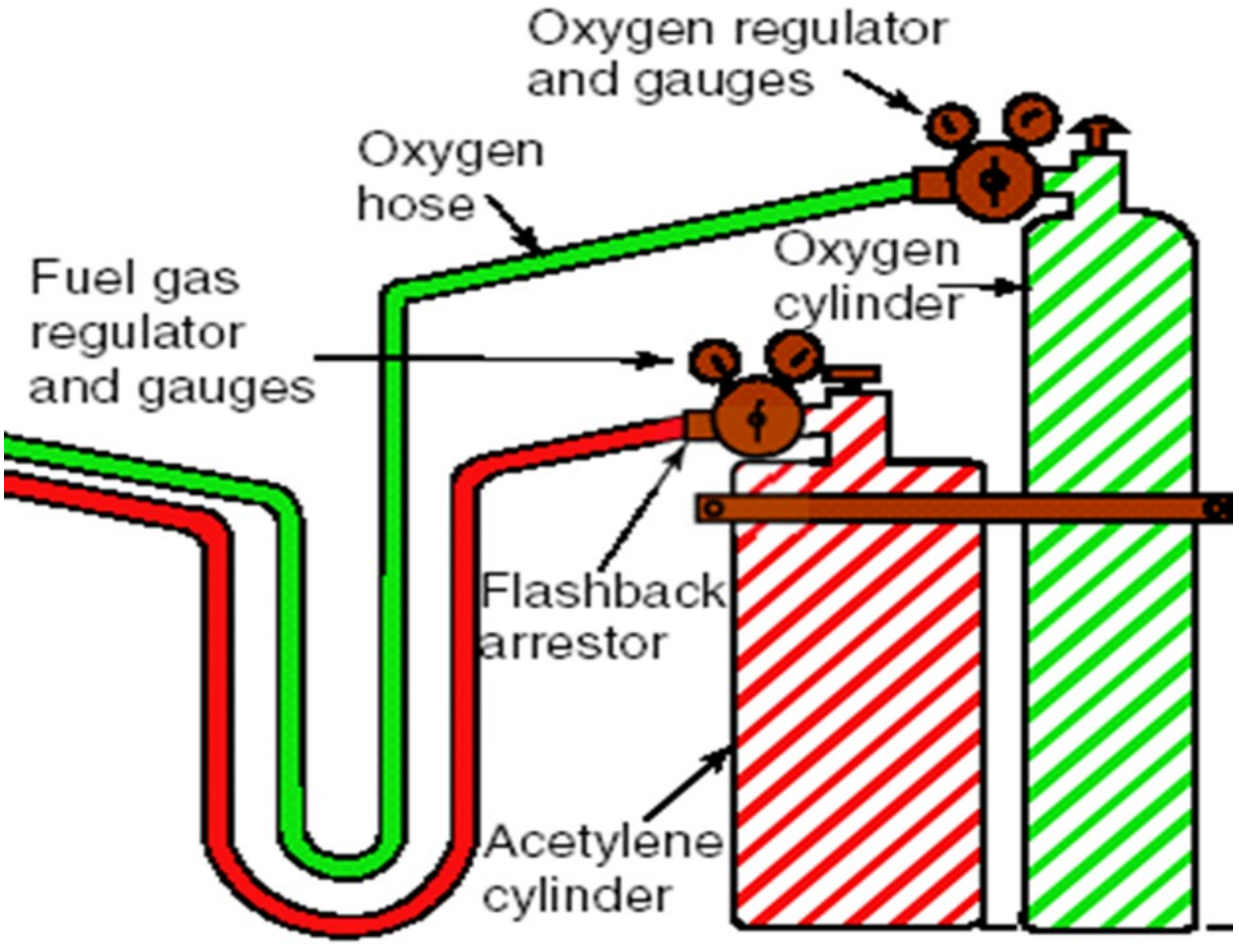


Cont.....

- Flashback arrestors are designed to eliminate the possibility of an explosion at the cylinder
- Check valves allow gas flow in one direction only
- Combination Check/ Flashback Valves can be placed at the torch or regulator.

Cont....

There are two types of flashback arrestors - a disposable type and a re-settable type.



Cont.....

- Flashback arrestors are fitted to the regulators on both the oxygen and acetylene cylinders. The purpose of these is to prevent flames getting back into the cylinders in the event of a backfire or similar accident.

- Back fire may occur when there is:
- A dirty nozzle tip
- Wrong pressure for nozzle
- Touching plate or weld pool with nozzle
- Overheating of blowpipe (Cool down in water.
- Make sure that the gas is passing through nozzle

Nozzle size

Thickness (mm)	Thickness (in)	Nozzle Size	Regulator Pressure (bar)	Regulator Pressure (lbf/in²)	Gas Consumption (l/h)	Gas Consumption (ft³/h)
0-8	1/32	1	0·14	2	29	1
1·2	3/64	2	0·14	2	57	2
1·6	1/16	3	0·14	2	86	3
2·4	3/32	5	0·14	2	140	5
3·2	1/8	7	0·14	2	200	7
4·0	5/32	10	0·21	3	280	10
5·0	3/16	13	0·28	4	370	13
6·5	1/4	18	0·28	4	520	18
8·2	5/16	25	0·42	6	710	25
10·0	3/8	35	0·63	9	1 000	35
13	1/2	45	0·35	5	1 300	45
19	3/4	55	0·43	6	1 600	55
25	1	70	0·49	7	2 000	70
25+	1+	90	0·63	9	2 500	90

Nozzle Size and Gas Velocity

- The power of the blowpipe is measured by the amount of gas that is used per hour.

(a) By the quantity of gas passed per hour

(b) By the diameter of the hole in the nozzle.

(c) By a number corresponding to the plate thickness that can be welded by that nozzle.

Filler Rods and fluxes

- Filler rods are used when additional filler metal is required in the weld area they come in different diameters.
- Fluxes protect the weld pool from contamination by oxygen and nitrogen, they are normally in paste form placed on a heated filler rod before welding begins

Hoses and Connections

- Hoses are fabricated from rubber
  - **Requires special nonporous hoses.**
  - **Hoses are color coded.**
    - **Green: oxygen**
    - **Red or Black: fuel gas**
  - **Connections**
    - **Oxygen: right hand**
    - **Acetylene: left hand**
  - **Hoses should be protected from hot metal and physical damage**



Cont.....

- Carry the gases from the regulators to the blowpipe. They are rubber, backed with canvas reinforcement. One end of the hose is connected to the flashback arrestor at the cylinder end, while the other end is connected to a hose check valve at the welding blowpipe end.

Setting Up Ox fuel System

- **Steps (assuming new system)**
  1. **Secure cylinders**
  2. **Remove caps**
  3. **Crack cylinder valves**
  4. **Connect regulators**
  5. **Open cylinder valves**
  6. **Connect hoses to cylinders**
  7. **Connect hoses to torch body**
  8. **Connect welding tip to torch body**
  9. **Set working pressures**
  10. **Check system for leaks**

Shutting Down System

- Close cylinder valves
- Open torch valves
  - Leave open until regulator gauges read zero.
  - Some sources recommend doing fuel first and oxygen last.
- Close torch valves
- Release tension on regulator adjusting screw.
- Roll up hoses and place torch in a safe position.

Oxy-fuel cutting

- Oxy-fuel cutting uses a flammable gas, generally acetylene or propane.
- Burning the gas in oxygen, rather than just air, produces a flame with a high temperature.
- The flame first preheats the work piece:

CONT....

- when a sufficiently high temperature has been reached, a jet of oxygen produces the cut by actually burning the metal.
- This produces a metal oxide in the form of liquid slag, which is blown out of the joint by the jet of gas.

Cont.....

- The flame also helps to maintain the upper surface of the plate above the ignition temperature of the metal while cutting is in progress, although most of the necessary heat required for the cutting comes from combustion of the actual material being cut.

Cont.....

- For example, when cutting 25 mm steel, about 85 % of the heat comes from combustion.
- In thinner materials, however, a greater prop applied by t



Equipment

- Besides the two gas bottles, there are gauges/regulators, hoses and the torch itself Each gas tank has it's own set of two gauges mounted on a regulator body designed to reduce the high cylinder pressure down to a useable pressure for the torch

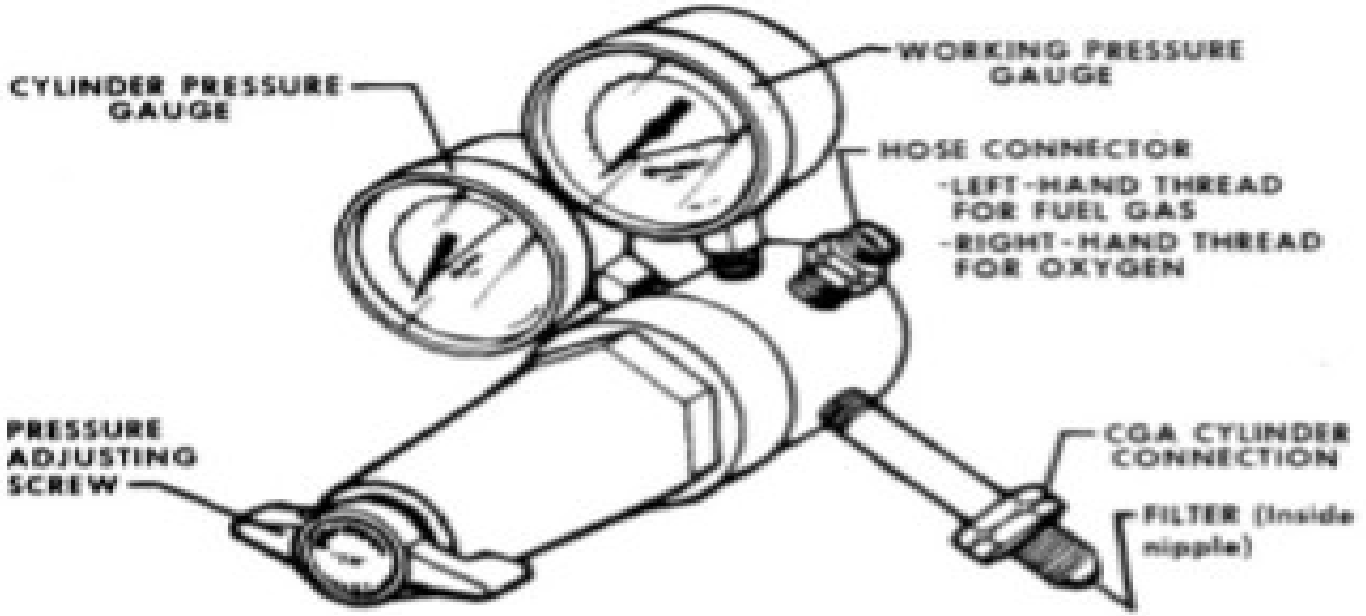
Cont.....

- On each tank there is one gauge to indicate the pressure in the tank, while the other gauge reads the pressure after the regulator, which is the pressure delivered to the torch and a very important adjustment in oxy-acetylene welding

Cont.....

- There are two basic types of regulators found on gas welding setups, single-stage and two-stage. The former type reduces the cylinder pressure to a working pressure in just one step, say from oxygen's 2200 psi to 3 psi for the torch.
- In the two-stage regulator, the first stage reduces pressure to about 30 psi; the second stage adjusts pressure from there down

Cont.....



3.10 The gauge/regulator setup screws onto the tank's cylinder valve, and has a fitting for attaching the hose leading to the torch.

Cont.....

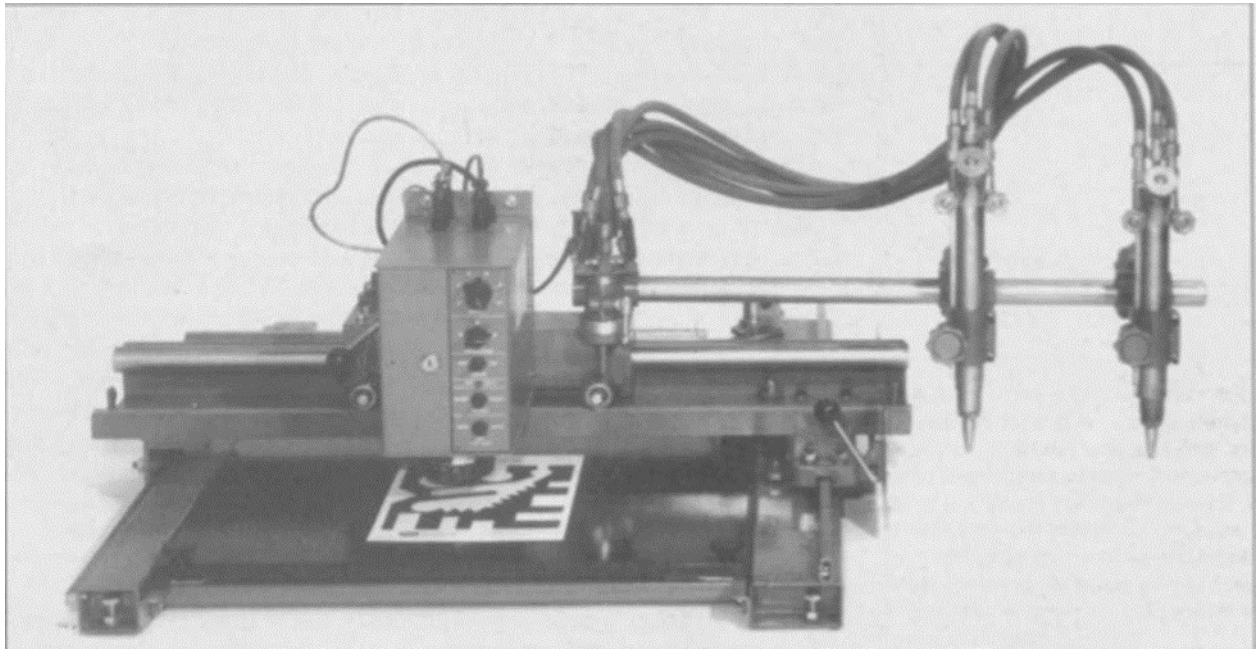
- Gas flow is regulated on the oxygen cylinder to 1 -5 psi for welding, depending on the thickness of the material to be welded, and the acetylene pressure is adjusted the same.
- Higher pressures are set when performing cutting, but acetylene must never exceed 15 psi to the torch.

Cont…….

- Common gauge settings for cutting
- 1/4” material Oxy 30-35psi Acet 3-9 psi
- 1/2” material Oxy 55-85psi Acet 6-12 psi
- 1” material Oxy 110-160psi Acet 7-15 psi

Welding torches

- Oxy-fuel cutting can be carried out either manually, using a cutting torch, or by machine, with a numerically-controlled cutter head. two main types of torch:



Cont.....

- One can distinguish between two types of welding torches: injector torches for low pressure acetylene and high pressure torches.
- In high pressure torches, the acetylene and oxygen flows are self-powered by the pressure in their storage bottles, and mix in the mixing chamber section of the torch

Cont.....

- In low-pressure torches, the oxygen flows into the torch through a central jet, producing an injection effect that draws in acetylene from the surrounding peripheral connection. From here, the gases continue to the mixing section prior to combustion.

Flame adjustment

- There should be a flame with some sooty flying particles. Quickly add some oxygen and the soot should disappear. A carburizing flame, which is overly-rich in acetylene. As you add more oxygen, the flame characteristics will change. While the rich mix gives you a wide, flared-out yellow flame, adding oxygen will make the flame narrower and brighter

Cont…….

- The proper method of shutting off the torch is equally important. Close the acetylene valve on the torch first, then the oxygen. There could be a small amount of gas left in the tip that could ignite. If you are through welding for some time, it is good safety practice to then close down the gas cylinder valves as well, but if you are going to weld again in a short while, just shut off the torch valves only.

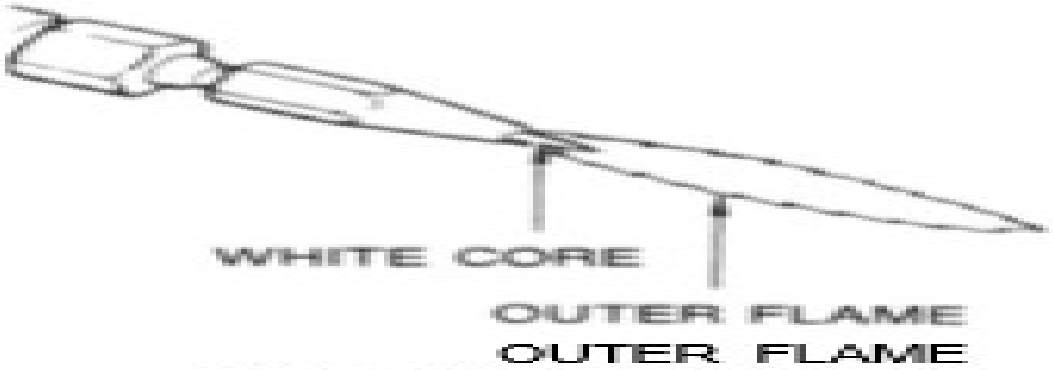
Cont...



Neutral Flame



Carburizing Flame



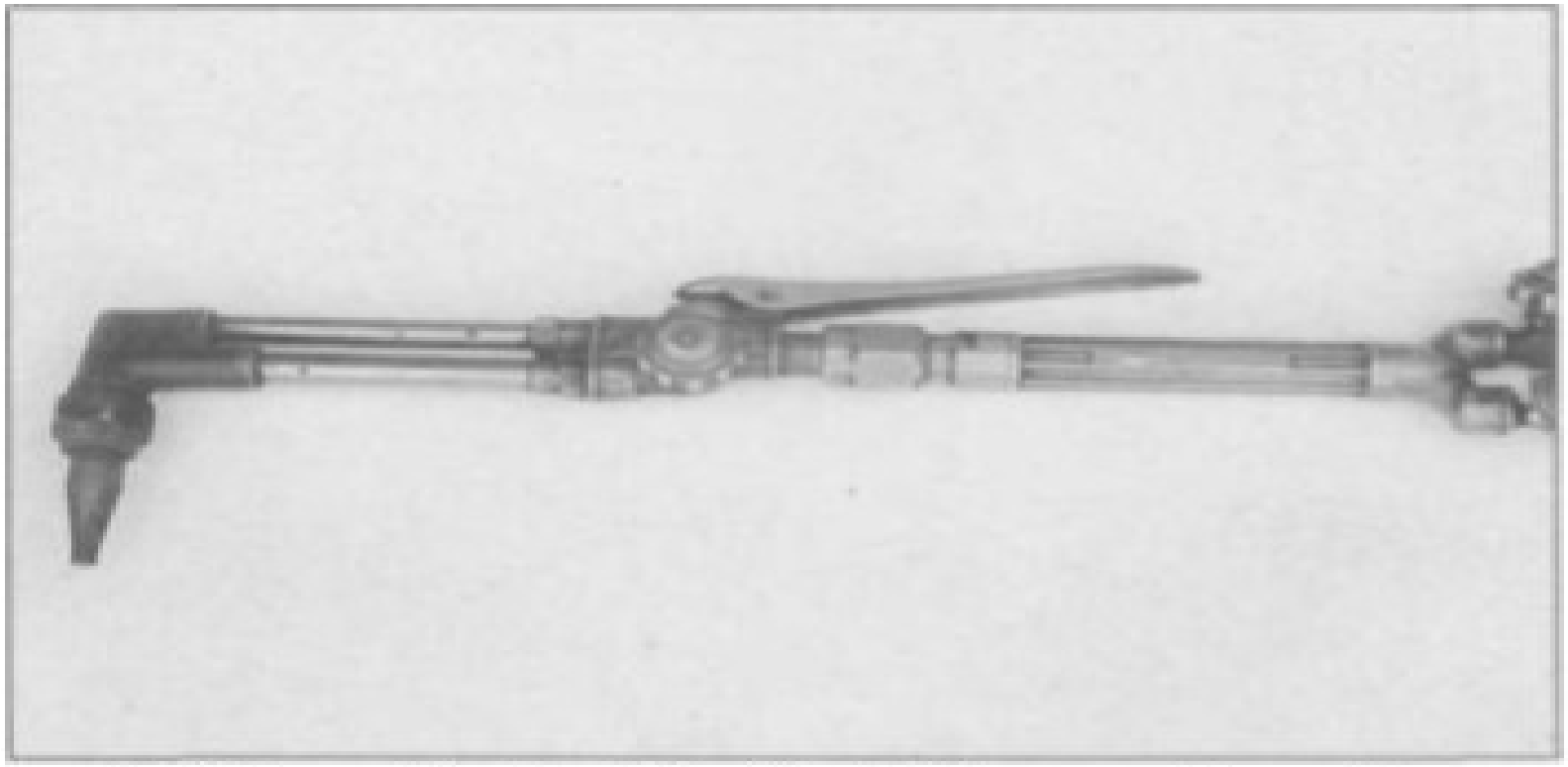
Checking your welds

SYMPTOM	CAUSE	REMEDY
FLAME FLUCTUATIONS	• Moisture in the gas, condensation in the hose. • Insufficient acetylene supply.	• Remove the moisture from the hose. • Adjust the acetylene pressure. • Have the tank refilled.
EXPLOSIVE SOUND WHILE LIGHTING THE TORCH	• Oxygen or acetylene pressure is incorrect. • Removal of mixed-in gases is incomplete. • The tip orifice is too large. • The tip orifice is dirty.	• Adjust the pressure. • Remove the air from inside the torch. • Replace the tip. • Clean the orifice in the tip.
FLAME CUT OFF	• Oxygen pressure is too high. • The flame outlet is clogged.	• Adjust the oxygen pressure. • Clean the tip.
POPPING NOISES DURING OPERATION	• The tip is overheated. • The tip is clogged. • The gas pressure adjustment is incorrect. • Metal deposited on the tip.	• Cool the flame outlet (while letting a little oxygen flow). • Clean the tip. • Adjust the gas pressure.
OXYGEN FLOW IS REVERSED **Oxygen is flowing into the path of the acetylene.**	• The tip is clogged. • Oxygen pressure is too high. • Torch is defective (the tip or valve is loose). • There is contact with the tip and the deposit metal.	• Clean the tip. • Adjust the oxygen pressure. • Repair or replace the torch. • Clean the orifice.
BACKFIRE **There is a whistling noise and the torch handle grip gets hot. Flame is sucked into the torch.**	• The tip is clogged or dirty. • Oxygen pressure is too low. • The tip is overheated. • The tip orifice is enlarged or deformed. • A spark from the base metal enters the torch causing an ignition of gas inside the torch. • Amount of acetylene flowing through the torch is too low.	• Clean the tip. • Adjust the oxygen pressure. • Cool the tip with water (letting a little oxygen flow). • Replace the tip. • Immediately shut off both torch valves. • Let torch cool down. Then re-light the torch. • Readjust the flow rate.

CONT……

- The cutting torch has one major difference from the welding torch: it has an extra oxygen supply, operated by a lever instead of a valve
- The basic principle of oxy-acetylene cutting is that the torch tip has several small holes surrounding a central larger hole

Cont.....



3.41 The cutting torch is adjusted for a good flame, then checked with the extra-oxygen supplied when the cutting lever is depressed. The flame should remain close to neutral. The excess oxygen is what is used to push the molten slag from the kerf as you cut.

Cont.....

- The smaller outside holes are where the basic oxy-acetylene flame comes out - actually several small flames. These flames are really used to preheat the metal to be cut. When the end is heated to a cherry red color, the weldor presses down on the cutting lever, which activates a strong flow of pure oxygen through the large central hole in the tip. This is the oxygen that really cuts through the metal

Materials

- Material to be cut must fulfil certain conditions.
- The oxide must have a melting point that is lower than the melting point of the metal itself.
- It is the melting temperature of the oxides that explains why stainless steel and aluminum are not suitable for gas cutting.

- The ignition temperature of the metal must be lower than its melting point. In the case of low-carbon steel, the ignition temperature is about 1050 "C. Combustion of the metal must create sufficient heat to maintain combustion

Cont…..

- Low-alloy steels with a carbon content of up to about 0.3 %, that can be cut in the usual way by oxygen burners. In such steel, thicknesses up to about 300 mm can be cut by oxy-fuel cutting. Thicknesses can be cut, up to about 30 mm. Below 25 mm, oxy-fuel cutting is in competition with plasma cutting, which gives a higher rate of cutting.

Cont.....

- Other methods of cutting are recommended for cutting stainless steel and cast iron. However, oxy-fuel cutting can be used to cut these materials, with the use of appropriate additive

Gas used for cutting

- Acetylene burn with an intense flame and a high combustion velocity.
- Disadvantage or even a danger, in that the combustion front can migrate backwards, into the burner nozzle.
- The hot core of the flame makes the gas suit- able for cutting thinner materials, which can be done with good productivity.

Cont…….

- Propane burns with a flame with lower heat concentration.
- This therefore spreads the heat more evenly along the cut, which can be an advantage when cutting thicker materials.
- Hydrogen is not commonly used as a fuel gas, In terms of their thermal characteristics, hydrogen flames are similar to propane flames.

Cont……

- Oxygen performs three duties in connection with gas cutting.
- It produces the heating flame with the fuel gas
- It burns (oxidizes) the material to be cut and
- It blows the resulting slag out of the cut.

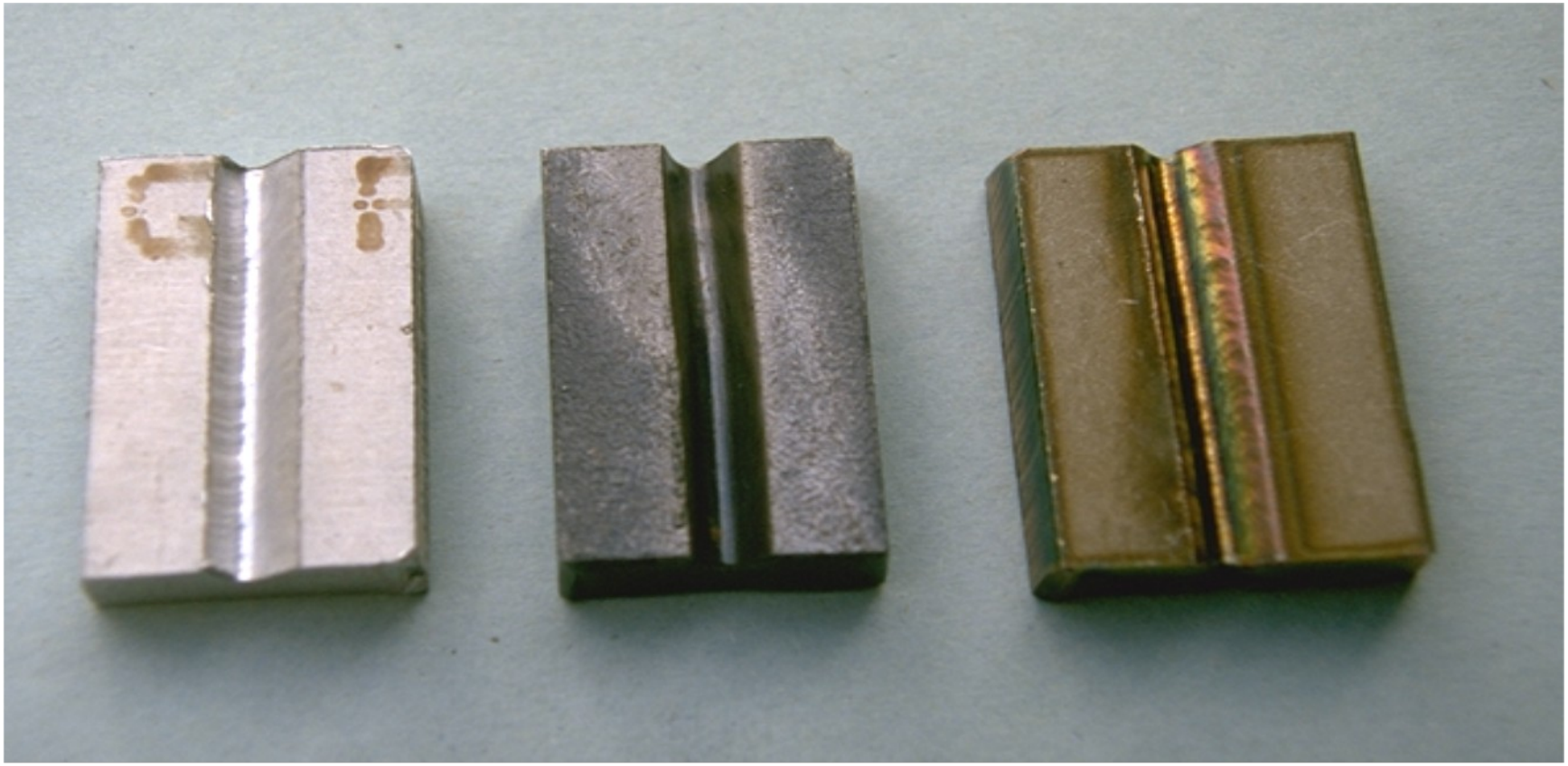
Cont.....

- The purity of the oxygen is very important for cutting speed: 99.3-99.7 % purity is common.
- A reduction of 0.5 percentage points reduces the cutting speed by about 10 %

Oxy-fuel gas flame gouging

- This method is based on the same technology as used for gas cutting. It uses a special nozzle, which facilitates working along the work piece surface.
- It is suitable for use with carbon steel and low-alloy steels, in the same way as is gas cutting

flame gouging cont....



PAC versus Oxy-Fuel

- In general, Oxy-fuel to be superior to plasma for cutting steel when thicknesses exceed about 1/2 inch.
- Because of the slight bevel (4 to 6 degrees) in the cut face that plasma produces.
- It is not noticeable in thinner materials, but becomes more so as thicknesses increase. Also, at thicknesses above 1/2 inch, plasma has no cutting speed advantage over oxy-fuel

Exercise

Question 4. (45 marks)

(a) Name the **three** types of oxyacetylene flame shown:

(b) Answer **any three** of the following in relation to **manual metal arc welding**:

(i) How is the heat produced for welding?

(ii) Why is a flux required at the joint?

(iii) What is the function for the earth clamp?

(iv) State **one** suitable safety precaution to be observed.

(c) Select **any three** from the following materials and identify the process used for making a permanent joint in **each** case.

(i) Tinplate, **(ii)** Mild steel plate, **(iii)** Acrylic, **(iv)** Light gauge aluminium.

(d) Give **two** reasons why goggles must be worn when gas welding.

Answer

QUESTION NO. 4 Total 45 Marks

(a)

(i) Neutral flame **(ii)** Carburizing flame **(iii)** Oxidizing flame

(b)

(i) Heat is produced by an electrical arc formed between the welding electrode and the metal being welded.

(ii) Flux is required at the joint to remove oxides, keep the weld pool clean from impurities and allow the weld to cool slowly by producing a slag covering.

(iii) The earth clamp is required to complete the circuit for current flow through the metal being welded and back to the welding unit.

(iv) Leather gloves must be worn to protect the user from hot metal particles, UV light and or high temperatures.