ARC AND GAS WELDING

I. ELECTRIC ARC WELDING

I.1 Arc welding

Arc welding is a fusion welding process in which heat from electric arc liquefies both the parent metal and the filler metals, fused it together to become one solid piece after it has cooled down. When metals are joined by fusion welding, its edges are heated until it melts and fused together.

Fig. 1.0 shows the elements involved in carrying out arc-welding

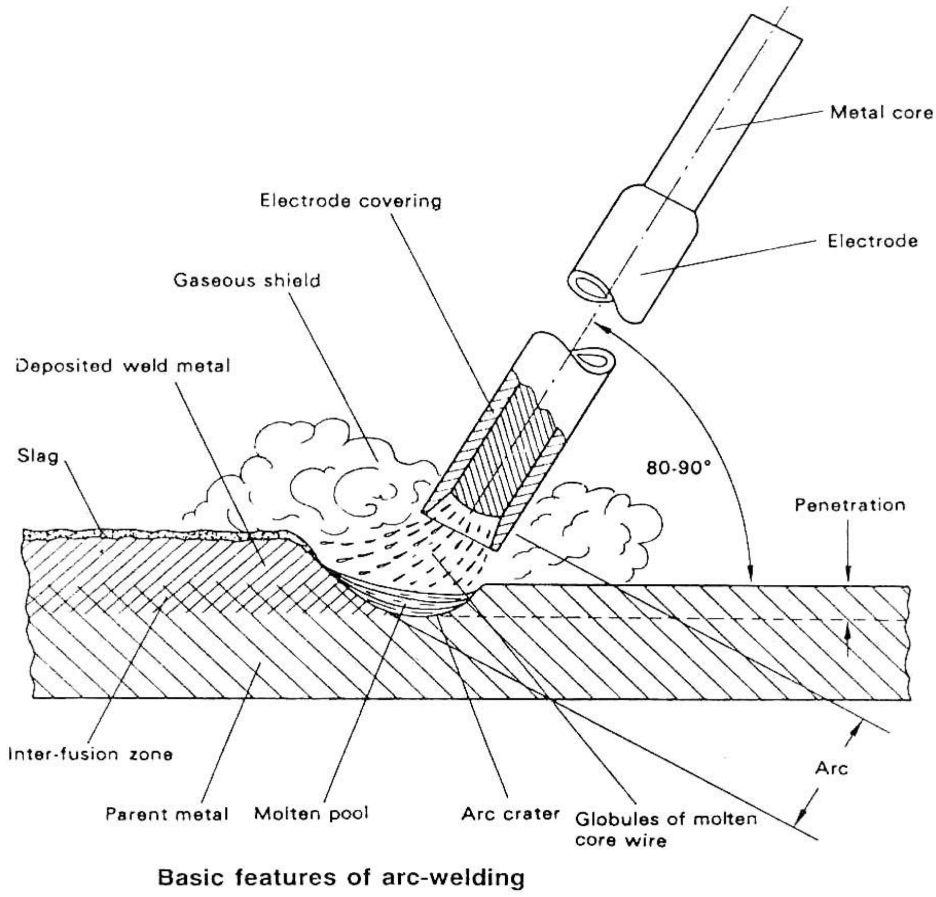


Fig. 1.0 Basic Elements of arc-welding

I.2 Arc welding safety

The light emitted from an electric arc in short wave length is very intense and rich in radiation such as ultra violet rays. Because of this, it is important to protect the welder's eyes, in particular, and the skin from this radiation.

A flash from an electric arc can cause severe irritation to his eyes which will take several hours to subside. Safety equipment must be used at all times.

Therefore, protection is based on these two categories:

a. Against arc light or short wave length radiation
b. Against the effects of spatter and hot metal.

I.2.1 Personal safety measures

I.2.1.1 Protective clothing for eyes and head

In doing welding operations, it is essential to protect the welder's eyes and head from radiation, spatter and hot slag, hence, a helmet or a hand shield must be worn. An arc welder's hand-shield protects one hand as well as the face. It is made with a handle and with the kind of material that insulates the hand against heat and electricity. The handle may either be fixed inside or fixed outside the shield but both gives the same kind of protection.

Welder's HEAD SHIELD is usually equipped with an adjustable band to fit the wearer's head. This adjustable band should be thoroughly insulated from the wearer's head. The insulation should be non- absorbent to provide precaution against wetness, e.g., perspiration which tends to make it conductive. Head shields are loosely designed to rotate in order to:

1. Lower it down in front of the face -the welding position for protection; and,
2. Raise it horizontally for the welder to see when not to strike the arc.

Some welders prefer to use a hand-shield, rather than a head-shield because it is easier to use. However, head-shields provide better protection and allow the welder to use both hands. Fig. 2.1 shows the two common type of face shield while the Fig. 2.2 shows the cross section of its lens.

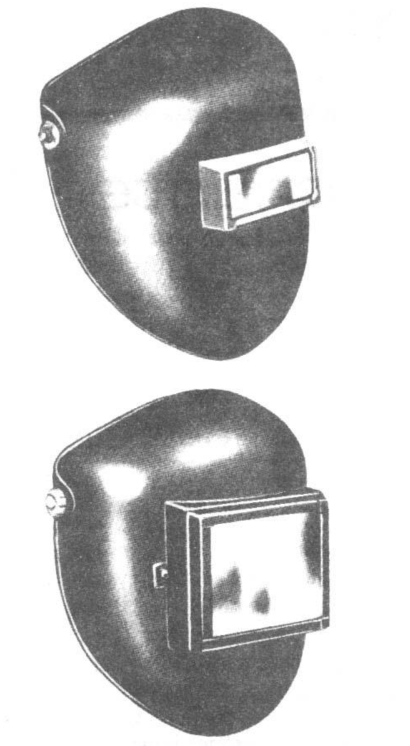


Fig. 2.1 Face shield

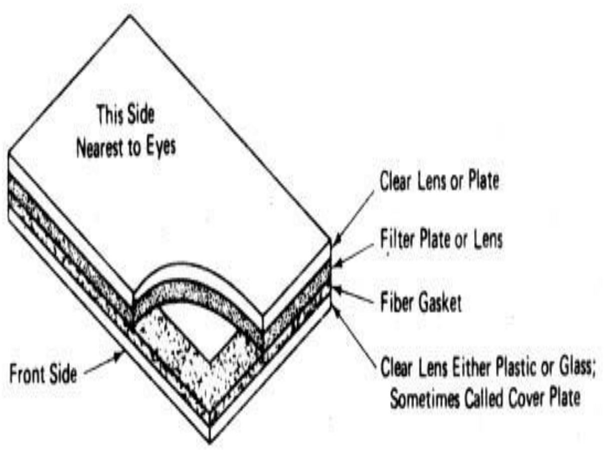


Fig. 2.2 Cross-section of the lens

The injurious effect of the radiation emitted by an electric arc is similar whether A.C or D.C. is used for welding. Exposing the eyes and face to INFRA-RED rays would lead to the face becoming uncomfortably hot and might induce serious eye troubles. If too much ULTRA-VIOLET radiation is received by the welder or anyone in the vicinity, it can cause an effect similar to sunburn on the skin and a condition known as ARC EYE. In addition, too much exposure on light will dazzle the operator and can also cause eyestrain with headache. The obvious precaution is to prevent the harmful radiation coming from the welding arc and from the molten weld pool in damaging the eyes. This is achieved by the use of special glass filter with suitable color and density; reducing the intensity of the visible light rays. All helmets and hand-shields are provided with a filter glass and a less expensive protective cover glass on the outside.

The removal of slag by chipping can create an accident hazard to the face and eyes. Although welders are often tempted to chip away without protection, the use of shield or goggles with clear glass windows is essential in all welding operations.

When taking out slag it is advisable to use a shatterproof glass or plastic cover. When using a hand-shield or helmet of the dual- purpose type, raising or lowering the dark filter glass should be safe.

I.2.2 Body Protection

The welder's body and clothing must be protected from radiation and burns caused by flying globules of molten metal. It is necessary for the welder to wear an apron, usually made from asbestos or thick leather, to protect his trunk and thighs whilst seated at a bench welding. An apron should also be worn if the welder's clothing is made of flammable material. The example of personal protection for Arc welding is shown in Fig. 3.0, 3.1 and 3.2 as body, foot and hand respectively.

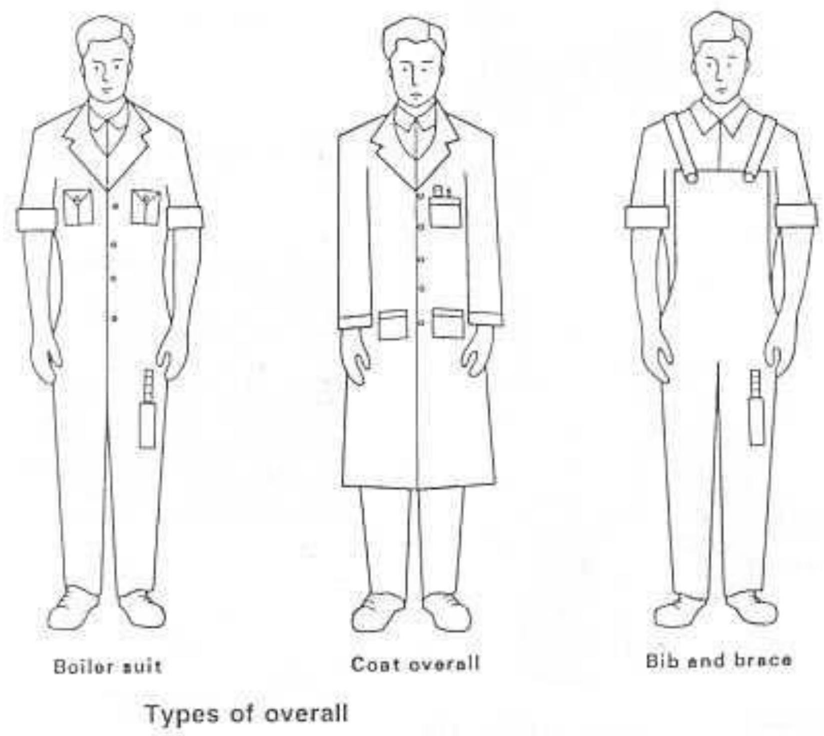


Fig.3.0 Example of body protection

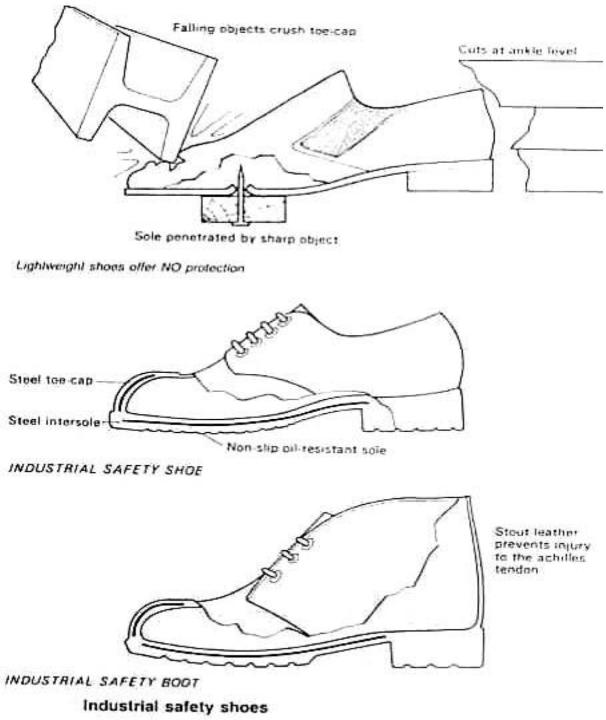


Fig 3.1 Foot protection

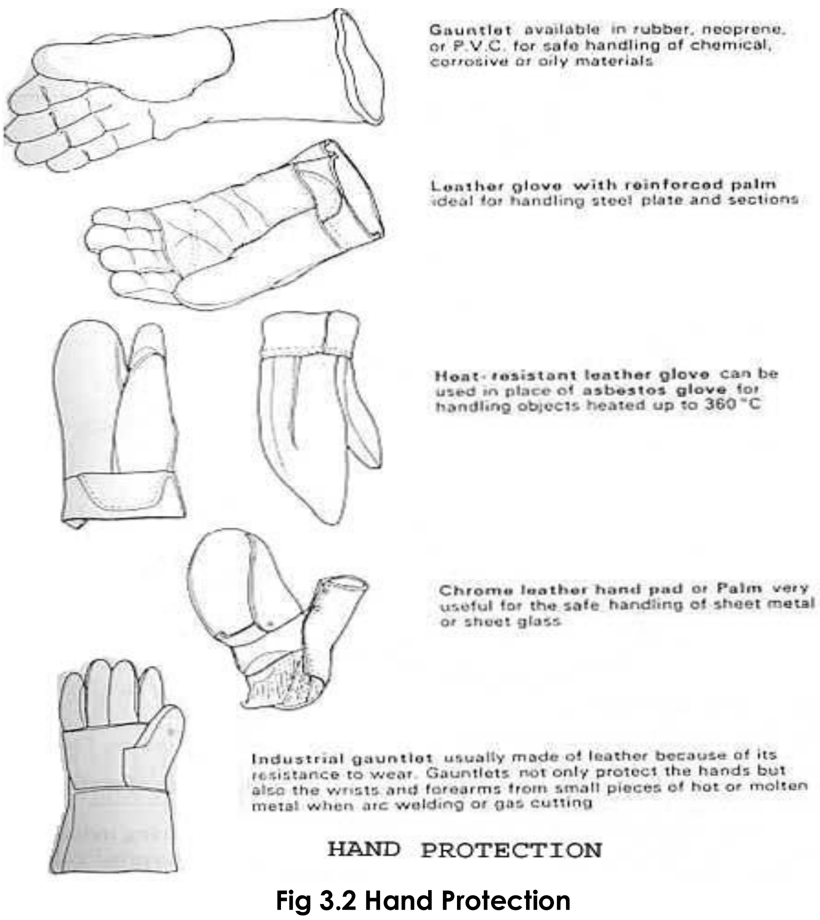


Fig 3.2 Hand Protection

When deep gouging or cutting is carried out using metal -arc processes, the amount of 'spatter' is considerably greater than that experienced with normal arc welding, and therefore it is necessary to protect the feet and legs in the same way as the hands and forearms. Suitable leather leggings and spats are available and should be used to prevent the legs, feet, and ankles from getting burn. Fig. 4.0 shows the kind of protection for welding galvanized steel.

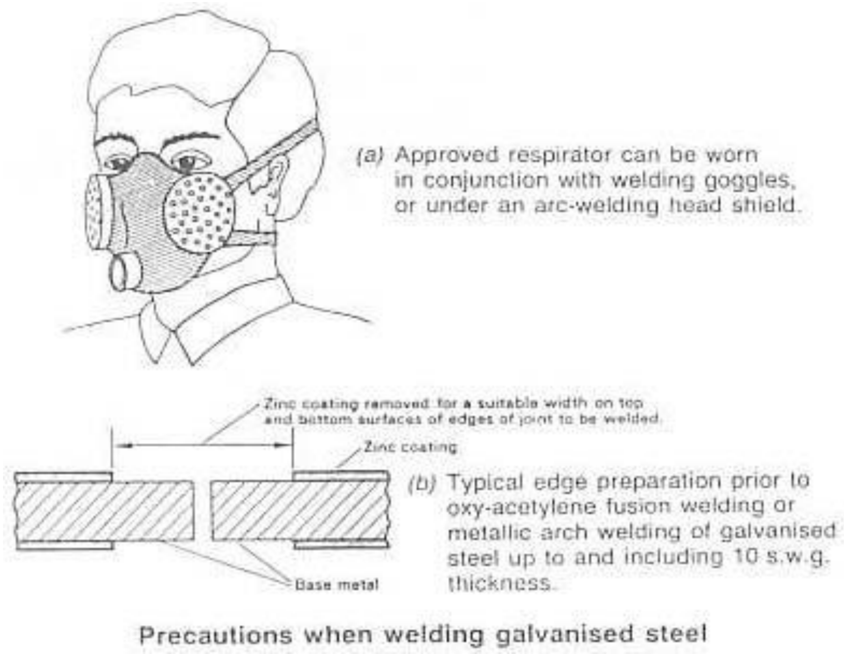


Fig. 4.0 Accessories for Galvanized steel welding

I.2.3 Screens

People working in the vicinity of a welding arc, including other welders, may be exposed to stray radiation from the arc, and can cause discomfort. Looking through an unscreened welding arc, even from a distance of several meters away can cause ‘Arc Eye’ in just a few seconds. The exposure effects is not yet painful between four to twelve hours later, however its effect will be felt after the worker wakes up at night with severe pain caused by “arc eye”. It would give the patient an uncomfortable feeling of having sand in his eyes which later on will become sore and watery. Whenever possible, each arc should be screened in such a way that stray radiation is kept to a minimum.

The walls of welding shops or individual welding booth should be painted with matt, absorbent type of paint with a very low reflective quality; the color of the paint should not be black, as there are proven experiments that matt pastel shades of grey, blue, or green are better.

If a person is exposed to a flash, the effects of 'Arc Eye' can be minimized by the immediate use of a SPECIAL EYE LOTION which should be available in the FIRST AID BOX. ONE EXPERIENCE OF THE DISTRESSING RESULTS WHICH FOLLOW EXPOSURE TO STRAY RADIATION IS USUALLY SUFFICIENT TO MAKE THE PATIENT MORE CAREFUL IN THE FUTURE.

I.2.4 Fire hazards

Fire hazards or burn caused by a newly welded metal are cases which are oftentimes ignored. Newly welded metals should be clearly marked HOT using chalk or crayons or special markers. This simple safety precaution should also be adopted when FLAME CUTTING operations is being carried out. In addition, sparks, molten metal and hot slag can start a fire. Therefore we need to keep all old rags, cotton wastes, sacks, paper, etc. away from the welding area.

Electrode stubs and hot electrode stubs can burn and penetrate through the soles of footwear and are hazardous when thrown to the workshop floor. In order to prevent this, metal bins surrounded by sand or asbestos sheet should be provided.

Treading on an electrode stub can have the same disastrous effect as for example, inadvertently stepping on a roller skate.

Wherever gas or electric welding or cutting operations is taking place, the work area should be screened off with asbestos blankets or metal screens. Wooden flooring should be covered with sand, or overlapping metal sheets; sparks or molten globules of metal must not be prevented from falling into gaps between boards.

I.2.5 Ventilation

When using the majority types of electrodes the welder is not likely to suffer any ill effects from fumes provided that reasonable ventilation is available. Localized exhaust ventilation can be provided by a good fume extractor, which not only dilutes and remove fumes but also assist in keeping down the temperature and adds to the comfort and efficiency of the welder.

Fig. 4.1 shows the proper air circulation during arc welding while in Fig. 4.2, the elimination of hazardous gas is provided by an exhaust fan is shown.

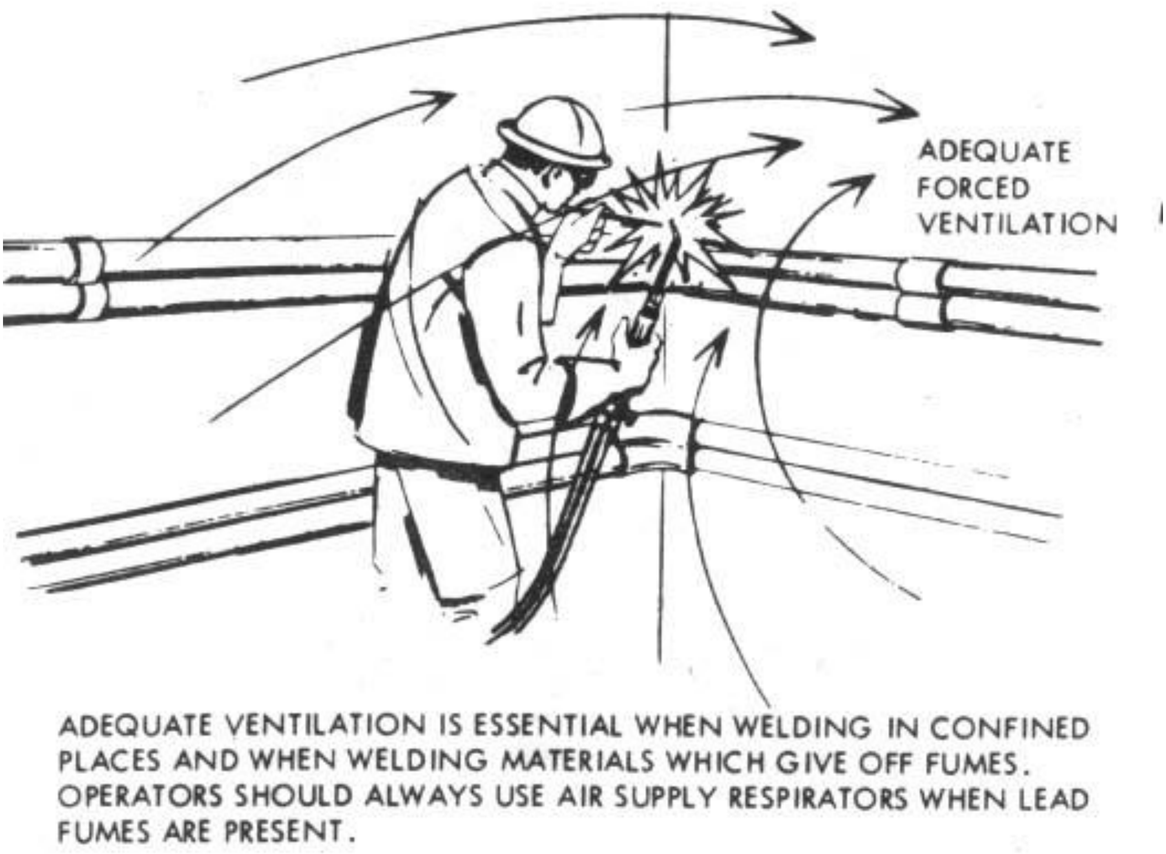
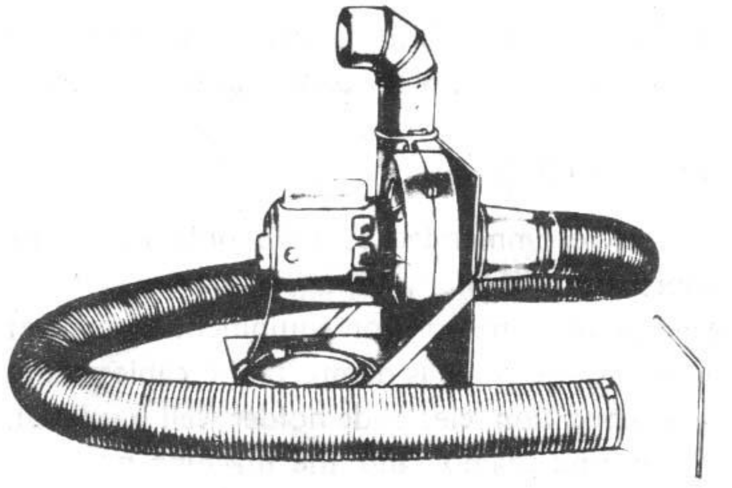


Fig.4.1 Method for a proper air flow



Use an exhaust system to exhaust toxic fumes when welding in a confined area.

Fig. 4.2 Portable exhaust fan

II. ARC WELDING EQUIPMENT

This equipment is designed to change the high voltage alternating current mains supply into a safe, low- voltage, heavy current supply suitable for arc welding. It will be seen that the output can have an alternating current waveform or a direct current waveform. For safety, the output voltage is limited to between 50 to 100 volts; however, the output current may be as high as 500 amps.

II.1. Welding machines are two basic types:

1. Direct current - The diagram in Fig. 5.0 uses a motor-driven generator to provide a direct current to the welding equipment. On the other hand, an explanation is provided in Fig 5.1 in working on a D.C. arc welding.

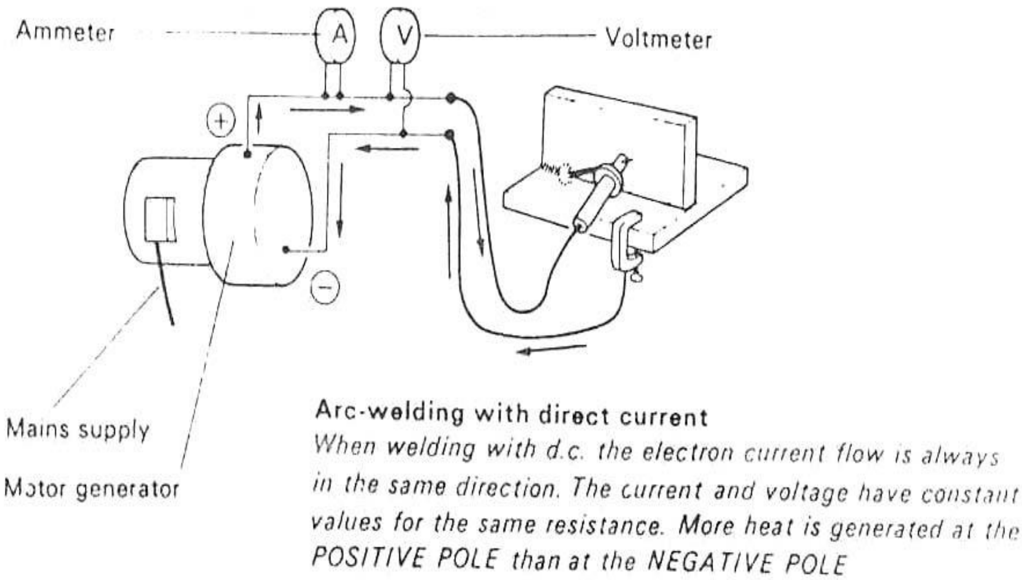


Fig. 5.0 Motor-driven generator

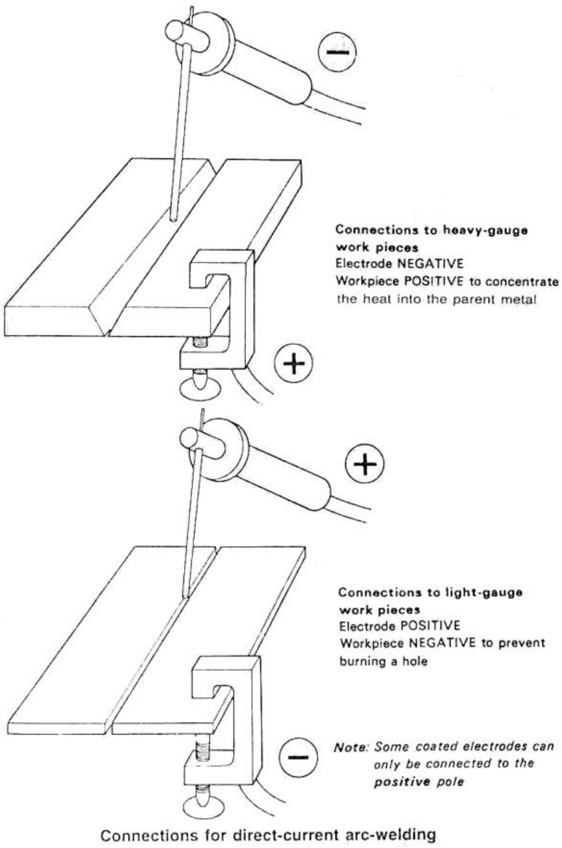


Fig. 5.1 Direct current arc welding connections

Alternating current - Employing a step down transformer with variable current control. This is the most commonly used type of arc welder. For reference see Fig. 5.2.

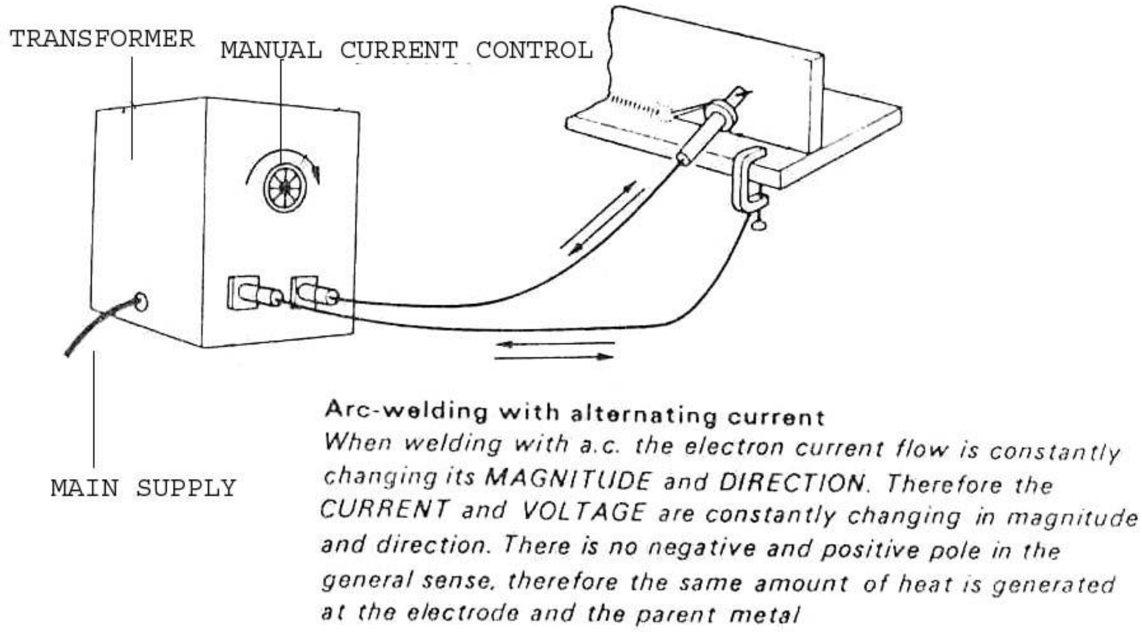


Fig. 5.2 Direct current arc welding connections

III. WELDING ACCESSORIES

III.1 Cables / The external arc -welding circuit

This is normally set up by the welder himself. There are three important connections for every welding circuit. Please refer to Fig. 6.0 and 6.1 regarding these connections.

1. The **welding lead**. This is used for carrying the welding current from the power source to the ELECTRODE HOLDER.

2. The **welding return cable**. This is the connection for carrying the 'return' current between the ' work' by a special spring or screw clamp which is properly secured to one end of the cable.

2. The **welding earth**. This is necessary on all welding circuits to maintain the work piece and any other conductors or metal structures that may come in contact with it at EARTH POTENTIAL. A metal platform directly connected to hull structure is a mean of providing a welding earth.

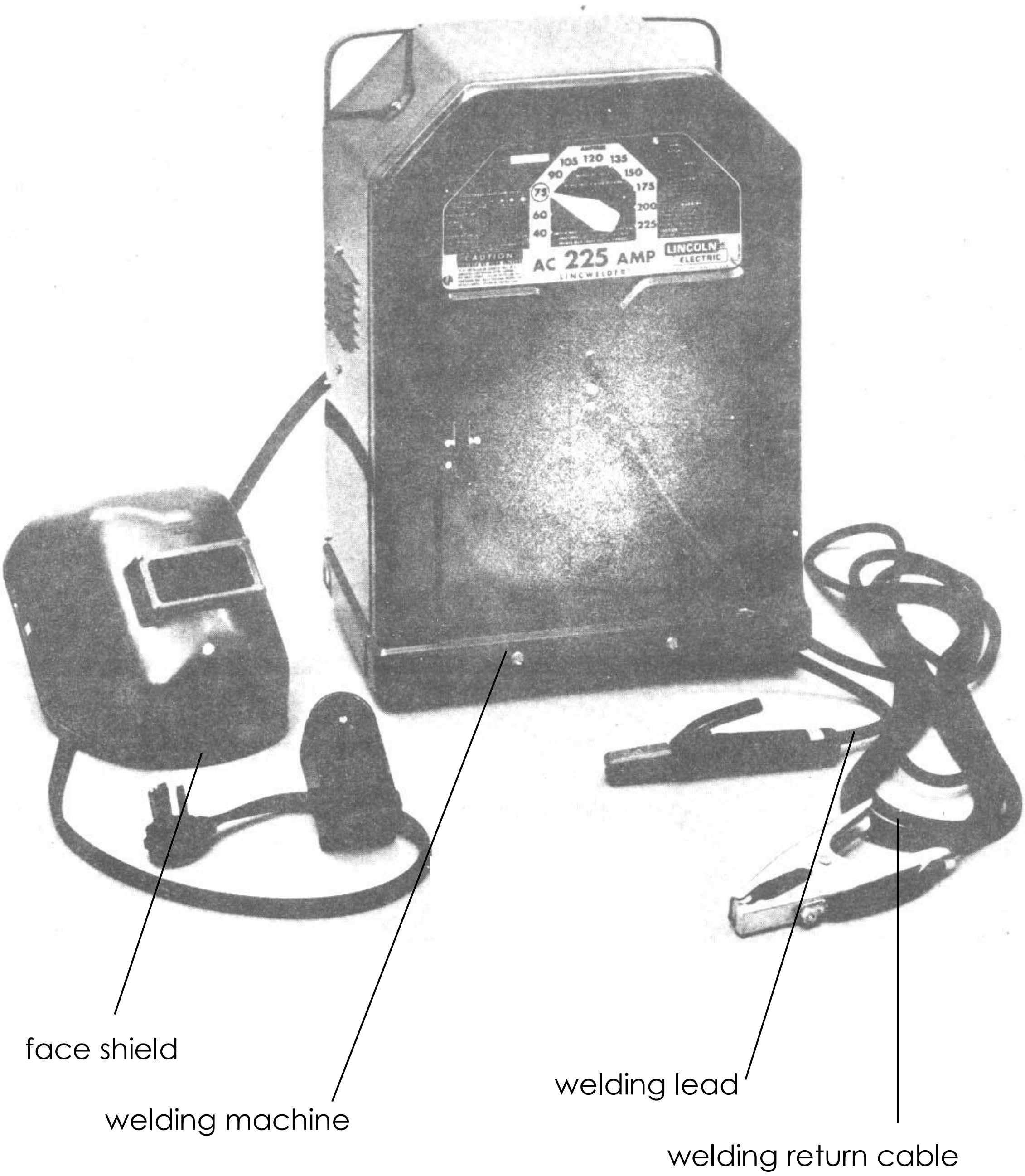
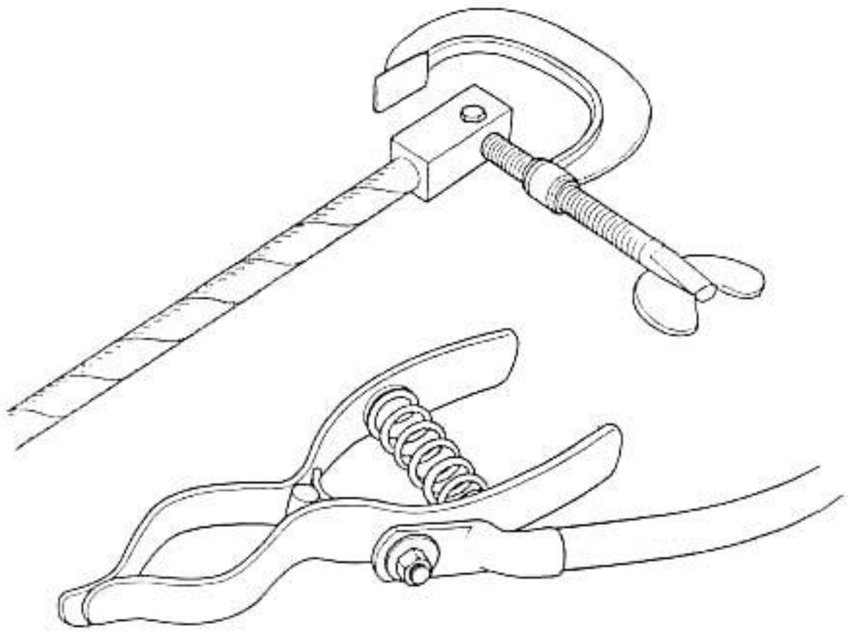


Fig. 6.0 Important welding connections.



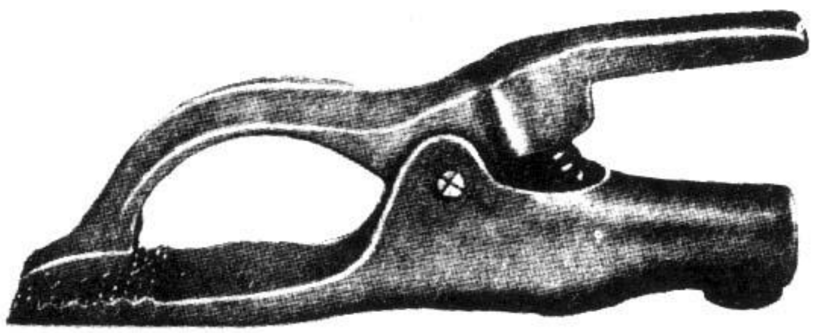


Fig. 6.1 A sample of a return cable and a ground clamp

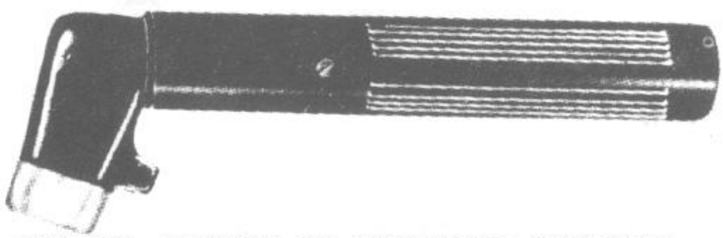
The proper selection and care of welding cables is an essential safety requirement, because it is surprisingly hard to understand why there are so many instances of inadvertent use of welding cables. The most common faults are:

1. Bad connections;
2. The use of longer cables than necessary (causing excessive 'volt drop')
3. Defective insulation

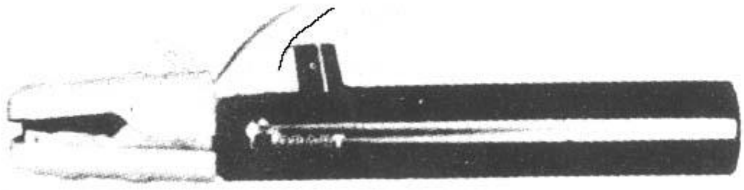
4. The use of secondary cables of incorrect current carrying capacity.

III.2 Electrode holder

This is the one being properly connected to the welding lead. They should be of adequate rating for the maximum welding current to prevent them from heating up and becoming too hot to handle. Many types of electrode holders are available; some are partially - insulated and others fully insulated. Fig.6.2 shows the fully insulated and the partially-insulated type of electrode holder respectively.



TWIST TIGHT ELECTRODE HOLDER



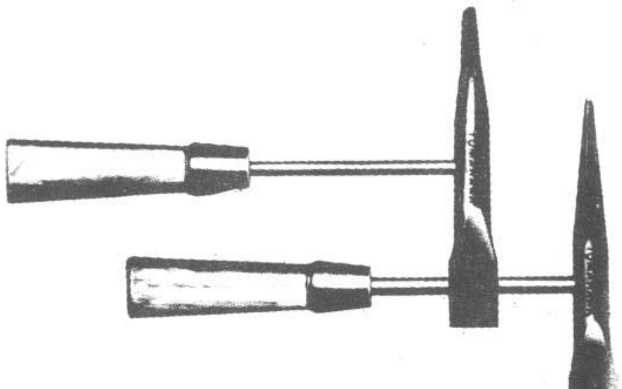
SPRING TYPE ELECTRODE HOLDER

Fig. 6.2 Two types of electrode holder

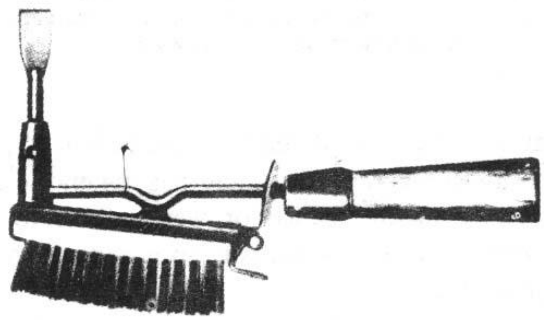
Electrode holders of the partially -insulated type have, in addition to a handle made of a heat-resisting non-ignitable insulating material, a protective guard in the form of a disc between handle and the exposed metal parts. This guard has a dual purpose. It gives protection to the operator's hand by preventing it from slipping down to the exposed metal parts, which are both electrically alive and physically hot. It also enables the holder to be in the work piece or supporting structure preventing the exposed parts from 'shorting'.

The fully insulated electrode holder, as the name implies, has all metal parts protected by an efficient insulating material, with the exception of the small portion where electrode is inserted. Many tools are associated with the Arc welding work as shown in Fig 6.3 and Fig. 6.4 namely, chipping google, chipping hammer, steel brushes, sander, grinder and vise grips.

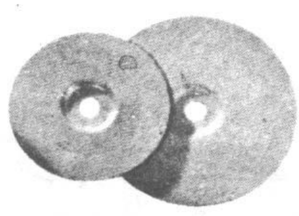
Chipping and grinding goggles.



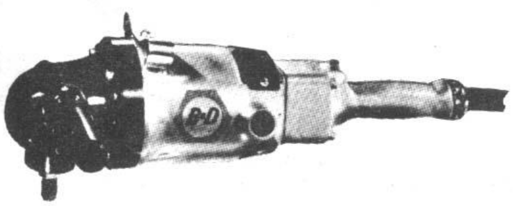
CHIPPING HAMMER WITH CHISEL AND
CROSS CHISEL OR POINT



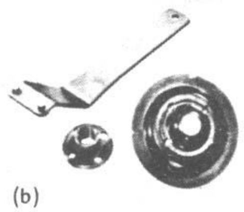
Chipping hammer with wire brush.



(a)



ELECTRIC HEAVY DUTY SANDER/GRINDER
SAFETY GLASSES IS RECOMMENDED TO USE



(b)

(c)

(a) Depressed center wheels; (b) disc wheel adapter; (c) guard.

Fig. 6.2 Tools associated with Arc welding

Fig. 6.3 Vise grips for handling hot metal

IV. SETTING UP THE EQUIPMENT

1. Connect the work cable to the job. This may be done by either connecting the clamp directly to the job or to the table.
2. Select the required type and gauge of electrode and fit it into the electric holder.
3. Adjust the current control to provide the correct current for the particular electrode and job.
4. Check that safety rules are observed.

V. ELECTRODES

An arc welding electrode consists of a core wire with similar composition as that of the material being welded, surrounded by a coating of flux. The flux coating serves varied purposes when burned:

1. It directs the arc like a gun barrel since the core wire burns back below the end of the flux.
2. It burns to produce a shield of reducing gases around the arc preventing contamination and oxidation of the molten metal by the air.
3. It promotes fusion by melting and combining with impurities in the molten metal.

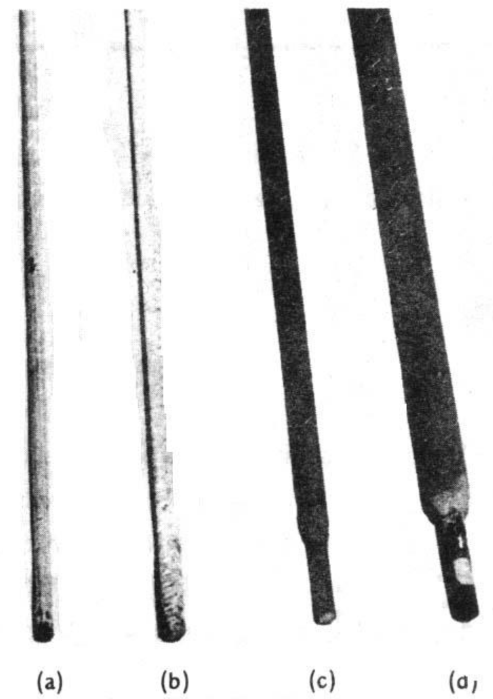
4. It floats on top of the solidifying weld bead to further protect the hot metal from atmosphere.

The residual flux is known as slag and is removed by chipping after welding run has been completed.

V.1 Flux coatings

1. Flux having high cellulose content has a deep penetrating arc, rapid burnt off rate and fairly high spatter lose.
2. A high rutile flux produces a fairly viscous slag. Electrode with this type of flux has a smooth running characteristic with medium penetration. The slag is dense, has good covering properties and is easily removed.
3. Fluxes that are mainly oxides and or silicates of iron and manganese produce an inflated slag, giving a deep penetration and smooth welded finish.
4. An electrode with a flux having a high content of calcium carbonate and calcium fluoride deposits a weld metal of low hydrogen content.

Different flux coating is provided in Fig. 7.0.



Picture of bare and coated electrodes: (a) & (b) Bare electrodes; (c) Thin coated electrode (E6011); (d) Heavily coated electrode (E7024)

Fig. 7.0 Flux coatings

VI. ARC WELDING PRACTICE

VI.1 Striking the arc

An electrode is used at amperage that is determined by its diameter and type. Two methods can be used to strike the arc but the method you would decide upon must be that which you can handle best. The electrode can be scratched across the surface, like striking a match as shown in Fig. 8.0. Once the arc has been established, it is moved to the point where welding is to commence. The other method involves lightly tapping the point of the electrode straight down at the welding point until arc strikes and immediately drawing the arc up and finally lowering the electrode slightly to shorten the arc to the normal welding length. It should be pointed out that it is usual to start an electrode by burning back the protruding core wire on a striking pad to lessen the possibility of the electrode sticking.

Fig. 8.0 Scratch method

VI.2 Running a bead

Once the electrode has been struck, it is inclined 20 ° - 30 ° from the vertical in the direction of travel and moved at a speed which will produce a bead of the required size. Since metal is melting from the core wire of the electrode and being transferred in the arc stream to the parent metal, the electrode becomes shorter. The electrode holder must be moved closer to the work as the bead is running along.

With practice, these two movements can be coordinated to give a smooth and an even build-up of metal. This is the correct welding procedure

VI.3 Re-starting the bead

The length of the bead may be interrupted by sticking the electrode or by changing electrodes. To restart the bead, chip the slag from the end of the bead and brush it away.

Restart slightly ahead of the existing bead, and return to the crater using a longer arc. Fill-in the crater with sufficient metal, then lower the electrode to the proper distance and continue with the beads.

Craters generally form at the end of the completed bead. This could cause failure if it is under load pressure. To eliminate the crater, pause a moment at the end of the bead to fill the crater using a short arc, then quickly back or whip the electrode backwards to break the arc as shown in Fig. 8.1.

Start the arc about 3/9 (9.5 mm) ahead of crater at A, move back to crater B. Using a longer arc, fill crater to proper height, then move forward, lowering electrode to proper arc length.

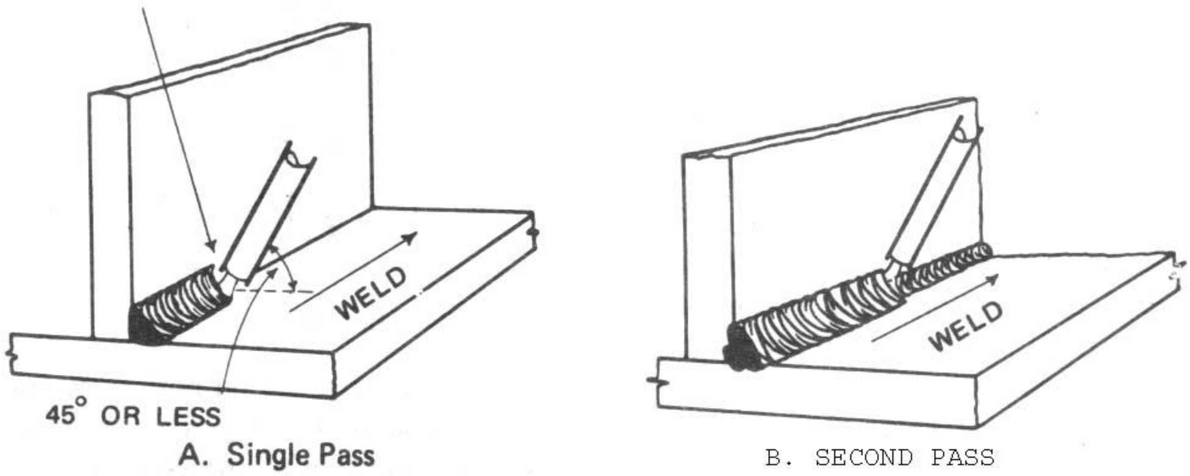


Fig. 8.1 Single pass and Second pass method

VI.4 Weaving Beads

VI.4.1 Types of weaving

Sometimes it is necessary to produce a wider bead, especially when welding a poorly fitted joint, where build-up is required, or when welding is in different positions. In many cases, it is better to make one wide bead rather that two or three narrow beads as shown in Fig. 8.2. Wider bead can be made by using the weaving technique, which is the sideways motion of the electrode while moving forward. Some of the more frequently used weave beads are: Box, Crescent or Open U, Figure of 8 and zigzag or side to side.

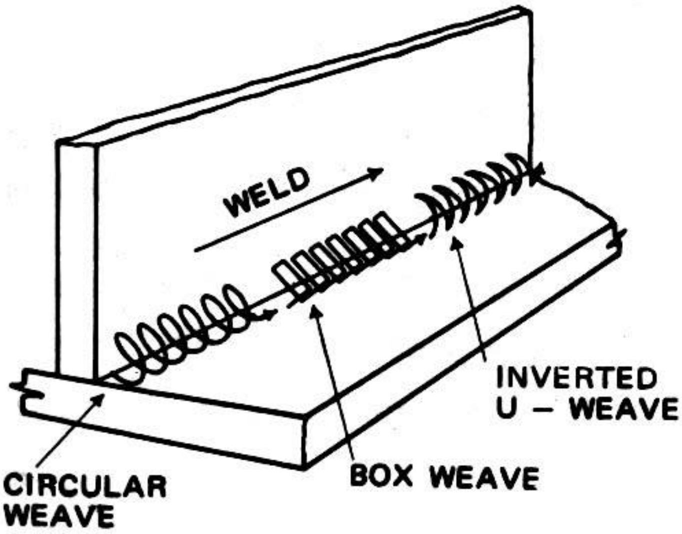


Fig. 8.2 Different weave figure

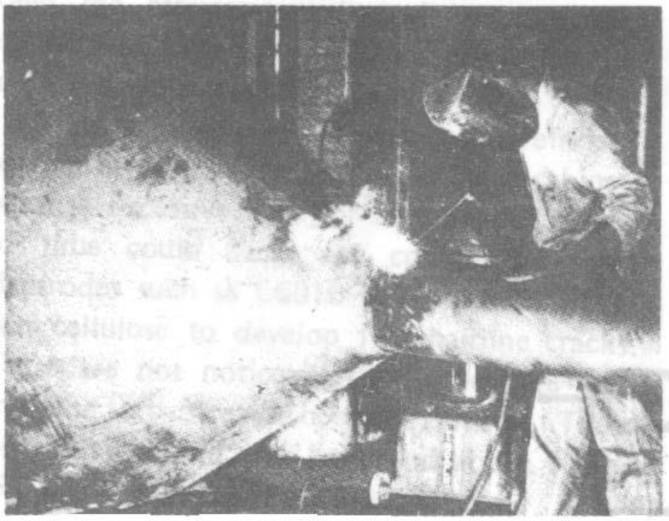
VII. QUALITY OF THE WELD

The quality of the weld depends on:

VII.1 Correct electrode size- the correct choice of electrode size involves the following factors:

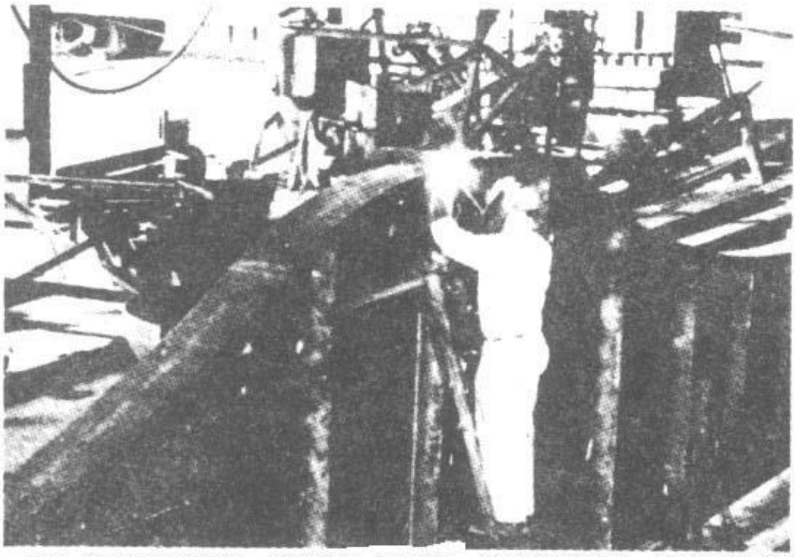
a. type, position and preparation of the joint;
b. the ability of the electrode to carry high current value without injury to the weld metal or loss of deposition efficiency;
c. the mass of work metal and its ability to maintain its original properties after welding;
d. the characteristic of the assembly with reference to effects of strains set up by heat application;
e. the practicability of heat treatment before and / or after welding;
f. the specific requirements as to weld quality; and,
g. cost of achieving the desired results.

Fig. 8.3 and Fig. 8.4 shows the use of the right type of electrode to accomplished a good quality weld.



SELECTING THE PROPER ELECTRODE FOR THE JOB AT HAND. THIN METAL WOULD REQUIRE A SHALLOW PENETRATING ELECTRODE.

Fig. 8.3 Shallow penetrating electrode

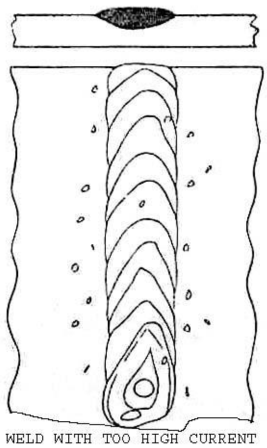


AN OVERHEAD JOINT THAT REQUIRES CERTAIN PROPERTIES ; LOW HYDROGEN ELECTRODE MAY BE BEST SUITED.

Fig. 8.4 Low Hydrogen electrode

VII.2 Correct amperage -It is an important factor because if the current is too high, the electrode will burn-off too fast with a large and uneven bead; this may result in excessive penetration as shown in Fig. 8.5. If the current is too low, there will be no enough penetration because there is no enough heat to melt the base metal and the bead will be either too small or too high and will become very uneven as shown in Fig 8.6. The current which the welding machine supplies to the arc must change the size of the electrode being used. Large electrodes require more current than the smaller sizes. A good rule to follow is: when welding with standard coated electrodes, the current setting should be equal to the diameter of the electrode in thousandths of an inch.

Example: A 1/8 inch electrode which measures 0.125 inch operates well at 125 amperes. Similarly, a 5/32 inch electrode which measures 0.156 inch operates well at 150 amperes.



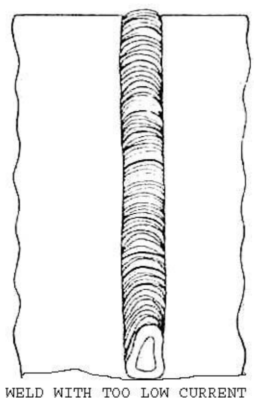


Fig. 8.5 Welding with too high current **Fig. 8.6 Welding with too low current**

VII.3 Correct arc length – It is important because if it is too short or close, the voltage will be too low. The heat will not be enough to melt the base metal for adequate penetration as shown in Fig. 8.7. The bead will be too high and uneven, and the electrode may stick to the metal. If the arc is too long, the voltage will be excessive, causing the arc stream to wobble. The metal from the electrode will melt in globules causing wide, irregular bead and excessive spatter as shown in Fig. 8.8. There will be decreased fusion between the base metal and the weld metal.

The rule on the arc length states: The arc length shall be slightly less than the diameter of the electrode being used.

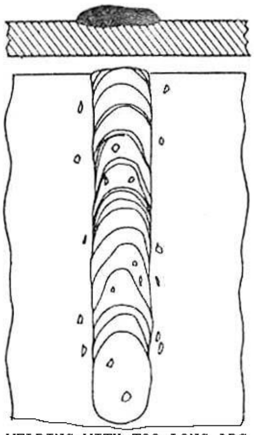


Fig. 8.7 Welding with too long arc

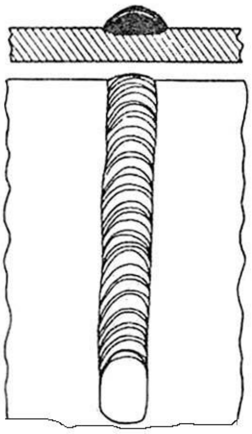


Fig. 8.8 Welding with too short arc

VII.4 Correct speed travel - If the speed is too fast, the bead is too narrow, leaving pointed ripple with pool of molten lead solidifying too fast with impurities being trapped inside. These beads are too high and lack the proper penetration as shown in Fig. 8.9. Consequently, if the speed is too slow, the beads are too wide, with excessive metal deposited and excessive penetration with holes burned in the metal if thin plates are being welded as shown in Fig 9.0.

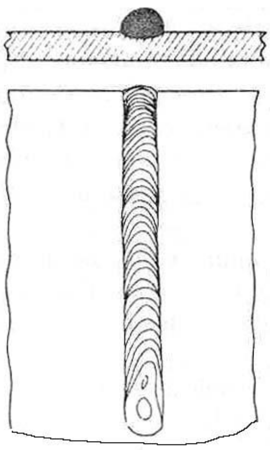


Fig. 8.9 Speed of travel too fast

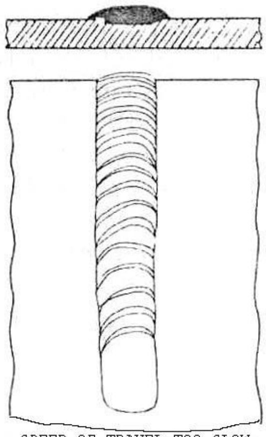


Fig. 9.0 Speed of travel too slow

VII.5 Correct electrode angle- is important when making fillet welds and groove welding. When using a heavy flux - coated electrode in fillet weld and lap welding, the molten slag could present a problem by getting in the middle of the bead.

This prevents the molten metal from flowing together between two plates if the electrode movement or manipulation is not correct. If the angle is too high, undercutting of the vertical plate could result. Undercutting of the vertical plate could cause a weak spot, depending on where the plate is used. In practice, it is found out that this angle may vary as much as 150 in any direction without affecting the appearance and quality of the weld. The electrode angle should be not greater than 200 toward s the direction of travel.

Note: When arc welding, always watch the formation of the bead at the edge of the molten pool of metal. This is a guide for a good bead with the proper contour and ripples. The ripples should be smooth and rounded as shown in Fig. 9.0.

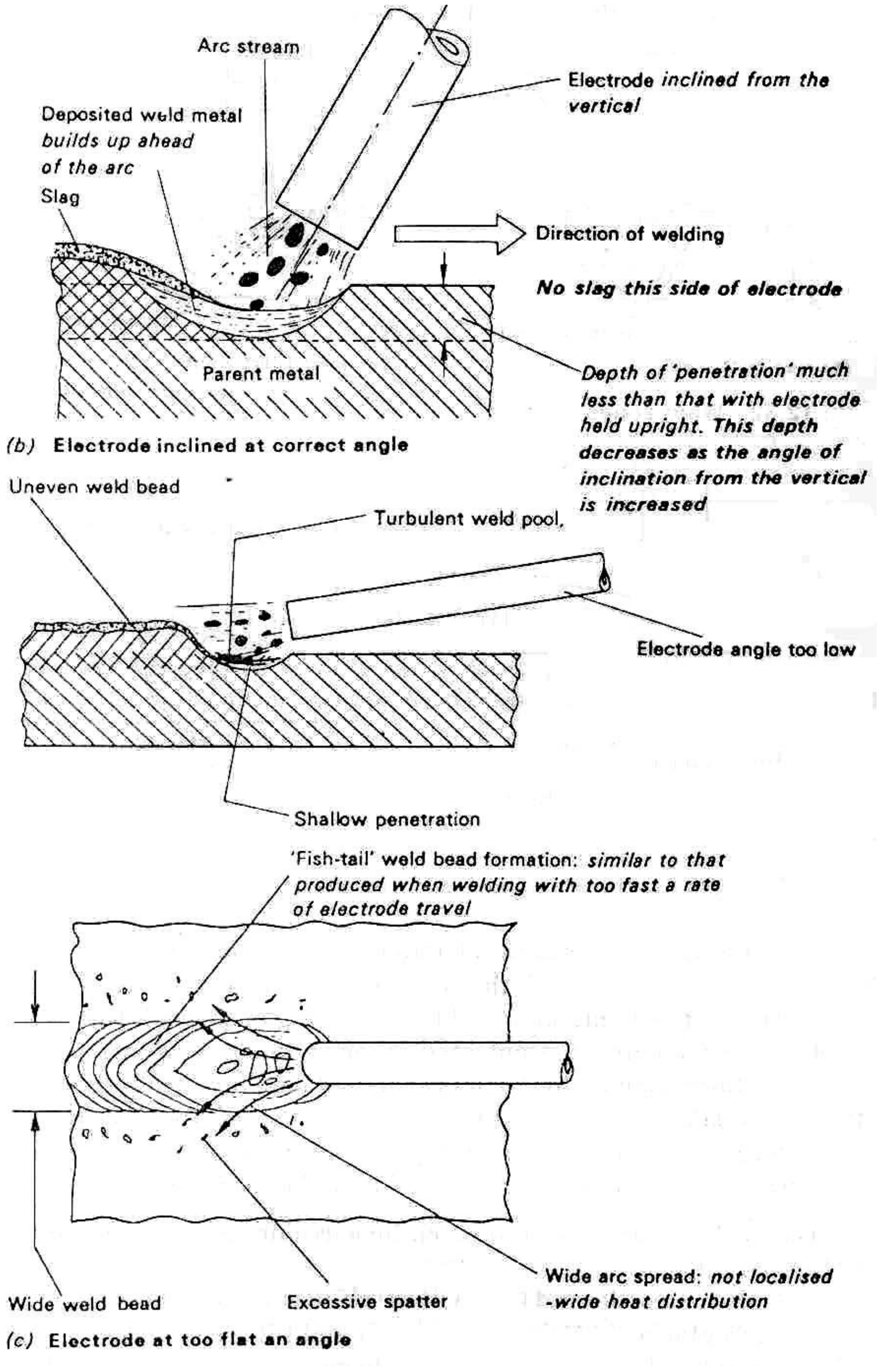


Fig. 9.0 Proper electrode angle position

VIII. WELDING POSITION

VIII.1. Flat Welding

Fig. 10.0 clearly shows that all joints can be welded in any position (flat, horizontal, vertical, and overhead), however, if possible, welding should be made in the flat position for easy working.

VIII.2. Horizontal Welding

Weld in horizontal welding positioning is welding a bead that is parallel to the ground. On beads or welds other than the flat position, the effects of gravity on the molten metal in the puddle will cause the metal to run down on the lower side of the weld. The amount of metal deposited in the weld area will be less, thus affecting the strength. Over lapping the lower side of the weld area with metal without penetration is called cold lapping. If excessive metal runs out of the weld area, it could present a hazard for the welder.

Two important factors that will help control the molten metal in the metal are:

a) slight reduction in amperage and

b) use of shorter arc than used in a flat position. The use of the weaving motion will help to control the amount of molten metal in the puddle. The electrode angle should be about 15 to 20 in the line of travel with electrode point upward about 5 to 15. If undercutting on the part of the weld takes place, tip the electrode a few more degrees upward.

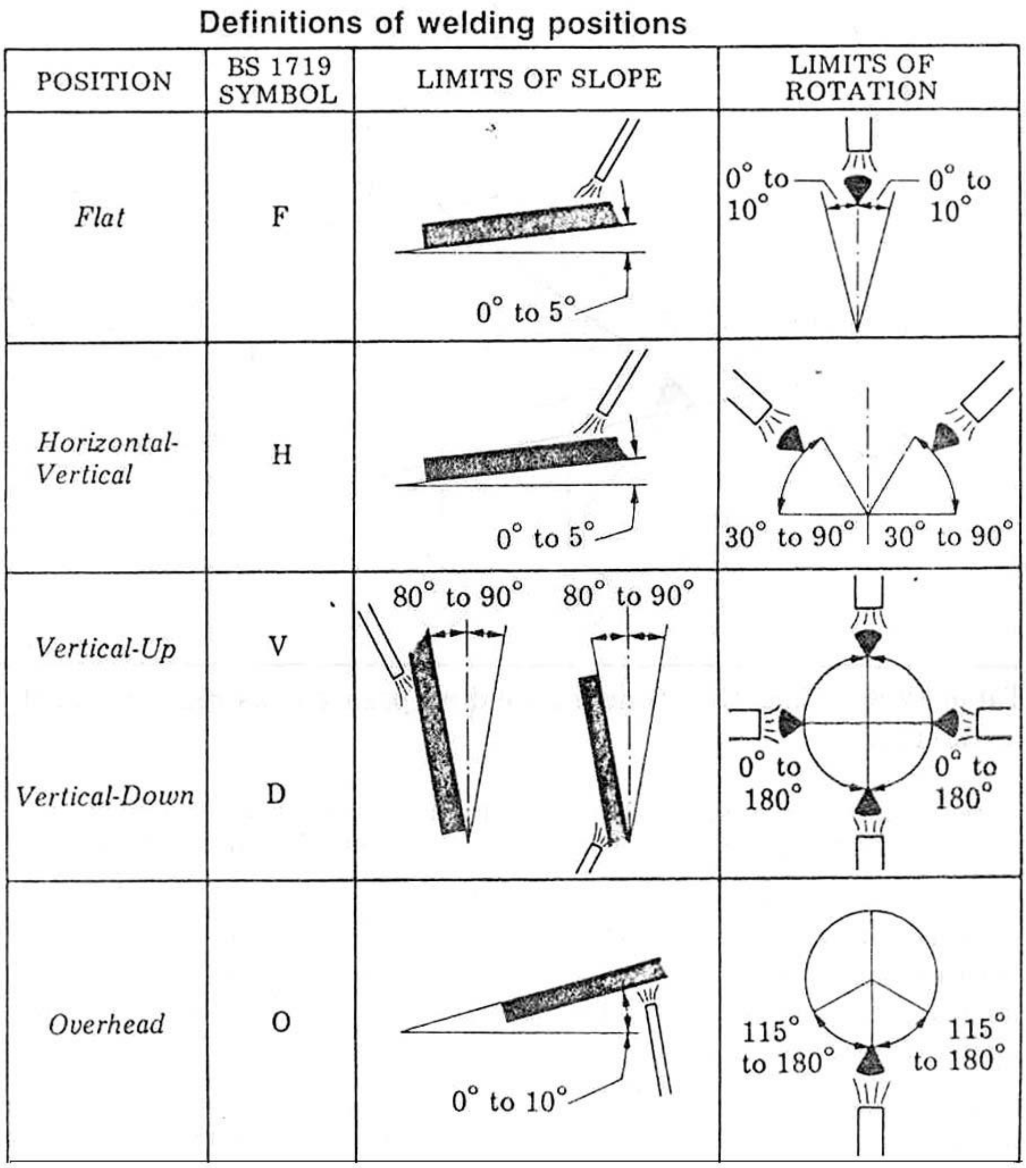


Fig. 10.0 Different welding positions

VIII.3. Vertical welding

Welding beads in a vertical position is perhaps the most difficult position because gravity tends to pull the molten metal downward from the weld area as shown in Fig. 10.1. Vertical welding requires more practice to master than any other position. For Maximum strength of joint in a vertical position, welding upward will deposit more metal than downward. Vertical down welding is suitable for thinner plates because the penetration is not as deep thus preventing burn through holes but still forming adequate welds.

The angle of the electrode for welding vertical up and down is very important to help control the molten puddle. When welding downward, the electrode should be pointed upward about 15° to 30° from the vertical plate.

The arc should be rather short and the speed fast enough to prevent the molten metal and slag from running ahead of the puddle. When welding upward in a vertical position, the electrode is pointed upward at about 10° to 15° angle. A whipping motion or rocking motion is used to control the molten metal in the puddle. A whipping or rocking motion tips the electrode upward out of the puddle or crater and back to the puddle again. This is simply a slight twist of the wrist and allows the molten metal to solidify. During the whipping motion, DO NOT BREAK THE ARC, THE SOLIDIFIED METAL WILL PROVIDED A SHELF FOR ADDITIONAL WELD METAL.

The U -shaped weave and the figure 8 weave type bead is used 'very often when welding vertical fillet welds. Start with the simple straight bead and then, as this technique is mastered, the weave bead will be easier to accomplish.

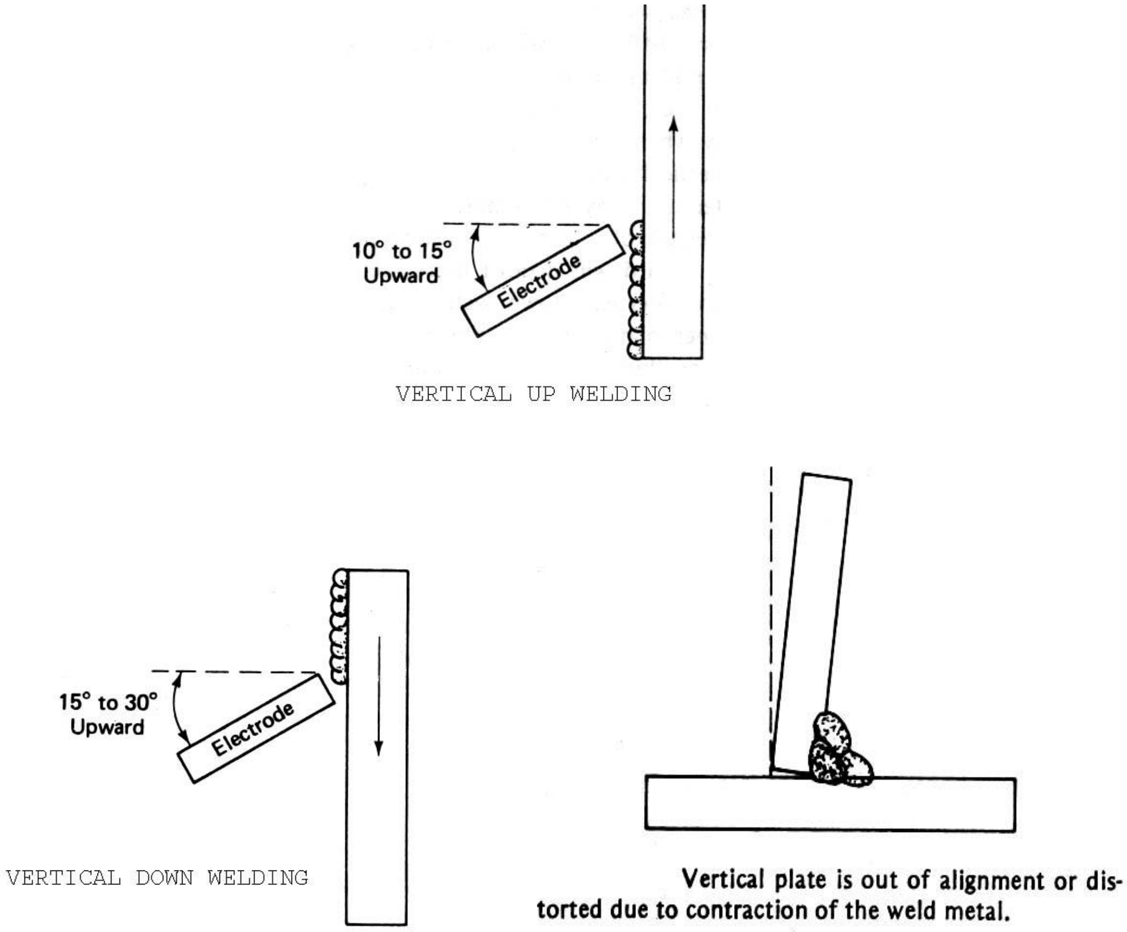


Fig. 10.1 Different types of vertical welding

VIII.4. Overhead Welding

Overhead is a very difficult type of welding because the force of gravity acts against the molten metal in the puddle and normally, the welder is place in an awkward or uncomfortable position. Overhead welding is dangerous because of the sparks or falling droplets of molten metal from the weld area. It is difficult to make well- shaped beads with the correct penetration because the molten metal tends to sag down. This is why fast-freeze electrode is recommended. The low - hydrogen electrode is quite popular because of the short arc which tends to hold the molten metal in place. The electrode is held at about the same angle as flat welding. Fig 10.2 shows overhead welding together with the other types of welding position.

IX. TYPES OF WELDS

IX.1 Every welding job or operation will contain one or more of the following welds and beads: surface weld, groove fillet, plug, rivet, and slot.

a. A bead weld is a narrow layer of weld metal deposited in a straight unbroken lines either on flat surface or deposited on a close butt weld. A bead weld can also consist of two or more layers of deposit weld metal called padding. A bead weld is often called a stringer bead.
b. A groove weld is a weld where weld metal is deposited in a groove which can consist of one or more beads depending on the type of groove and the thickness of the metal. The groove is formed by an open square butt joint, a beveled butt joint or, a U-joint.
c. A Fillet weld is a weld where metal is deposited in one or more beads in the angle formed by two plates such as lap weld, inside corner weld, or an open outside corner and beveled outside corner joint.
d. The plugs, rivet, and slot welds are very similar because they join two overlapping pieces of metal. The plug weld is where a hole is drilled into the upper plate and the pieces are welded together by welding the hole. The plugs is sometimes called a button hole use for welding light gauge metal
e. The rivet weld is where the hole is drilled through both upper and lower pieces of metal and the weld is made clear though the hole. A variation of the type is when the hole in the upper pieces is larger than the lower pieces.
f. A slot weld is where the weld metal is deposited into an oblong slot instead of a round hole. The slot is generally use for fastening down deck plates.
g. The plug, rivet, and slot welds are not used as often as the bead, groove, or fillet weld; and they are comparatively inefficient.

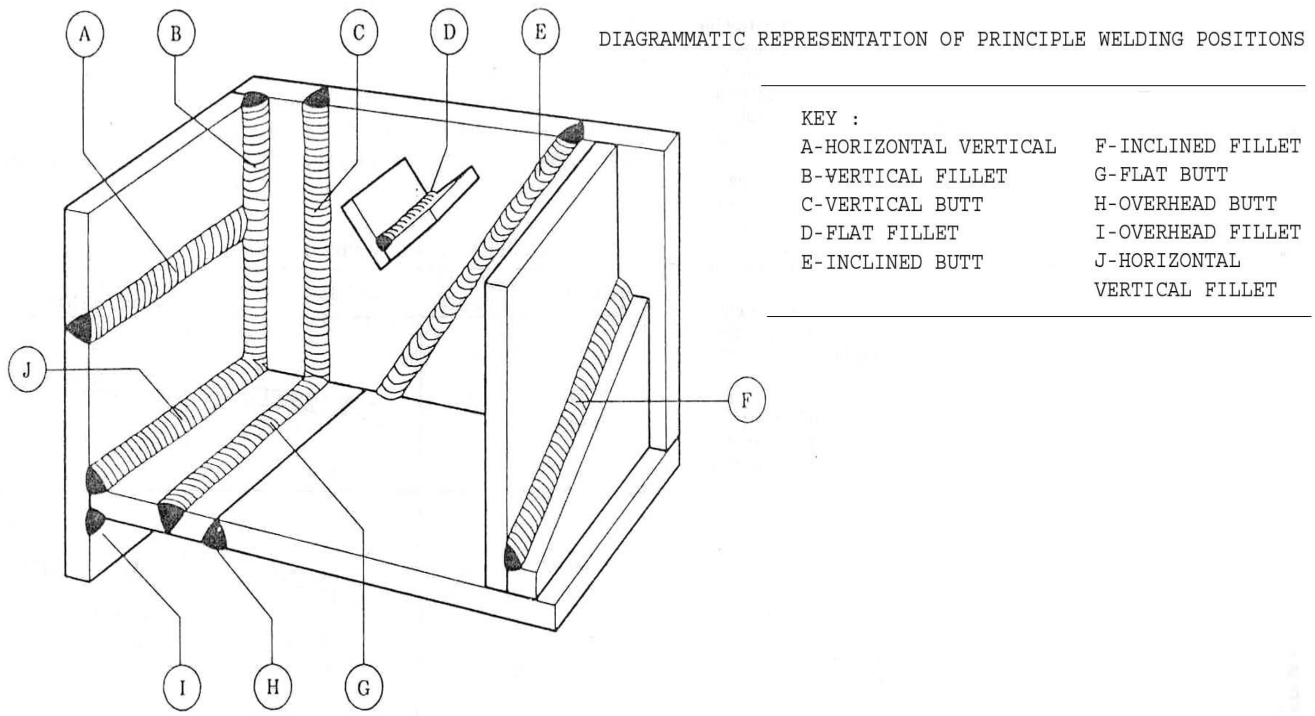


Fig. 10.2 Types of welding position

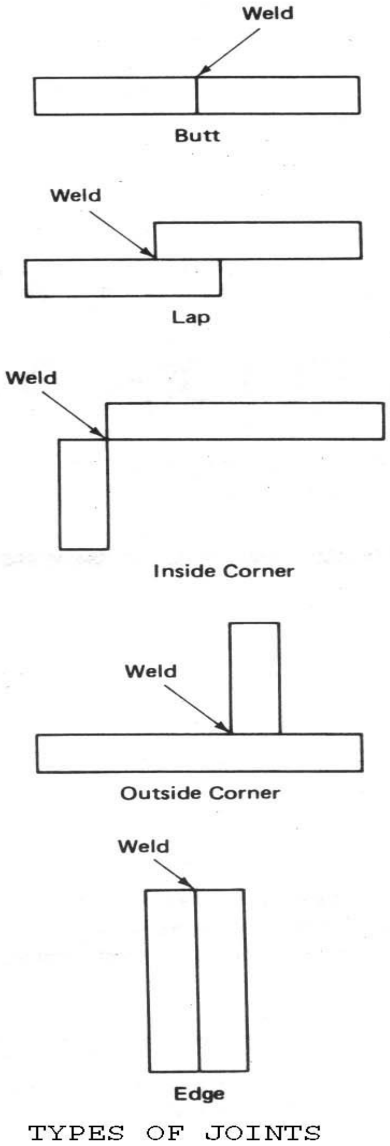
X. TYPES OF JOINTS

a. There are five basic types of joints used in arc welding. They are the butt, lap, inside corner of T -joint, outside corner, and edge joint. The welder must decide what is the best type of joint to use or which is the strongest and the weakest under certain stress or load conditions.

b. Some other factors to consider are the following: Can the type of joint selected be welded easily? What is the cost of preparing the joint and how much material will be used?

c. A certain type of structure can be made with the proper design rather than one that was improperly designed.

Fig. 10.3 shows the type of joints.



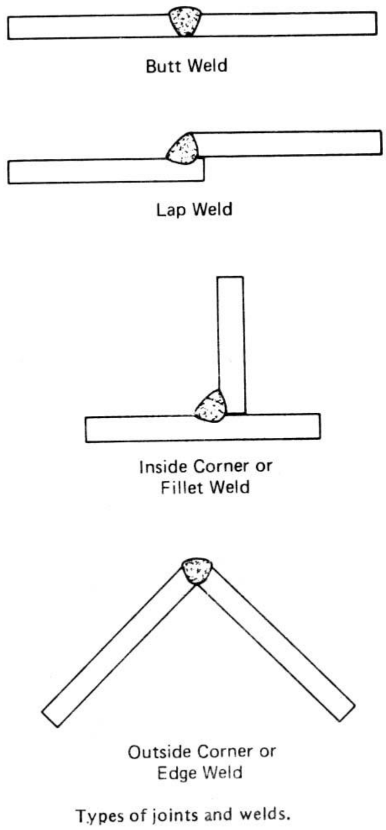


Fig. 10.3 Type of joints

XII. WELDING PROCEDURE

XII.1 Safety check before welding

Follow safety precautions discussed previously such as: checking fire hazards, locating the fire extinguishers, and making sure the area is free of litter and scrap. Check welding equipment such as cables, electrode holder, good ground clamp, helmet and lenses.

Clear the work table and cable connections. If there are any defects, correct them before starting to weld. Personally check for proper clothing, pants, cuffs, buttoned shirt pockets, proper shoes; clear pair of safety glasses put on protective clothing if available and remove matches or inflammables from your pockets. Fig.10.4, Fig. 10.5 and Fig. 10.6 shows the different precaution on arc welding jobs.

Fig. 10.4

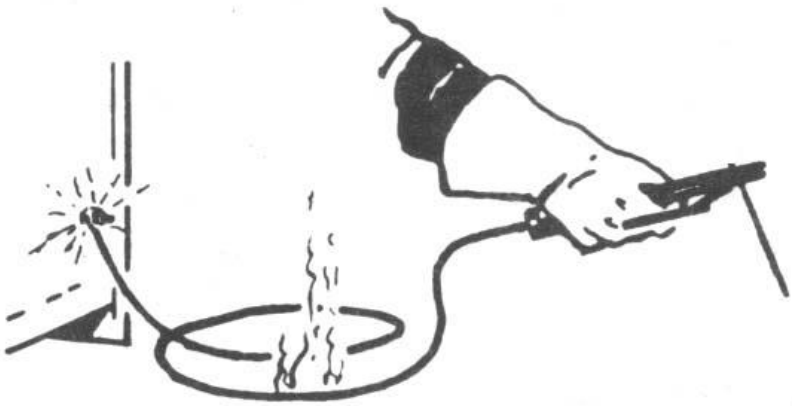


Fig. 10.5

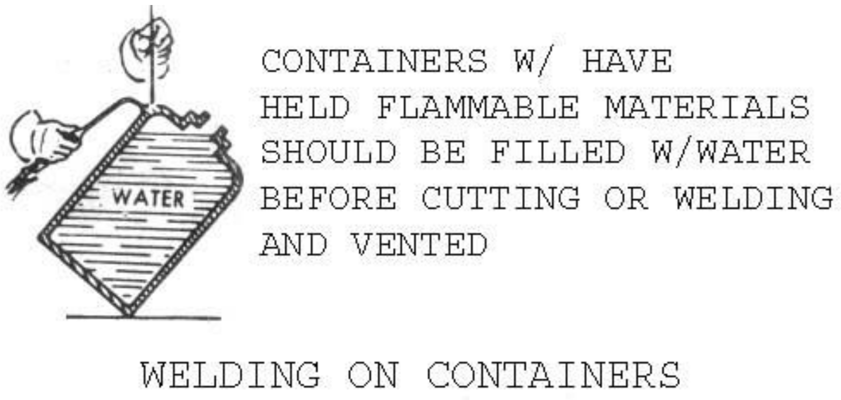


Fig. 10.6

WELDING

Select the proper electrodes for the plates and check the amperage setting. Many machines work well from 90 to 100 amperes. Make sure you have a chipping hammer and wire brush.

Position a plate in the bench, remove dirt and rust with wire brush, Place an electrode in the holder with the bare end in the jaw of the holder.

CAUTION: DO NOT TURN THE MACHINE ON.

Practice using one of two methods to strike an arc; scratching or tapping. The Scratch method is scratching the electrode along the surface of the metal, the same as striking the match. Tap method is striking the plate with an electrode at a 90 degrees angle then moving the electrode upward about 1/8 inch (3.17mm.) from the surface. Try one or both of these methods to get used to the feel of the holder. Do not grip the holder too tightly because it becomes tiring after a short time. Connect the ground cable to the bench and check for good contact. Put on the helmet and check for headband adjustment. It should be tight enough to stay on your head when the helmet is raised but it should not be uncomfortable. Put on gloves if available. Pick up the electrode holder and electrode and turn the machine on. Be sure you know the location of the switch in case of emergency.

Lower the electrode to 1 to 2 inches (25.4 to 50.8 mm.) from the surface of the plate and then lower your helmet. Strike the electrode on the plate with either .the scratching motion or tapping motion to establish an arc. Do not move to fast or else the arc will stop. As the arc starts, raise the electrode up a little, about 3/16 inches (4.76 mm. long arc) for a moment to establish the arc and form a molten pool of metal. Lower then the electrode up to about 1/8 inch (3.17 mm.) from the surface. After a few seconds, move the electrode up to break the arc. Repeat striking or starting the arc using both methods at least ten times.

Note: If the electrode sticks to the surface, twist the electrode and break it loose. If still stuck, release electrode from the holder or shut the machine off, but keep the helmet down over your face.

After you practice striking an arc, the next step is running short beads. Strike the arc and maintain the arc moving forward. If you are right-handed, move the electrode from left to right. If left-handed, move the electrode in the opposite direction. This way, you can observe the formation of the puddle and bead. Keep the electrode at right angle or vertical to the plate and tip the electrode at about 10 to 20 degrees angle forward at the tip. Move in a straight line for a distance and stop the arc. Chip off the slag with the chipping hammer and observe the result.

CAUTION: Be sure to wear the clear safety glass or chipping goggles.

XIII. OXY-ACETYLENE WELDING

XIII.1 Introduction

Use of the oxy-acetylene welding ranges from repairing or salvaging large maintenance equipment to repairing smaller items such as kitchen chairs and other household articles. Fig.11.0 shows all the elements regarding oxy-acetylene welding.

The oxy-acetylene welding equipment is used for welding, cutting, heating, bending, and soldering. With a wide assortment of different sized welding and cutting torches and a good selection of tips, the torch can supply sufficient heat for various thicknesses of metals. Many things can be repaired if the repairman is a good welder.

Misuse of the oxy-acetylene torch can cause injuries, fires, and other dangers. However, with reasonable care and knowledge, the torch is as safe as any hand tool. Carelessness in handling the equipment and cylinders and failure to exercise precaution when using the torch around flammable can make the torch a very dangerous tool. Most injuries and damage are caused by human error rather than equipment failures.

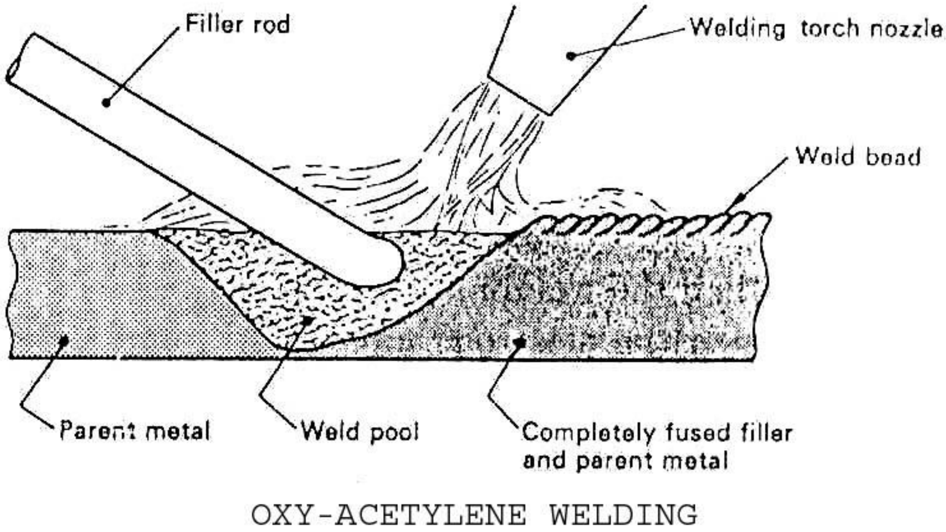


Fig. 11.0 Elements involved in oxy-acetylene welding

The oxy-acetylene flame produces a very high temperature; in fact, it is the hottest flame known, approximately 3482° C. It is capable of melting all commercial metals. The flame does not affect the melted metals, and the molten metal is protected from atmospheric contamination or from oxygen and nitrogen attacking the molten metal.

XIII.2 Storage of the Gases in Cylinders

XIII.2.I OXYGEN CYLINDERS

The oxygen cylinders are made of a seamless high carbon steel no less than 3/ 8" (9.52mm) thick. The normal full tank of oxygen contains 2200 psi (15,170 kPa) at 70° F (21°C). The oxygen will expand when heated and contract when cooled; the pressure may vary depending on the temperature.

The oxygen cylinders are tested periodically to a pressure over 3300 psi (22.750 kPa). The inside walls may deteriorate over a time and must be checked for any weakness.

A malleable iron neck is shrunk in at the top of the cylinder and the tank valve is screwed into the neck. The neck is then threaded on the outside to permit a protective cap to be attached.

Note: Never leave a cylinder either empty or full to stand by itself without adequate support.

Oxygen cylinders must be upright position and away from heat. Always keep the cylinder valve closed when empty to avoid having foreign particles enter the cylinder. Keep oil or grease away from the cylinder, especially from the valve. Do not strike an electric arc on the cylinder because it may cause it to rupture.

The cylinder valve is made of forged brass and made to withstand high pressure. The valve is called a back seated or double seated valve. The back-seated part of the valve, seals off the thread to prevent oxygen from escaping. The cylinder valve must open all the way to seal the threads. Partially opening the valve will waste oxygen. Oxygen valve have right-handed threads.

Each valve is equipped with a safety pressure disc that will burst when the pressure gets too high (caused by excessive heat.). This will prevent a rupture of the cylinder.

Note: Never use oil or grease on a cylinder or any part of the welding set-up at any time because a serious fire or explosion could result. Fig 11.1 shows the parts oxygen and acetylene bottle.

The cylinder is painted different colors for different gasses; however, the colors may vary with each manufacture or distributor.

It is not advisable to use the oxygen cylinder after the pressure is down to100 psi (690 kPa) welding or 200 psi (1380 kPa) for cutting because a serious backfire could result if the oxygen pressure were less than the acetylene.

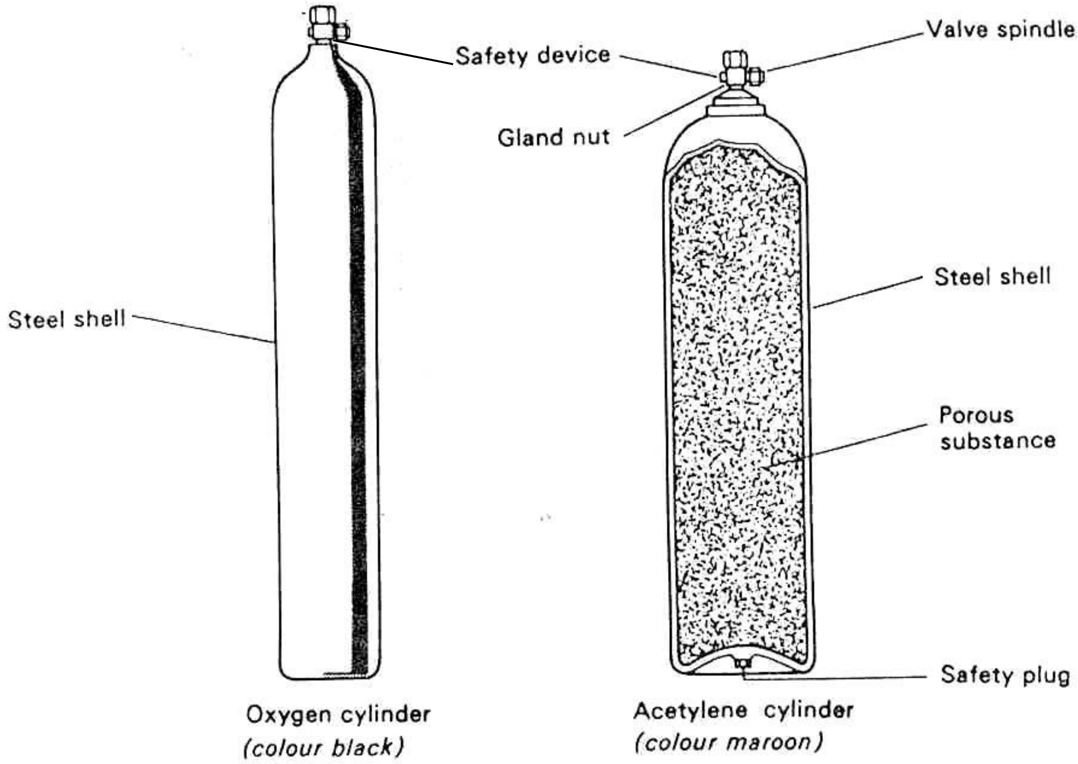


Fig. 11.1 Oxygen and acetylene bottle

XIII.2.2 Acetylene Cylinder

Acetylene must be stored in a different type of cylinder than that used for oxygen. Acetylene cannot be stored in a hollow cylinder at a

pressure over 15 psi (103 kPa) in a gaseous form because of its explosive nature. In order to store acetylene in a cylinder at a pressure up to 250 psi (1750 kPa), the cylinder are filled with a porous material such as Fuller's Earth or wood pulp, depending on the manufacturer, Next, acetone is added and is absorbed by the porous material. Acetylene is then pumped into the cylinder to a pressure of about 250 psi (1720 kPa).

The acetone readily absorbs many times its own weight of acetylene. In addition, the porous material prevents pockets of acetylene. In addition, the porous material prevents pockets of acetylene gas from accumulating. This method is the safest way to store acetylene. Some cylinders have concave bottoms and two safety plugs that will melt out at around 220 °F (104 °C) to relieve the pressure in case of excessive heat.

Note: As state, one gauge indicates the approximate amount of regulated pressure or cylinder pressure. This means that not all regulators will indicate the exact pressure; the gauges may have become worn out or damaged by handling.

One indication of the gauges not being accurate is when the acetylene regulator is set at 5 psi (34 kPa) and the torch will not light. However, by setting the regulator at 10 psi (68 kPa), the torch will light. This means that the regulator gauge is off or out of calibration. Also, when the cylinders are shut off and the gas drained from hoses, the low pressure gauge may indicate pressure.

Opening the cylinder valve too fast, especially the oxygen cylinder; is one of the main causes of damage to the gauge. Most gauges use a Bourdon tube which tends to straighten out as the pressure increases.

XIII.2.3 Hoses and Fittings

The hoses are to carry the gasses from the regulator to the torch. The hoses must be of special construction and made of a non- porous material to withstand pressure, to take abuse and to be unaffected by either oxygen or acetylene gas. A good hose is made in four layers: a high quality gum inner liner, then two layers of strong fabric, and finally, a tough rubber outer covering. The oxygen and acetylene hoses are either fastened together by vulcanizing or by clips to avoid tangling. Most acetylene hoses are colored red with left-handed grooved ferrules or nuts. The oxygen hoses are either green or black and have right -handed ferrules or nuts. Fig. 11.2 shows the type of hoses and fitting used in oxy-acetylene welding.

Note: Do not attempt to use an acetylene hose for oxygen because a combustible mixture could result; do not switch the fittings.

Caution: Avoid dropping sharp objects or hot metal on the hoses. A rupture in the hose could cause a fire. Avoid kinking the hoses because it will hinder the flow of gas.

Be careful with the hoses and make sure that it will not be cut by sharp objects and be subjected to heavy weights which will restrict the flow of gas. Never, repair a broken line with a piece of copper tubing because the tubing could cause a chemical reaction.

Two types of valve are used for acetylene cylinders. One type use a hand wheel, the other type uses a square shank and key.

Note: When the cylinder is being used the regulators must be kept on the cylinder always to permit closing the valve in case of emergency:

The valves are of simple construction because of the lower cylinder pressure as compared to the pressure in the oxygen cylinder. The tops of the cylinder vary, some have recessed tops to protect the valve while the others have tops shaped similar to the oxygen cylinder, but the cylinder is wider.

The acetylene cylinder has left-handed threads on the cylinder outlets to avoid putting the wrong regulator on. The oxygen regulator is made to withstand a must higher pressure as compared to the acetylene regulator.

Caution: Never attempt to transfer acetylene from one cylinder to another cylinder or container'

Note: Acetylene is sold by weight, not by pressure. This is determined by weighing the cylinder after it is fined and subtracting the weight or the empty cylinder'. The difference is multiplied by 14.5 (14.5 cubic feet equal to 1 pound 410.5 liters is equal to 0.453 kilometers).

ALWAYS store acetylene cylinders in an upright position as acetone may enter the valves and gauges. Store away form heat.

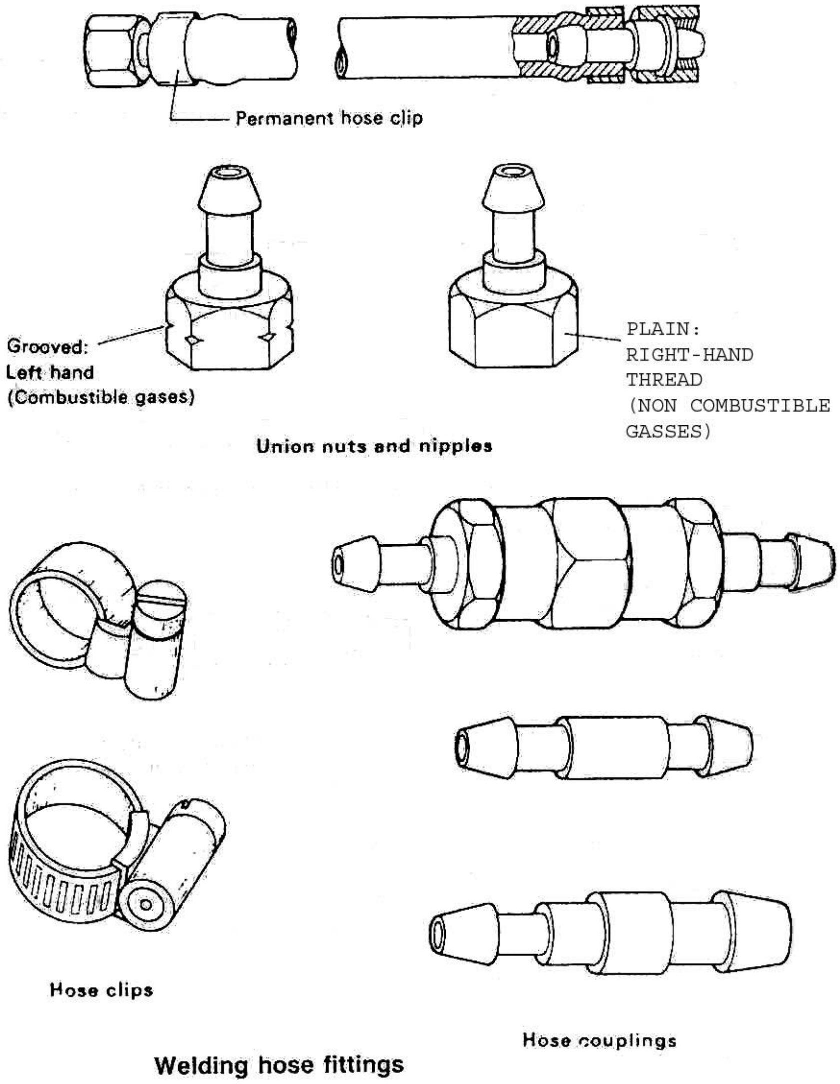


Fig. 11.2 Welding hoses and fittings

XIII.2.4 Regulators

It was noted that the pressure of the cylinder is about 2200 psi (15,170 kPa), while the acetylene is about 250 psi (1720 kPa). This pressure is too high to be used for welding. Therefore some means must be used to reduce the pressure so that it is suitable for welding or cutting. Moreover, a constant pressure must be maintained for welding. Regulators are used for this purpose.

The regulator will maintain a constant pressure at the torch even though the pressure of the cylinder decreases as the gas is consumed. On some occasion, some regulators may have to be readjusted as the cylinders become nearly empty.

Regulations are high quality; sensitive instruments made for accurate regulation of pressure but are made rugged enough for shop handling. The regulators for both acetylene and oxygen operate on the same principle. Each regulator has two gauges, one indicates the approximate cylinder pressure and the other is for the approximate amount of regulator pressure that will be delivered to the torch as shown in Fig. 11.3.

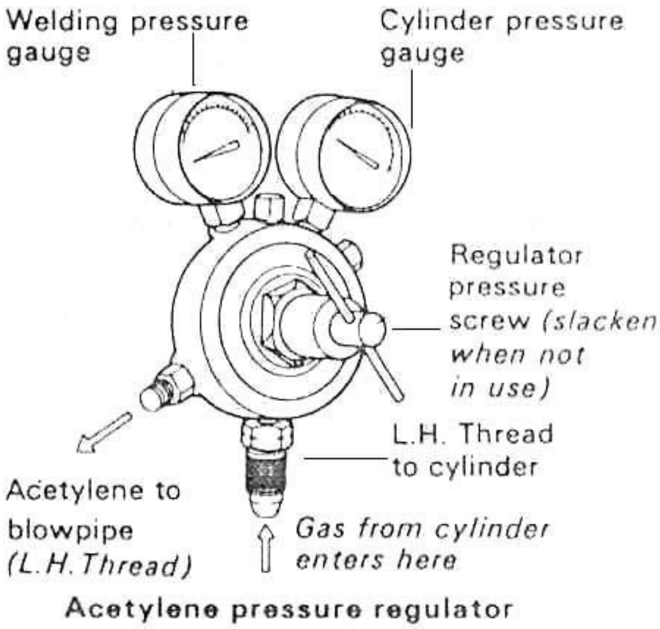


Fig. 11.3 Oxy-acetylene pressure regulator

XIII.2.5 Safety Check Valves

A device that must be included with all oxygen and acetylene equipment is a back-fire device called Safety Check Valve. This device permits gas to flow to the torch but does not allow gas to flow back from the torch to avoid what is called backfires. This device will reduce the danger to the torch, hoses, and regulators. It is either attached near the torch or near the regulators.

XIV. CONSTRUCTION OF THE TORCH

The torch, sometimes called the blowpipe, is a precision engineered piece of equipment. It is sometimes considered the most important part of the welding equipment because it directs the flame. In the torch, the oxygen and acetylene gases are mixed in the proper proportions. The mixture is burned at the end of the tip allowing the operator to direct the flame to the work.

The torch is divided into four parts:

Body - serves a handle

Valves - controls the amount of gas desired Mixing Head

Chamber -where the gases are mixed in proportions

Tips/Tubes -where combustion takes place (at the tip's end)

The torches are made of several of materials such as brass and aluminum. Size and capacities vary from small torches for welding sheet metal or soldering to large ones used where great amounts of heat are necessary or for cutting heavy steel. The smaller the torch, the easier it is to handle in restricted places as provided in Fig. 11.4.

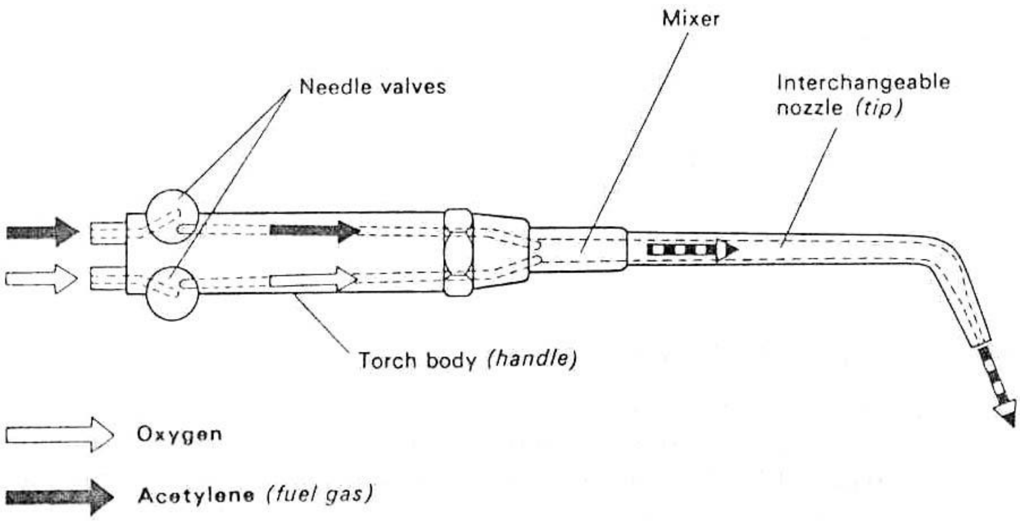


Fig. 11.4 Parts of an oxy-acetylene welding torch

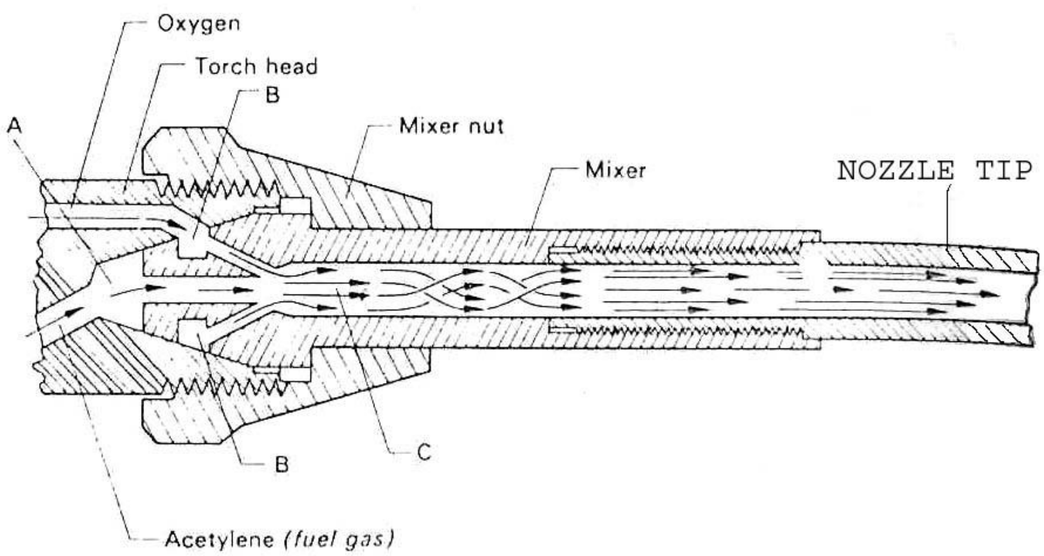
There are two types of torches: the injector and the equal pressure. The injector types; the acetylene at low pressure is carried through the torch by the higher pressure oxygen flowing from a jet or venturi. In equal pressure types, the gasses pass through the mixing chamber.

All torches are equipped with a pair of needle valves or ball type valves that serve two purposes. One is to turn the gases on or shut them off, while the other is used to make the proper adjustment to obtain the desired flame.

Note: Care must be taken not to close the valves too tightly when shutting off the gas. This could result in damage to the needle and seat. Sometimes, an operator may experience difficulty in holding the proper flame adjustment. If faulty gauges are not the cause and if the connections are tight, a loose packing seal nut is the problem. Let the valves move freely the packing seal or stiffness. Occasionally the seal nuts are too tight and it is difficult to turn the torch on. This can be remedied by backing off slightly on the packing seal nut.

XIV.1 Mixing Chamber

Some torches have the mixing chamber in the torch only. Many torches have the mixing chamber combined with the tip and head assembly. Each time the tip is changed, the mixing chamber to a sufficient amount of mixed gasses for a certain size tip. Each mixing chamber is drilled with holes or orifices to match the size to be use. Some are stamped on the sides showing what size tips can be used - either size numbers or letters. These holes or orifice must nor be altered or enlarged because they are precision drilled to permit the proper amount of gasses to pass through. Fig.11.5 shows the full view of a mixing chamber.

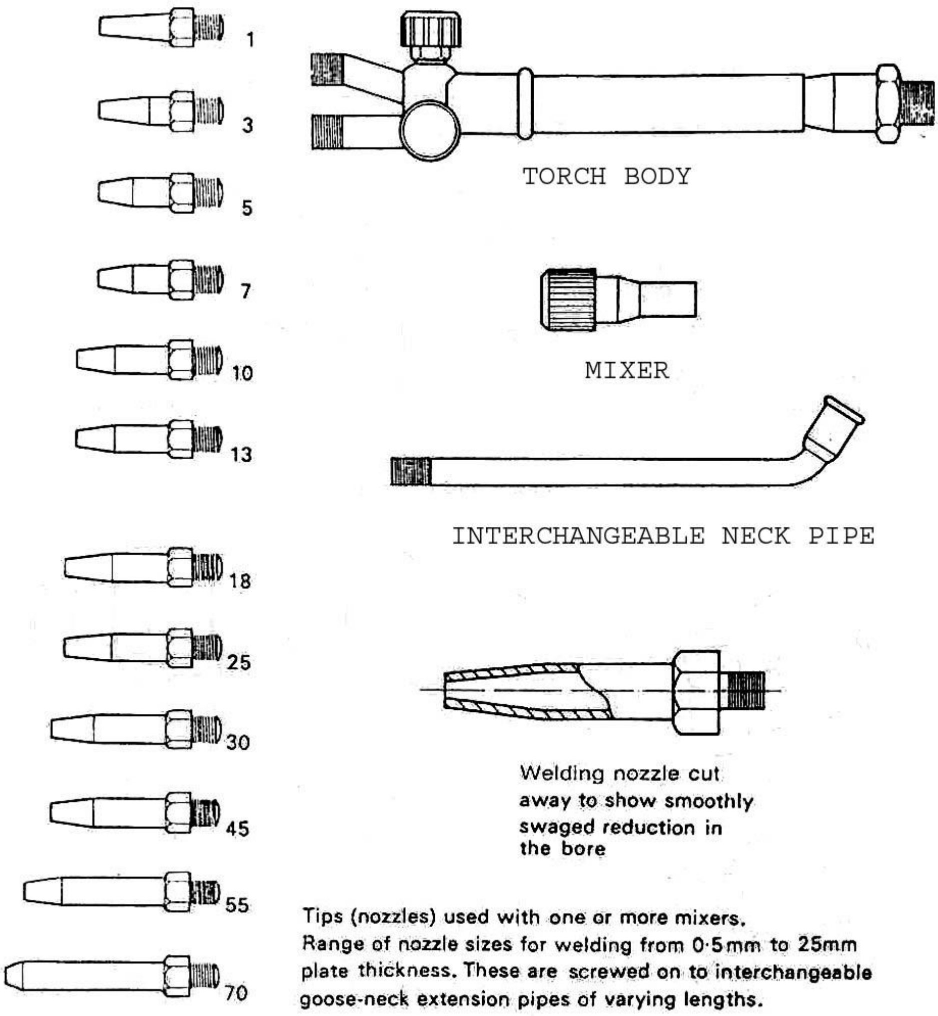


Mixing chamber for a welding torch

Fig. 11.5 Mixing chamber

XIV.2 Tips or Tubes

The tips or tubes are either permanently soldered or are removable from the mixing head or chamber. All tips are made of copper. Tips are made in various sizes and numbered or lettered according to the manufacturer. These tips are calibrated to permit a certain amount of mixing gasses to pass through at a given length of time. Normally, the lower the number the smaller the tip, but some manufacturers use the tip drill size as a numbering device. These tips average from 5 to 71bs. (34 to 38 kPa) for acetylene and for oxygen, 1/4 inch (6.350 mm) metal, up to 12 lbs. (82 kPa) . The types of tips or tubes are shown in Fig. 11.6.



Welding torch and nozzle/mixer combinations

Fig. 11.6 Sizes of welding tips or tubes

XIV.3 Welding Goggles

The welder must wear suitable welding goggles when welding, brazing, and cutting with a torch. The welding flame produces light and heat rays that can damage the eye tissue. Continued exposure will result the loss of sight. Sparks and molten that fly from the weld or cutting area can cause painful eye injury. Brazing although performed at a lower temperature gives off harmful rays from the flame and the molten flux. These protective devices are available in goggle type eye shields (can be used with eye glasses and the full face shield. The full face shield is recommended for cutting and welding overhead to protect the face from flying sparks and metal. For most welding and cutting, lenses with a shade number from 4-6 are recommended. For welding and cutting heavy metal .shades numbered from 6 to. 8 are recommended. A clear plastic lens should be inserted in from of the welding lens to prevent the welding lens from being damaged by flying sparks and molten metal. If the welding lens becomes severely chipped, the amount of protection from lens will decrease. Another important piece of welding equipment is a striker. The striker of flint lighter is a device used to ignite the gases flowing from the welding torch. The striker is the simplest and safest mean of lighting a torch. A typical safety protection for person performing an oxy-acetylene welding is shown in Fig. 11.7.

Fig. 11.7 Recommended body protection for oxy-acetylene welding

XV. OPERATION OF THE TORCH

XV.1 Setting-up the Oxy-Acetylene Equipment

Setting up means preparing the equipment as follows:

- Positioning the cylinders
- Attaching the regulators
- Connecting the tubing's
- Attaching the appropriate torch

IMPORTANT PRECAUTION: DO NOT USE OIL

Make sure that the equipment and hand are free from oil, grease and dirt. Oil and grease may ignite violently in the presence of oxygen under pressure. Fig.11.8 clearly shows the safety set-up during oxy-acetylene welding.

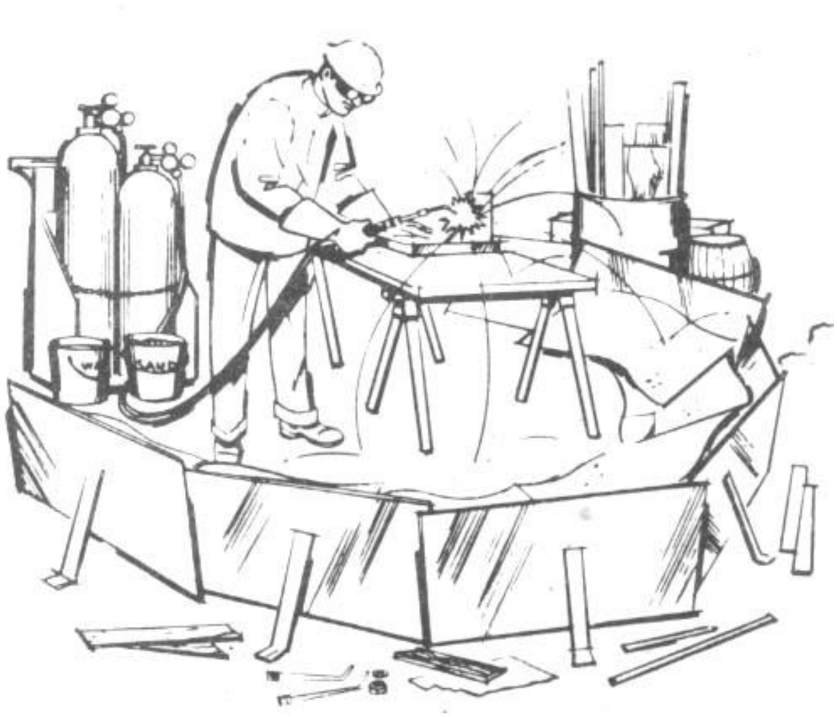


Fig. 11.8 Safety set-up in oxy-acetylene welding

XV. PROCEDURE

1. Place the cylinder in position and fasten them securely: they must be kept vertical.
2. " Crack open" (open slightly and then close) the cylinder valve to remove any foreign matter which might damage the regulator.
3. Check the seat of the cylinder valve and regulator for scoring and cleanliness.
4. Fit the regulator to their correct cylinder and tighten the nuts with the correct spanner. Remember that the acetylene regulator has a left hand thread.
5. Loosen the regulator adjusting knobs.
6. Open the cylinder valves slowly, the oxygen cylinder being opened first so that the key remain in the acetylene cylinder. The valves should be opened only half a turn as this is sufficient for normal work under no circumstances should they be opened more than 11/2 turns. Do not stand in front of the gauges when opening the cylinder valves.
7. Attach the red tubing to the acetylene regulator and the black or green tubing to the oxygen regulator. Acetylene connections are identified by a groove around the nut indicating that they have left hand threads.
8. Screw in the regulator adjusting knobs slightly and allow a small quantity of gas to blow through in order to remove any dust or other foreign matter from the regulator and tubing.
9. Attach the appropriate torch and tip.
10. Test for leaks by either:

- Closing the torch valves and adjusting pressures to 10 p.s.i., then closing the cylinder valves and noting any drop in pressure.

- Applying soapy water to the connection when bubbles will indicate leaks.

XV.2 Opening Up Oxy-Acetylene Equipment

1. Make certain that both regulator adjusting knobs are released this prevent damages to the regulator.
2. Check that the torch valves are closed.
3. Open both cylinder valves slowly for half a turn. The content pressure gauge hand should move up gradually to prevent damages to the gauge and to the regulator. The cylinder key must be left in the acetylene cylinder valve as a safety precaution.

4. Adjust the delivery pressures by turning the adjusting knobs clockwise until the correct pressures are indicated on the delivery

gauges. The pressures must be set according to the type of equipment being used with equal pressure blowpipes 5 to 10 p.s.i. is suitable for welding.

Fig. 11.9 shows the flame setting in oxy-acetylene welding.

XV.3 Lighting The Torch And Setting The Neutral Flame

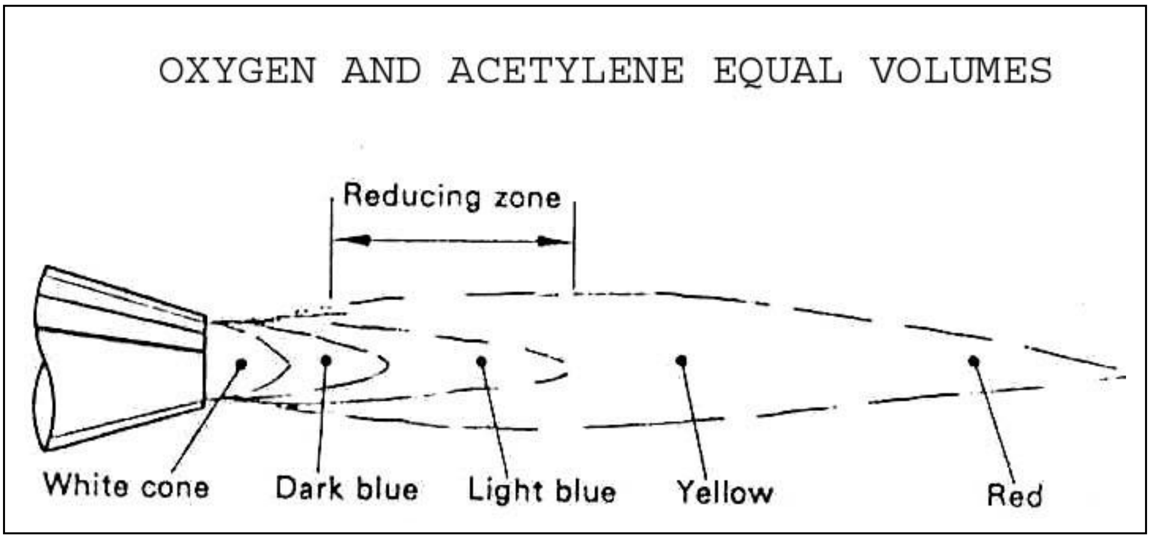


Fig. 11.9 Setting of flame volume

XV.3.1 Before attempting to light the blowpipe, clear the welding area of all inflammable materials. Take care that the blowpipe is not directed to any person. It is a safe practice to light the blowpipe with the tip pointing up.

1. Open the blowpipe acetylene valve slightly and light with a flint lighter if the flame burns away from the tip, close the valve slightly.
2. Adjust the acetylene valve until the flame almost ceases to produce soot. This is the method for determining the correct amount of acetylene.
3. Open the oxygen valve until the last trace of the feather disappears leaving a well defined cone. This is a neutral flame and it is the flame used for most welding operations.

XV.3.2 Closing Down

When welding is completed, the blowpipe can be closed down as follows:

1. In closing the blowpipe acetylene valve, the flame will then go out owing to lack of fuel, and oxygen will purge the tip to prevent it from soothing up.
2. Close the blowpipe oxygen valve.

3. Close the blowpipe acetylene valves.
4. Tidy up the welding area.

XVI. THE OXY-ACETYLENE FLAME

The "tool" of the welding process is the flame. The purpose of the various parts of the equipment is to enable the operator to produce a flame of the character best suited for the job at hand. The Oxy-acetylene flame has the highest temperature of any gas flame (3482°C) and also has chemical characteristics that can be varied over a wide range to suit a number of welding processes.

There are three distinct types of oxy-acetylene flame depending upon the ratio of oxygen and acetylene used as shown in Fig. 12.0.

XVI.1 Neutral Flame

A neutral flame is one in which the inner cone, or that portion of the flame being used, has no chemical effect on the metal during welding so that the inner cone will not touch the metal. The illustration for neutral flame is provided in Fig. 12.0.

It is recognized by:

1. A sharply defined cone, and
2. A pale (almost colorless) outer envelope

This flame is the most widely used flame and it also serves as a basis of reference when making flame adjustments.

XVI.2 Carburizing or Reducing Flame

A carburizing flame is one in which there is an excess of acetylene. There is sufficient oxygen for complete combustion of the excess acetylene.

It is recognized by:

1. An inner cone.
2. A whitish feather on the cone.
3. An outer envelope.

The feather contains white hot particles of carbon some of which, during welding, may dissolve in the molten metal. During the welding of iron and steel, the flame tends to remove oxygen from iron oxides present, giving the flame the alternative name," Reducing Flame". The illustration for reducing flame is provided in Fig. 12.0.

XVI.3 Oxidizing Flame

An oxidizing flame contains an excess of oxygen. It is recognized by:

1. A short somewhat distorted inner cone.
2. A pale purple short envelope.
3. Being usually noisy and harsh.

The excess oxygen in the flame has and oxidizing effect on the metal and causes steel to spark excessively. The illustration for oxidizing flame is provided in Fig. 12.0.

XVI.4 Flame Adjustment

When adjusting the flame as shown in Fig.12.1, the following points must be observed:

1. The tip must be the correct size for the job. Tips are designed to pass a certain volume of gas at the correct velocity. It is this volume that provides the amount of heat required to make a certain size weld.
2. The gas pressure must be correct for the particular blowpipe.
3. The correct amount of gases must pass through the tip. This also gives the desired fuel-oxygen ratio.

CAUTION: If the above points are not observed, "backfires" and "flashback" could result.

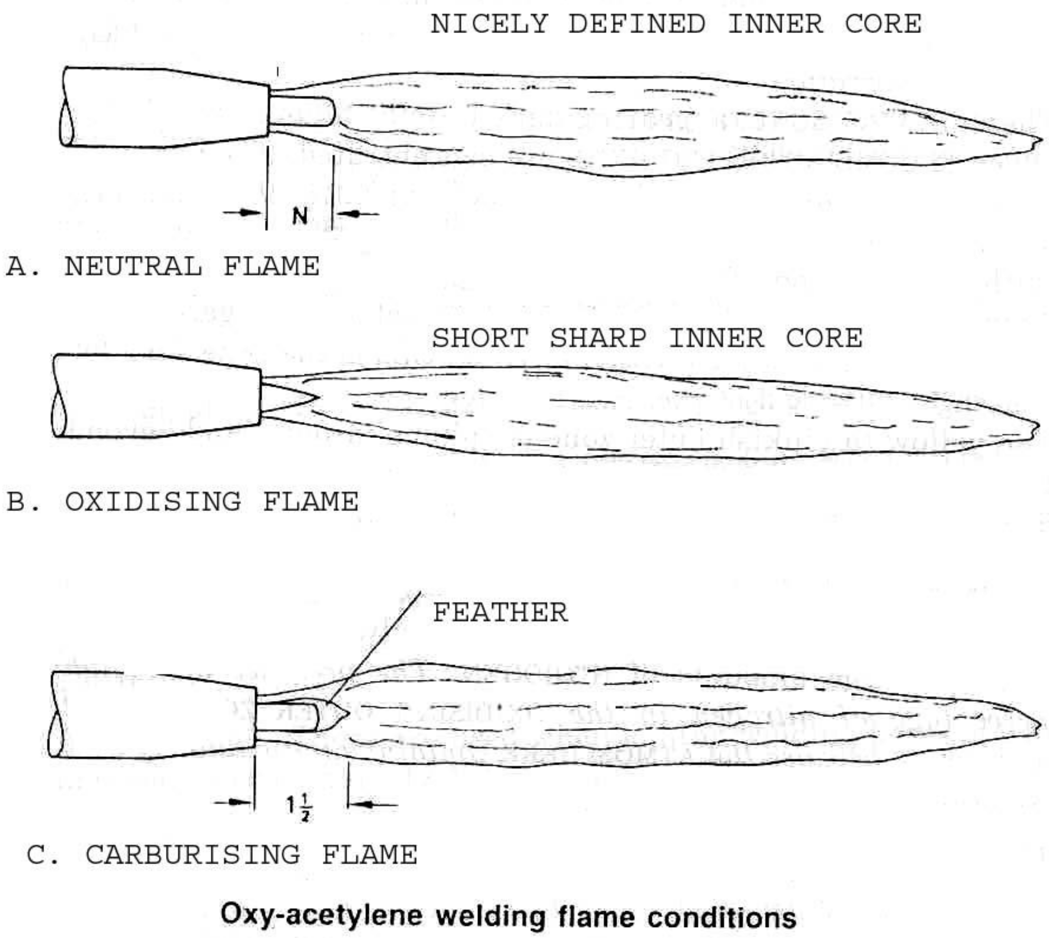


Fig. 12.0 Flame conditions in oxy-acetylene welding

XVI.5 Backfires

Backfire are caused by the flame burning back inside the tip and going out with a loud pop. This is caused by:

1. The tip touching the work.
2. A small obstruction in the tip orifice.
3. Gas velocity below the burning rate of the gas because of incorrect flame adjustment, a loose tip, or faulty equipment.

Backfire occurs while welding and the heat from the job usually re-light the flame.

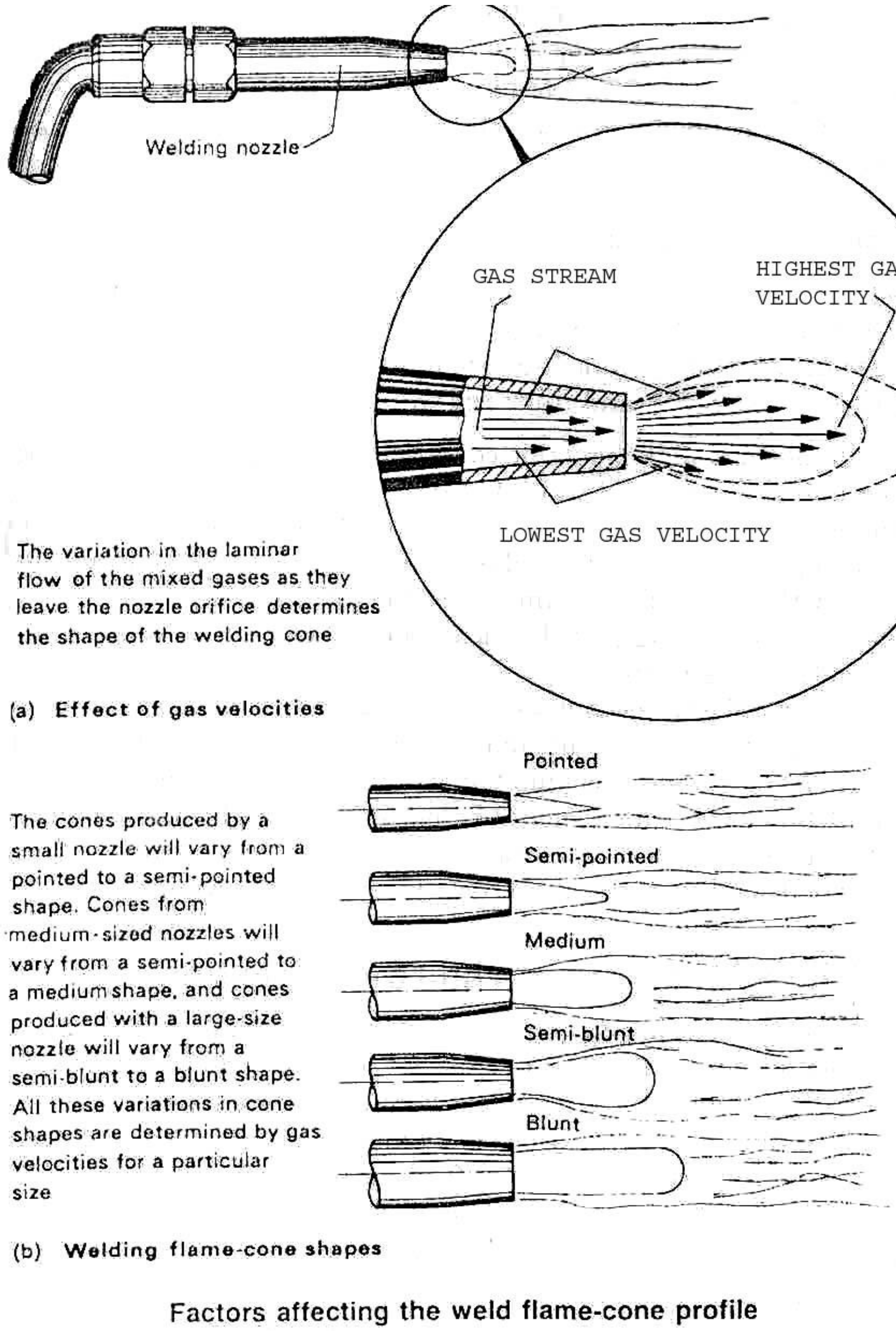


Fig.12.1 Effects of flame adjustment

XVI.6 Flashbacks

Flashbacks occur when the gases ignite in the tip or blow pipe. This condition is very dangerous as, in some cases; the flame could travel inside the gas lines to the cylinders. It is recognized by shrill whistling noise and heating of the blowpipe.

Flashbacks are caused by faulty equipment or excessive backfiring

NOTE: If a flashback occurs, immediately close the blowpipe oxygen valve and then the acetylene valve cools the blowpipe.

If there is further evidence that the flame has not been extinguished, immerse the blow pipe in water and close the cylinder valves.

XVII. OXY-ACETYLENE WELDING

XVII.1 Fusion Welding:

Fusion welding is that type of welding in which the edges of the two pieces of metal being joint are melted and completely fused without pressure, and in which the filler rod, is of a similar composition to the parent metal.

Most common metal and alloys can be welded by this means provided both parent metals are of the same type.

XVII.2 Techniques For Fusion Welding Mild Steel

XVII.2.1 Flame Setting

A neutral flame is always used when fusion welding mild metal.

XVII.2.2 Filler Rod

This should be of similar composition but slightly thinner than the parent metal.

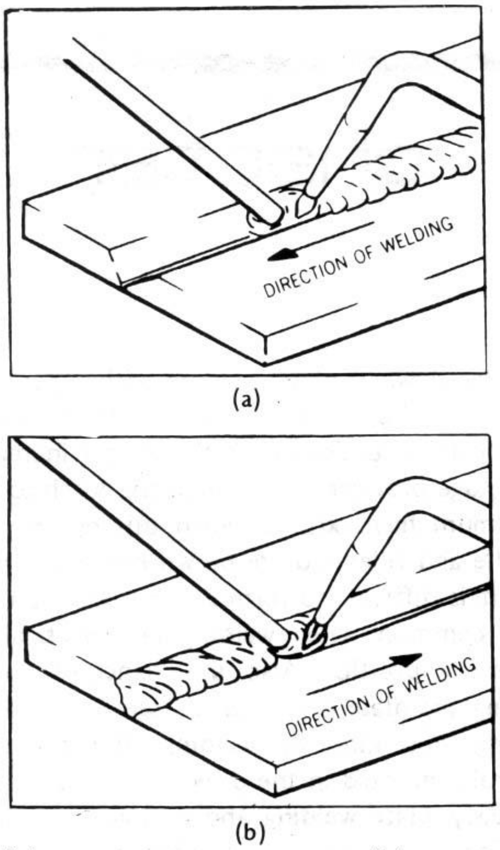
XVII.3 Forehand Welding

In this type of welding, the filler rod is moved ahead of the flame pointing to the direction of the welded seam (this tends to move the molten metal along the seam).

Forehand welding as shown in Fig.12.2 is used on steel for flanged edge welds, for not beveled plates up to 1/8" thick and for beveled plates up to 3/16" thick. It is also the method usually adopted for cast iron and non-ferrous metal.

PROCEDURE

1. The blowpipe is normally held at an angle of 300-400 to the surface of the working area.
2. The inner cone of the flame is held 1/16"-1/8" above the work.
3. For a right handed operator, the movement along the joint is from right to left. The edge preparation, spacing and tacking vary according to the thickness of the metal being welded.



(a) FOREHAND WELDING AND (b) BACKHAND WELDING

Fig.12.2 Comparison between forehand and backhand welding

XVII.4 Backhand Welding

In this type of welding, the flame precedes the filer rod and the blow pipe is held pointing towards the previously welded seam.

Backhand welding as shown in Fig. 12.3 is only recommended for steel plates exceeding 3/16" in thickness. Plate's edges from 3/16"to 5/16" thickness should be beveled at 30° to give an included angle of 60° for the V type welding.

PROCEDURE

1. The blowpipe and filler rod are both at angle from 49°-50° to the surface of the metal.
2. The inner cone of the flame is held 1/16"to 1/8" above the surface of the metal.
3. For a right- handed operator, the movement along the joint is from left to right.

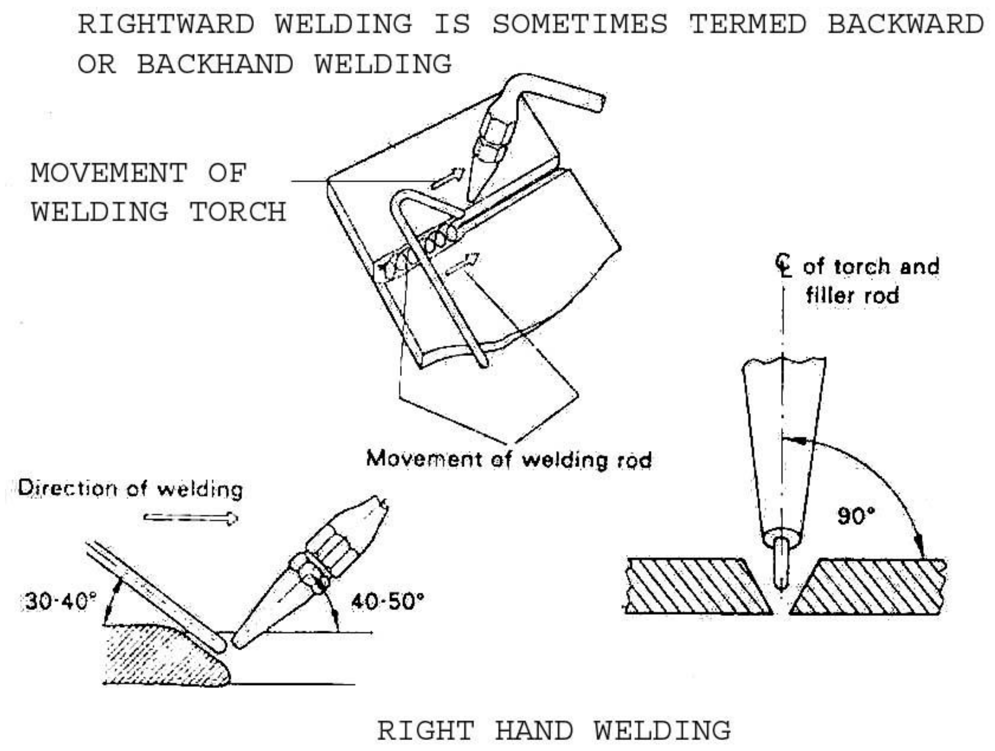
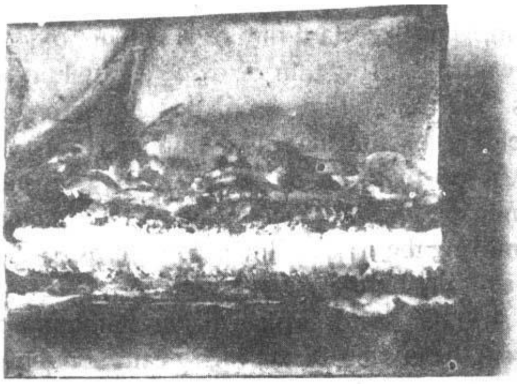


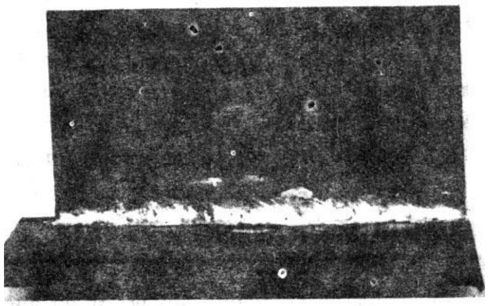
Fig. 12.3 Procedure for backhand welding

XVII.5 Braze Welding

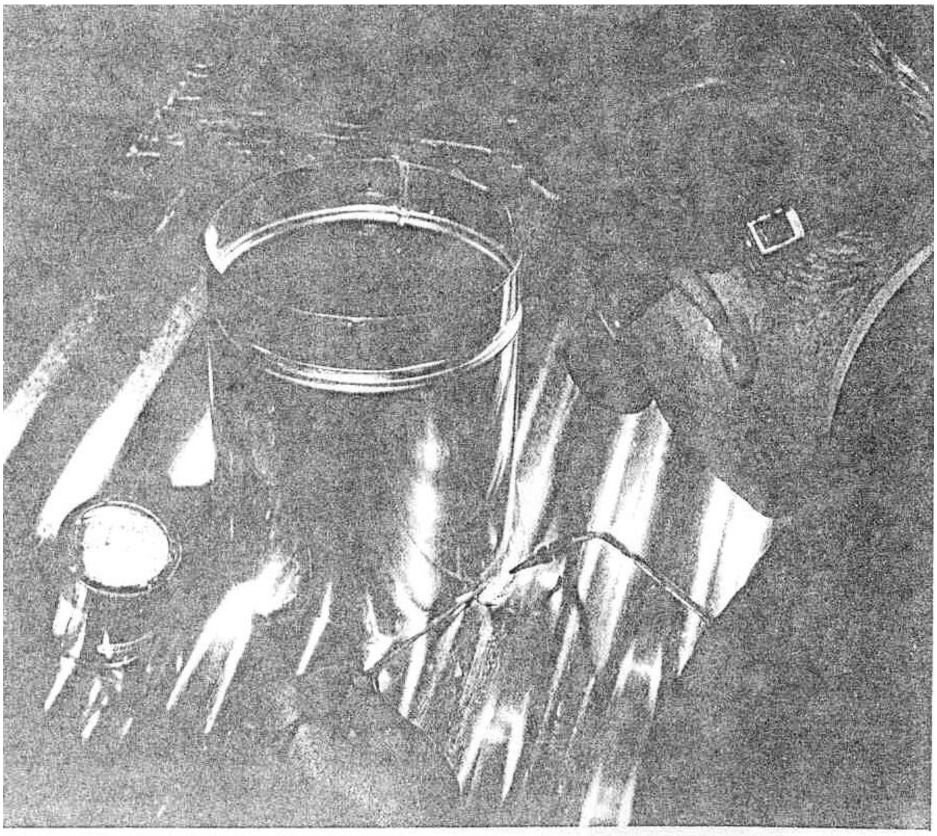
Braze welding is non-fusion process. The parent metal is not melted during the joining operation which allows braze welding to be used for dissimilar metals. This process is also suitable for joining zinc coated steel because the lower temperature required lessens the damage to the protective coating. Fig.12.4 shows the different application of braze welding while Fig. 12.5 shows the various type of braze welding torches.



A BRAZED TAP JOINT

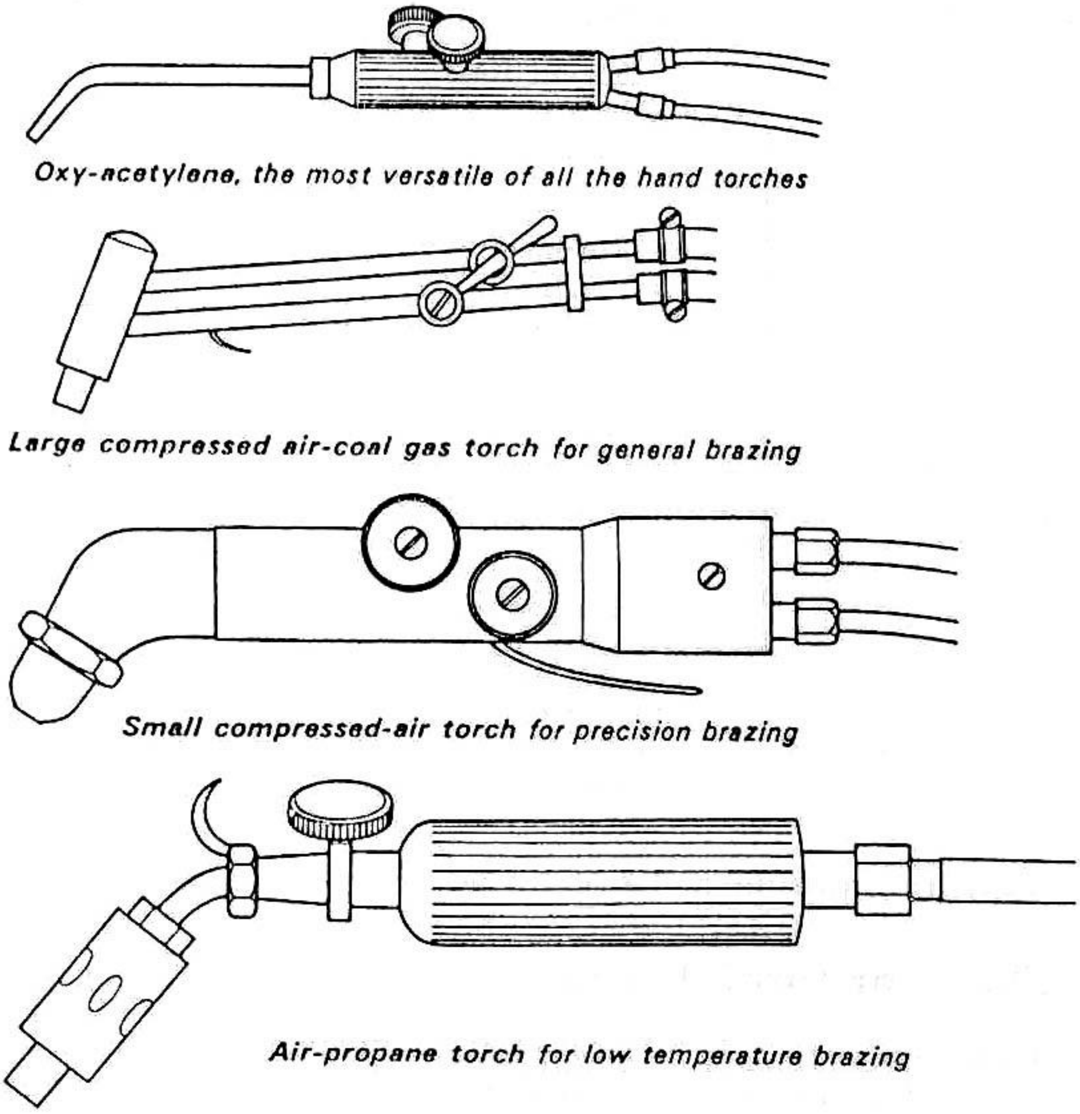


BRAZED INSIDE CORNER



BRAZING A VENTILATOR SLEEVE INSERTED INTO A LARGE CORRUGATED SHEET BOTH MADE OF ALUMINIUM

Fig. 12.4 Application of braze welding



Typical hand torches used for brazing

Fig. 12.5 Hand torches used for brazing

XVII.5.1 Flame Setting

A neutral flame is the most suitable type for general work. A reduced flame will result in a smooth weld but the joint is weak, whereas an oxidizing flame will give a strong weld but with a rougher surface as shown in Fig. 12.6.

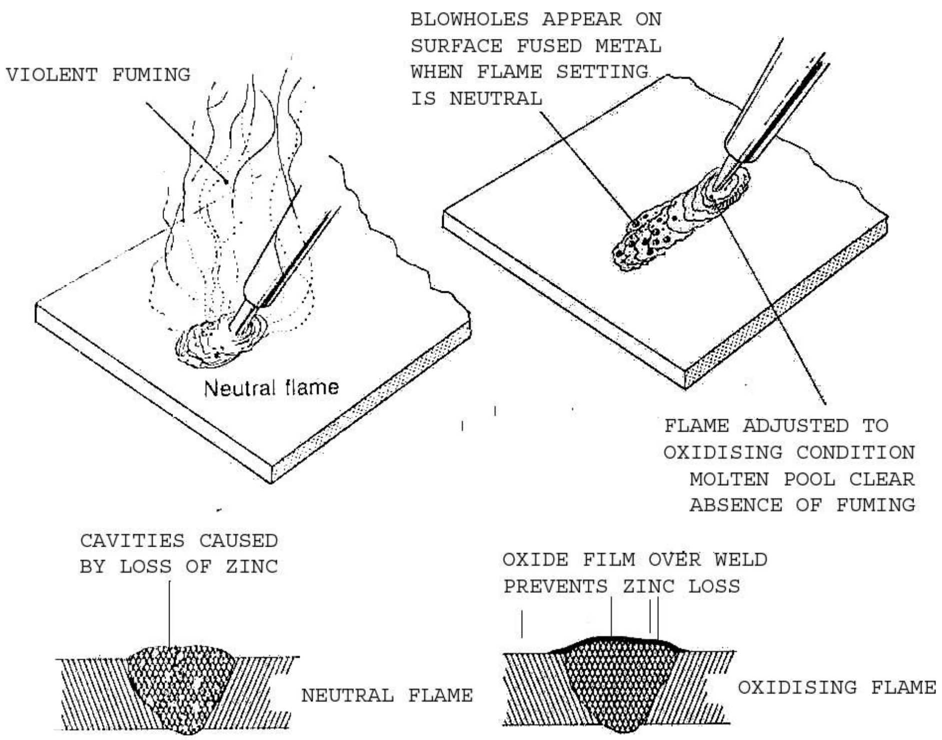


Fig. 12.6 Comparison of work based on flame setting

XVII.5.2 Heating

1. Overheating will result in the zinc content of the filler metal fuming. This gives a burnt porous weld which will look “coppery" and is easily identified by white zinc oxide deposits.
2. Under heating gives a poor bond and weak joint with a lumpy surface and rounded edges.
3. At the correct temperature, the bronze will flow out to a smooth feather edge.

XVII.5.3 Strength

The strength of a braze weld depends on correct tinning that provide a good bond on the strength of the weld metal.

XV.5.4 Filler Rods

The filler rod is a copper-zinc alloy with the addition of small quantities of other metals. These brass rods are commercially called bronze filler rod. The main types of filler rods are Manganese Bronze, used for ferrous metals and Tobin Bronze, used for copper and brass.

XV.5.5 Fluxes

Adequate use of the correct flux is necessary to chemically clean the base metal and dissolve oxides which are formed during welding. Mechanical cleaning is also desirable before applying the flux.

PROCEDURE

1. The forehand method of welding is used with a blowpipe and filler angle of approximately 40°.

2. The joint is heated until bronze will flow out evenly, coating the welding area with a thin layer this is know as" tinning".

3. Additional bronze is added and fused with this surface to build up the weld metal.

4. Where possible weld "uphill" so that molten filler metal does not flow over the un- tinned surface.

XVIII. HANDS-ON FOR ARC WELDING/ GAS WELDING

Level I

- Butt welding
- Contact welding
- Flat single bead welding
- Flat weaving bead
- Flat butt welding

Level 2

- Horizontal fillet welding (single)
- Horizontal fillet (weaving bead)
- Horizontal fillet (multi -layer bead)

Level 3

- Vertical fillet weld (single)
- Vertical weave bead. (3 layers)
- Overhead fillet (single pass)
- Pipe welding (Galvanized pipe)

Level 4

- Cutting of steel plates (Oxy-Acetylene)
- Gas welding (mild steel plate)
- Brazing (copper rod brass rod to galvanized iron plate)