



WELDING BASICS SERIES

MAKE SOMETHING BETTER



GAS WELDING & CUTTING BASICS



Gas Welding & Cutting Basics

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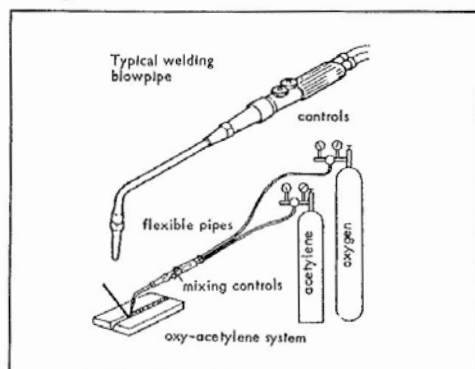
Please note:

The equipment shown in the following pages are not current models.

Gas Welding & Cutting Basics

Oxy-acetylene welding (GW1)

Safety



Oxygen and acetylene gases when mixed in suitable proportions burn at approximately 3300°C. The gases are usually contained in high pressure storage cylinders and are fed to a welding torch through regulators and hoses. The resultant process is known as oxy-acetylene welding and is used in the welding of a variety of metals.

Gas cylinders

These are recognised by a colour code.

- Oxygen: black
- Acetylene: maroon

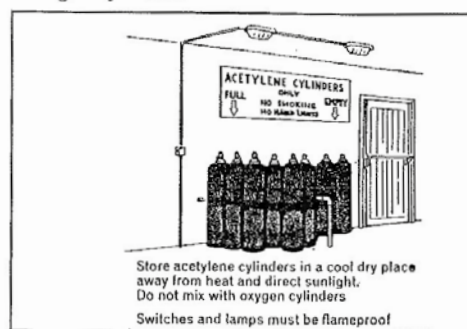
Store oxygen and fuel gas cylinders apart. Handle cylinders carefully. Take care that they are not dropped or allowed to fall from a height.



Cylinders should be used in an upright position and fastened to prevent them falling or being knocked over.

Do not allow any flame near cylinder walls.
Do not allow any electric arc welding to be undertaken in the immediate vicinity.

Fuel gas cylinders



Close cylinder valve when not in use.

If gas leaks when valve is closed:

- Move the cylinder into the open, and away from electric motors, sources of sparks, heat or naked lights.
- Ensure that suppliers are advised immediately.

! SAFETY – Acetylene and other fuel gases are highly flammable and form explosive mixtures with air and oxygen. Fuel gas leaks are a source of fire risk and explosion.

Oxygen cylinders

Do not inhale oxygen from the cylinder.

Do not use it as a method of ventilation.

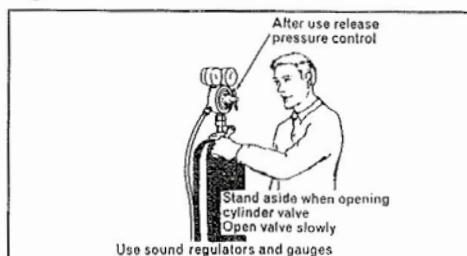
Do not allow it to leak.

Do not use oxygen as a substitute for compressed air.

In an oxygen-enriched atmosphere, clothing and any combustible material can be ignited easily by a spark and will burn fiercely.

! SAFETY – Never allow oil or grease to come into contact with valves or cylinder fittings. Oxygen reacts explosively with oil or grease.

Regulators



Do not use regulators with broken gauges.

Do not stand in front of gauge faces when opening cylinder valve.

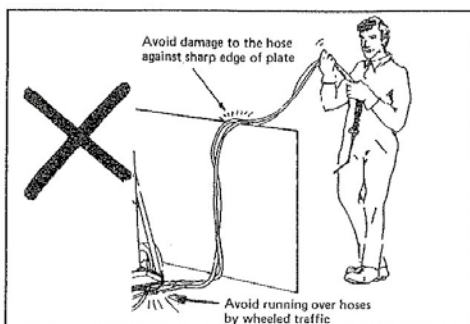
Select the correct regulator for the gas being used.

Do not use:

- Low pressure regulator on dissolved acetylene cylinders.
- Dissolved acetylene regulator on hydrogen cylinders.
- Compressed air regulator on oxygen cylinders.

Gas Welding & Cutting Basics

Hoses



Use only pressure type rubber canvas hose in good condition and fitted with the correct type of connections.

Do not allow hoses to 'kink' or tangle and thus obstruct the gas flow.

Keep hoses clear of abrasive surfaces, sharp edges, and hot metal.

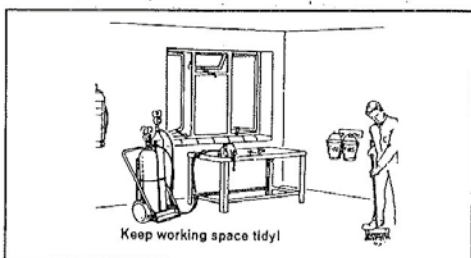
Do not allow traffic to pass over them.

Do not pass oxygen through hose previously used with compressed air.

Use the correct fittings to join lengths of hose or when repairing damaged hose.

Never use copper pipe on acetylene hose connections.

Working area



Welding and cutting should be performed in areas free from fire risk.

Wooden floors should be covered with non-combustible material and kept clean and free from litter within 10 m of welding and cutting operations.

Lighting blowpipes

Spark lighters are recommended. Do not use methods involving fire risk.

Ventilation

Ensure that there is thorough natural ventilation during welding and cutting operations. Do not allow fuel gases to leak into the atmosphere.

! SAFETY – Ensure that suitable fire extinguishing equipment, including buckets of dry sand, is readily available and maintained in good condition.

Oxy-acetylene welding (GW1)

Flashbacks

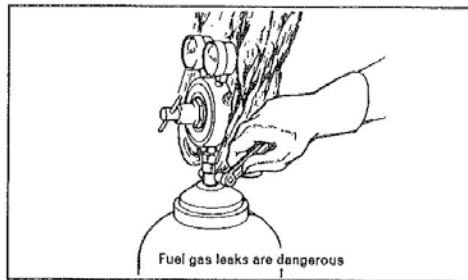
If 'backfire' is arrested at the blowpipe mixer or injector no damage will occur, provided the blowpipe valves are closed promptly.

Outward signs of severe flashback include:

A squealing or hissing noise; heavy black smoke; sparks coming out of nozzle; blowpipe handle overheating.

In such cases:

- Turn off cylinder valves.
- Detach regulators and equipment from cylinders.
- Check hoses and blowpipe for damage before re-use.



When gas from the cylinder catches fire at the valve or regulator because of leakage at the connection:

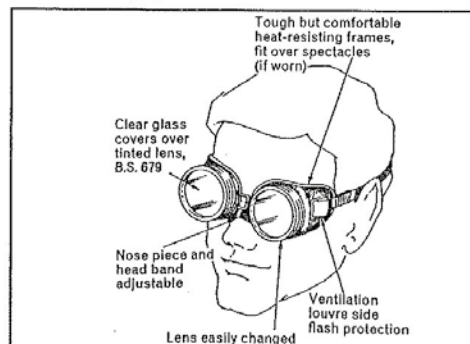
- Close the cylinder valve, wearing asbestos gauntlet gloves.
- Make the leaky joint gas tight before further use.

If cylinder becomes overheated or if fire prevents immediate closing of valve:

- Extinguish flame by using a carbon dioxide fire extinguisher or by smothering with an asbestos blanket.
- Remove the cylinder to open space; forbid smoking or naked lights in the vicinity.
- Cool cylinder by spraying it with water.
- Advise the suppliers immediately.

! SAFETY – Keep fuel gas cylinder valve key to hand so that gas supply can be turned off immediately.
Asbestos gauntlet gloves should be available at all times.

Protective equipment



The eyes must be protected from heat and glare, and from particles of hot metal or scale.

Gas Welding & Cutting Basics

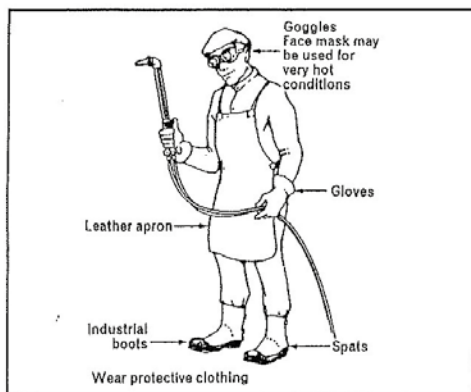
Goggles should be fitted with an approved lens.

Use:

- Shade 4 G W for light work.
- Shade 6 G W for heavier work.

Lens supplied for gas welding and cutting operations must not be used for arc welding and cutting.

Protective clothing

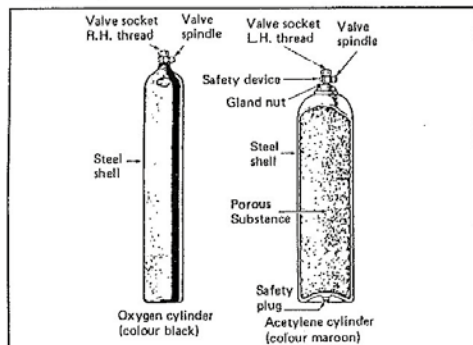


With normal dress the outer clothing should be free from oil, grease or flammable substances. Cuffs on overalls and turn-ups on trousers are possible lodging places for sparks or globules of hot metal.

The protective clothing worn depends upon the nature of the work. Safety boots and asbestos spats should be worn when doing cutting work. Leather gloves should be worn for all cutting operations involving the handling of hot metal. Gauntlet gloves and leather apron should be worn when working on vertical and overhead material.

Welding equipment

Oxygen cylinders



The steel cylinders are painted black; usual sizes are 3.39 m³ (120ft³), 6.78 m³ (240ft³) and 8.49 m³ (300ft³). The valve outlet has a right hand screw thread. Mild steel cylinders are charged to a pressure of 136.5 bars (1980 lb/in²); alloy steel cylinders to 172.5 bars (2500 lb/in²).

* Now often 200 bar (3000psi)

Oxy-acetylene welding (GW1)

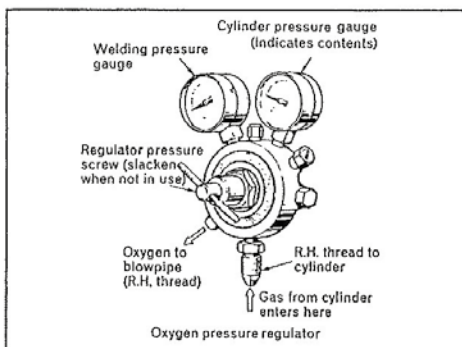
Acetylene cylinders

The steel cylinders are painted maroon. They contain porous substances with acetone to act as solvent for the gas hence 'dissolved acetylene'. The usual sizes are 3.39 m³ (120ft³) and 5.66 m³ (200ft³). The valve outlet has a left hand screw thread. Cylinders are charged to a pressure of 15.5 bars (225 lb/in²).

Manifolds

Two or more cylinders may be manifolded together.

Regulators

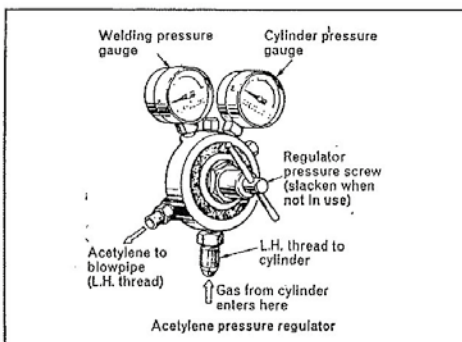


Pressure regulators are required to reduce cylinder gas pressure to required working pressure. Regulators for oxygen cylinders have right hand screw thread. Regulators for acetylene cylinders have left hand screw thread.

Pressure gauges

For oxygen these should read up to 30 lb/in² (2.08 bars) for outlet pressure. For acetylene these should read up to 15 lb/in² (1.04 bars) for outlet pressures.

Contents indicators



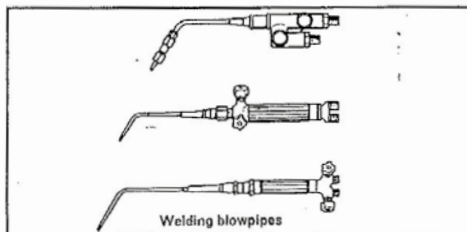
Pressure gauges can be used to indicate the amount of oxygen in the cylinder. Gauges used for this purpose should have a dial reading of not less than 4000 lb/in² (275 bars).

A 'pop-up' device pre-set to indicate the cylinder contents may be used on oxygen cylinders.

Gas Welding & Cutting Basics

Pressure gauges having a dial reading of not less than 600 lb/in² (41 bars) can be used to indicate pressure in an acetylene cylinder. Pressure gauges cannot be used to indicate the contents of dissolved acetylene cylinders. The weight of the cylinder compared to its pre-charge weight is the only guide to content.

Nozzles



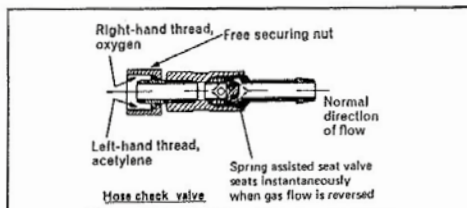
Nozzles for welding blowpipes may be gooseneck extensions fitting into the mixer portion of the blowpipe, or tips to screw on to the head of the blowpipe.

Size numbers for high pressure nozzles usually indicate the approximate consumption of each gas in ft³/hr (non-metric), when using a neutral flame.

Hoses

Hoses for oxygen are black or blue. Right hand threaded connections. All further references to black hoses should be taken to mean black or blue.

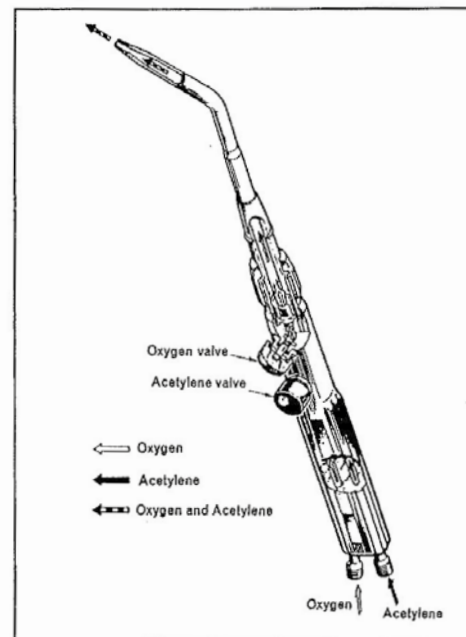
Hose protecting devices



These should be fitted at the blowpipe end of the hoses. They eliminate conditions of flashback and backfire by preventing gas in a line feeding into the other line, which is at lower pressure.

Oxy-acetylene welding (GWI)

Blowpipes

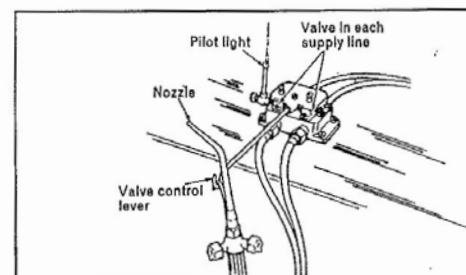


High pressure blowpipes for use with dissolved acetylene are of the mixer pattern.

Both gases must be supplied to the blowpipe at pressures appropriate for the blowpipe nozzle in use.

The mixer design ensures that the oxygen and acetylene are thoroughly mixed before they arrive at the nozzle.

Gas economizer



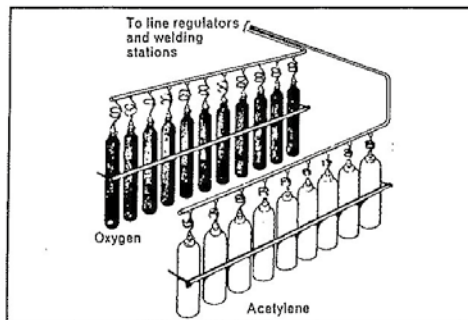
The economizer will extinguish the blowpipe flame simply by the action of hanging the blowpipe on the lever of the valve controlling the gas supply.

The flame can be re-established ready for welding by lifting the blowpipe and re-lighting at the pilot light.

Gas Welding & Cutting Basics

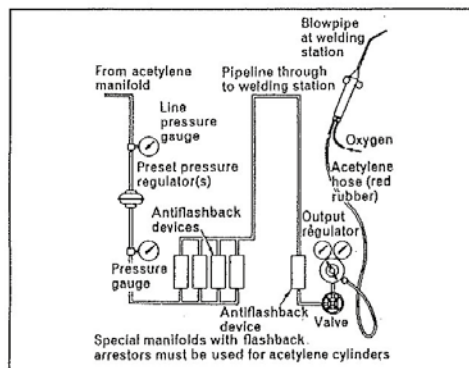
Assembly of equipment

Connections to cylinders



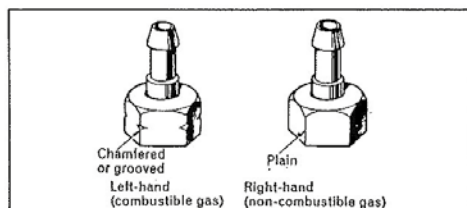
Gas supply may be from separate cylinders secured to a rack, workbench or mobile trolley, or piped to the welding station from an evaporator or cylinders linked by manifolds.

Note: Copper pipe is never used for acetylene.



At the welding station (or at the cylinders) the high pressure gases are passed through regulators to reduce to correct working pressure. Usually these regulators are screwed into the cylinder outlet valves.

Regulators may be fitted with gauges on the high pressure side to indicate cylinder gas pressure, and on the low pressure side to indicate the gas flow pressure.



Note: All threaded connections conform to the following rule:

- Right hand screw thread for oxygen and other non-combustible gases. (Black hose).
- Left hand screw thread for acetylene and other combustible gases. (Red hose).

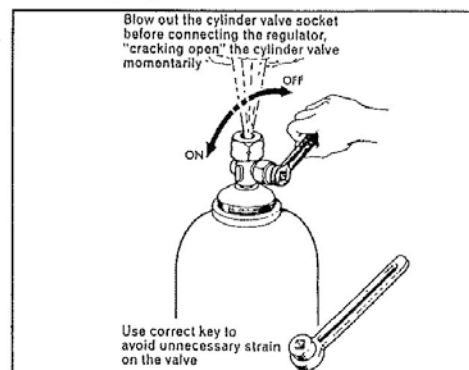
Oxy-acetylene welding (GW1)

The nuts on oxygen and other non-combustible gas connectors are plain hexagons.

The nuts on acetylene and other combustible gas connectors are chamfered and/or grooved to indicate left hand threading.

! SAFETY – Do not use any oil, grease or oil-based substance to aid the assembly of equipment. It may cause an explosion.

Connecting regulators

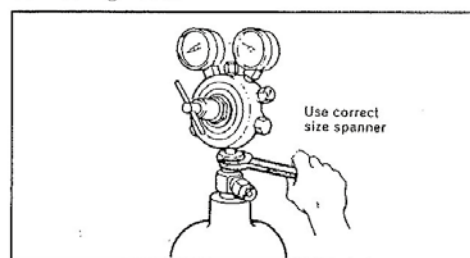


Before screwing the regulator into the outlet valve socket make sure that the socket is clean, dry, and free from dust.

Screw regulator into valve socket until gently home, then a sharp blow with the hand on the spanner shaft will ensure a gas-tight seating.

Slacken regulator pressure control screw to relieve pressure on the regulator diaphragm.

Connecting hoses

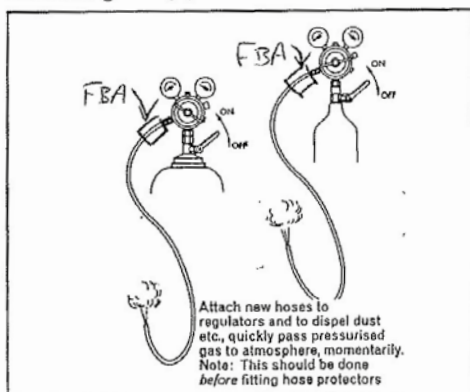


Attach hoses to the regulators making sure that an anti-flashback device is fitted at the blowpipe end of the hose. Tighten all nuts, using only the correct size spanners. *

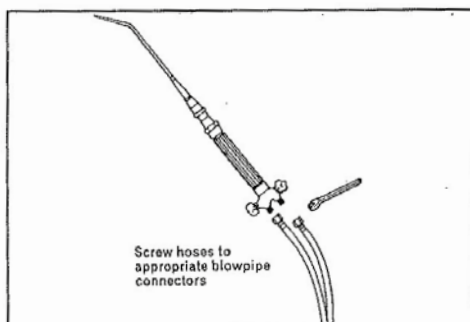
* It is now a legal requirement that Flashback-Arrestors (F.B.A.) are fitted between the Regulators and the Hoses.

Gas Welding & Cutting Basics

Connecting blowpipes

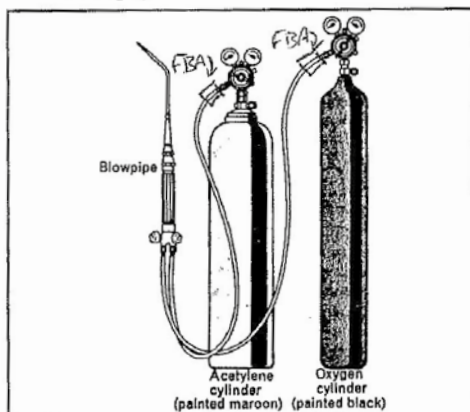


Using correct size spanner, screw hose connectors on to the blowpipe after fitting hose protectors. Fit welding nozzle to blowpipe; do not strain by over tightening.



Nozzle size and gas pressures appropriate to the size are quoted by equipment manufacturers to suit thickness and type of material being welded.

Pressurizing system



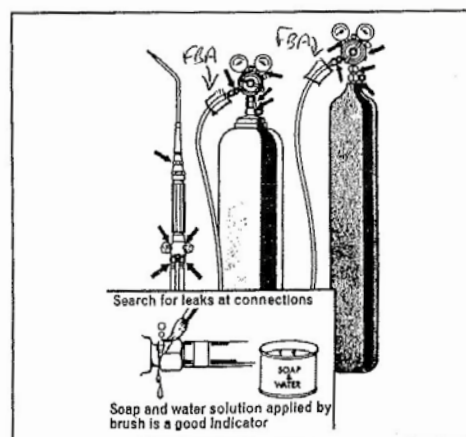
Close the blowpipe valves.
Turn on the gases.

Oxy-acetylene welding (GW1)

Dealing with one gas at a time:

- Open the blowpipe valve.
- Set the working pressure by adjusting the regulator control.
- Allow gas to flow so that the hose is purged of any other gas.
- Close the blowpipe valve.

The system is then pressurized and purged.



At this stage carefully check the system for leaks using soap solution or 5% Teepol in water solution. Apply at all connections using a small soft hairbrush or fitch.

Escaping gases can be detected by sound and feel (or smell in the case of acetylene).

! SAFETY – Do not investigate for gas leaks with a naked flame

When a leak is found rectify immediately. Even small amounts of acetylene escaping into a confined space can cause a serious explosion.

Closing down procedure

At the end of the work period, or when there is a long interruption, close down the system:

- Turn off the blowpipe control valves, the acetylene valve first and then the oxygen valve.
- Close the cylinder valves.
- Release the pressure in the hoses by first opening the oxygen valve on the blowpipe and closing it.
- Release the pressure on the regulator diaphragms by turning the pressure regulating screw to the minimum pressure position.

Gas Welding & Cutting Basics

Filler rods

Handling and storage



- Handle filler rods with care.
- Store under clean dry conditions to prevent deterioration.
- Do not mix different types of filler rod. Ensure that packages and their labels make for easy and correct selection.
- Where it is not practicable to store filler rods under heated conditions, an absorbent (such as silica-gel) for moisture may be used in the storage area.

! SAFETY –

- Always place a hot filler rod where it cannot be accidentally touched or handled.
- Always position the filler rod to avoid personal injury while welding – bend filler rod end to prevent injury to the eyes and to facilitate identification of the hot end.
- Take care to avoid fire hazards by keeping hot filler rods away from combustible materials.

Selection of correct filler rod

- Filler rods are either drawn or cast.
- Ensure that the composition of a filler rod is suitable for the parent metal to be welded.
- The filler rod diameters to be used depend upon the thickness to be welded and the welding position. The table below gives details of the filler rod used for welding low carbon steel.
- Select a filler rod of suitable composition and of correct diameter.

Typical filler rod and application for low carbon steel

| Filler rod | Diameter of filler rod | | Flux | Applications | Filler rod British Standard no | Notes |
|------------------|--|-----------------------------------|------|--|--------------------------------|------------------------------------|
| | inches | mm | | | | |
| Low carbon steel | $\frac{3}{64}$, $\frac{1}{16}$, $\frac{5}{64}$, $\frac{3}{32}$, $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$ | 1.0, 1.5, 2.0, 2.3, 3.2, 4.5, 6.4 | None | Welding of low carbon steel and wrought iron | BS 1453:A1 | Often copper coated for protection |

Oxy-acetylene welding (GW1)

Economy in use

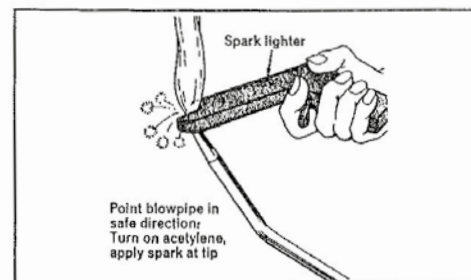
To ensure economy in the use of filler rods, join the short ends to a new length of filler rod.

Preparing the filler rod for use

- Ensure that the rod is free from contamination such as rust, scale, oil, grease and moisture.
- Ensure that the rod is reasonably straight to assist manipulation during welding.

The welding flame

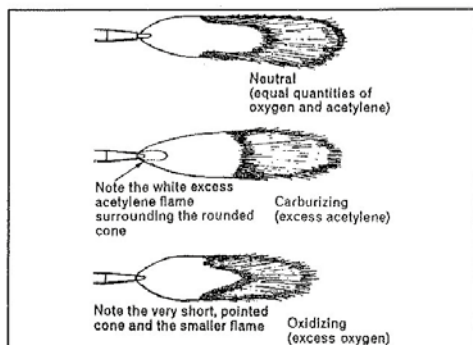
The essential requirement of oxy-acetylene welding is a hot, controlled flame easily manipulated, to heat or melt metal without altering the chemical composition of the metal.



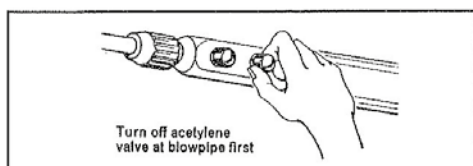
To light and adjust the blowpipe flame:

- Close all valves on the blowpipe.
- Open cylinder valves very slowly by one turn only of the spindle.
- Set the regulators to the correct working pressures.
- Open the acetylene control valve on the blowpipe about three-quarters of a turn.
- Wait a few seconds while the acetylene flushes the system (ensure that the blowpipe is pointed in a safe direction). This purges the blowpipe from the mixer forward and prevents backfires on lighting up.
- Using a spark lighter, light the acetylene.
- Reduce or increase the gas supply, by operating the blowpipe valve, until flame just ceases to smoke.

Gas Welding & Cutting Basics



- Open the oxygen control valve on the blowpipe until the white inner cone in the flame is sharply defined with the merest trace of 'feather' or acetylene haze at the tip. This is the neutral flame used for the welding of low carbon steel.



- To extinguish the flame, close the acetylene valve and then the oxygen valve on the blowpipe. Alternatively, hang lit blowpipe on gas economizer valve control lever.

Operating the equipment

! SAFETY – Do not remove the cylinder key from the acetylene cylinder, it may be needed urgently for fire prevention purposes. Keep asbestos gloves readily available.

Always:

- Comply with the prescribed safety precautions and fire prevention procedure.
- Check that hoses are not 'kinked' or otherwise obstructed.
- Check that correct size nozzle is fitted to blowpipe.
- Check that cylinder valves are open.
- Check that regulators are set to correct working pressures.
- Use effective protective equipment and any necessary protective clothing.
- If gas economizer is used, check that pilot light is lit.
- Point the blowpipe in a safe direction when lighting.
- Handle the lit blowpipe with due caution and take care that the flame does not impinge on gas cylinder walls.
- Concentrate on watching the welding operation.
- Hold the blowpipe with just sufficient grip at the point of balance to give full control.
- Extinguish blowpipe flame when not in use or when moving location, and follow closing down procedure when necessary.

Oxy-acetylene welding (GW1)

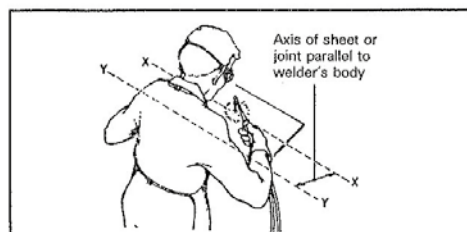
Leftward welding



In leftward welding the flame is directed towards the unwelded part, and the filler rod, when used, is directed towards the welded part of the joint. With the blowpipe held in the right hand, welding proceeds from right to left; with the blowpipe held in the left hand, welding proceeds from left to right. In vertical welding the movement is upwards.

Fusion without filler metal

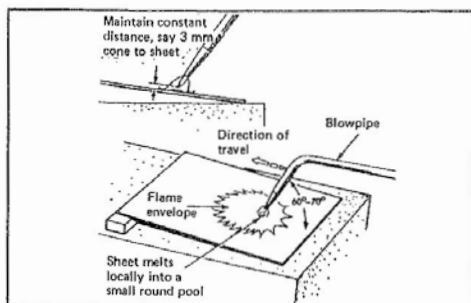
| | |
|--------------------|--|
| Material | One piece of low carbon steel 1.5 mm thick. Minimum size 100 mm x 200 mm |
| Preparation | Clean surface |
| Assembly | Right hand short edge of sheet resting on bench, left raised about 15 mm |
| Nozzle size | No 2 |
| Regulators | Each 2lb/in ² (0.15 bars) |



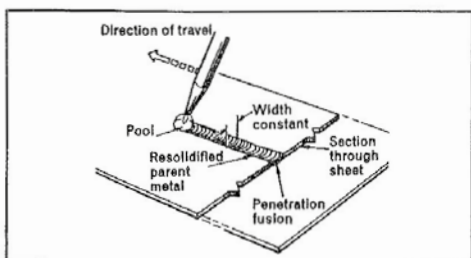
Set flame to neutral, and with goggles in position, lower the blowpipe until the end of the inner cone is about 3 mm above sheet surface near right hand edge.

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Oxy-acetylene welding (GW1)



Adjust angle of nozzle to 60° to 70° to sheet, positioning in direction of travel.



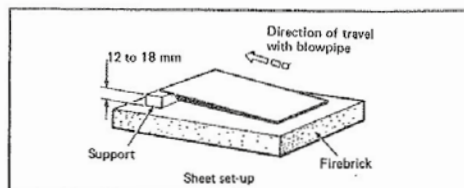
As soon as local fusion (to form a small round pool of molten metal) is achieved, move the blowpipe in leftwards direction.

Synchronize rate of travel with the progressive formation of the molten pool and avoid excess concentration of heat.

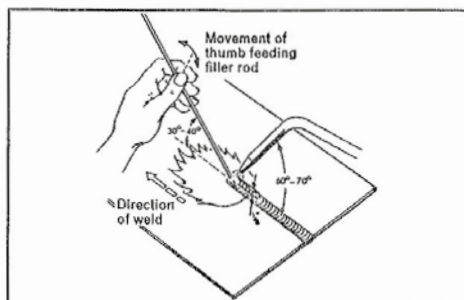
If speed of travel is correct the fused and solidified metal will be uniform in width.

Depositing straight runs

| | |
|--------------------|--|
| Material | One piece of low carbon steel 1.5 mm thick. Minimum size 100 mm x 200 mm |
| Preparation | Clean surface |
| Assembly | Support in slightly inclined position |
| Nozzle size | No 2 |
| Regulators | Each 2lb/in ² (0.15 bars) |
| Filler rod | 1.6 mm BS 1453:A1 |

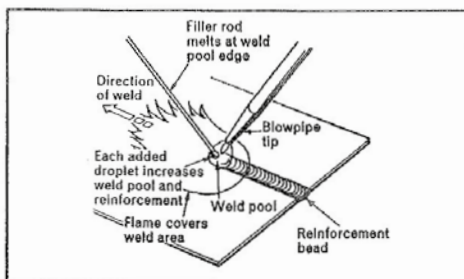


With the blowpipe nozzle held at an angle of 60° to 70° , establish a small pool of molten metal at right hand edge of sheet.



Hold filler rod in left hand, pointing at the front edge of molten pool and at an angle of 30° to 40° to sheet surface.

Allow the flame to melt a droplet of metal from the end of the filler rod.



Start the progressive leftwards movement of blowpipe and filler rod.

Keep the end of the filler rod within the flame envelope but not in the hot portion near the cone.

Continue addition of molten filler metal by moving the end of the filler rod repeatedly to the front edge of the molten pool and the hotter portion of the flame.

Rate of travel leftwards should be co-ordinated with melting of filler rod to control size of bead and extent of penetration.

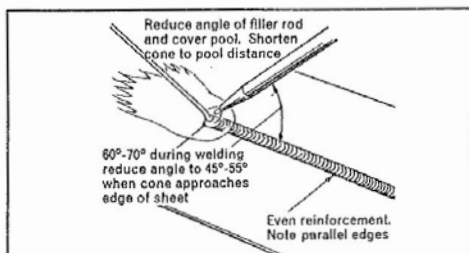
When near the left hand edge of the sheet slowly withdraw the flame.

Stopping and re-starting

An incorrectly finished weld or an uneven join-up in a weld run may be a source of weakness. Care must be taken to build up craters at the ends of runs and to make smooth join-ups.

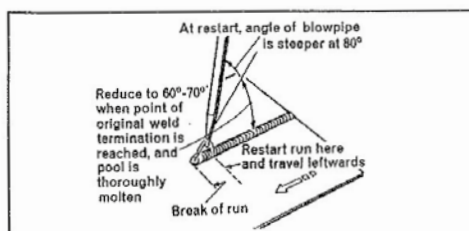
The following techniques should be used in all future oxy-acetylene welding procedures unless otherwise stipulated.

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Build up crater as follows:

- As the weld pool nears the left hand edge slightly reduce the angle of the blowpipe nozzle to reduce heat concentration.
- At the same time slightly reduce the angle of the filler rod.
- At the edge of the sheet, add a little filler metal and advance the tip of the white cone nearer to the weld pool.
- Remove the flame, gradually covering the weld pool with the end of the filler rod to protect the solidifying weld metal.
- Remove filler rod end from weld zone before solidification occurs.

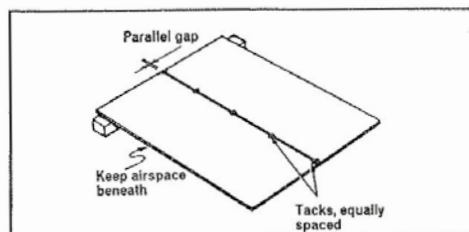


When re-starting interrupt the deposition after 50 mm run length, removing flame slowly.

To re-start, apply the blowpipe nozzle at 80° angle with the cone pointing on the last 3 mm of weld bead deposited.

When the end of the weld bead has re-melted add filler metal to the molten pool and proceed with the deposition.

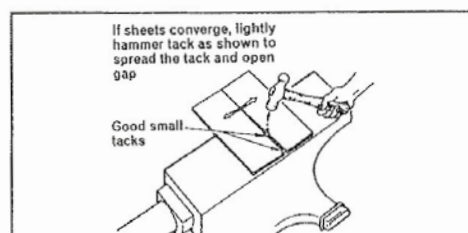
Tack welds



Tack welding is important particularly for the maintenance of gap and alignment of parts. Tack welds on sheet metal should be short in length but must be sound and sufficient in number to prevent movement of the parts being welded. The distance between tacks should be about 40 mm for sheet metal

Oxy-acetylene welding (GW1)

up to 1.5 mm and about 50 mm for sheet metal between 1.5 mm and 5 mm thickness. These distances may be doubled for fillet welded T joints.

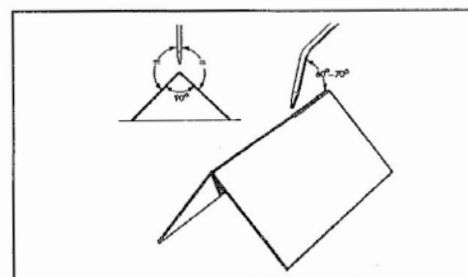


Tack welding procedure is as follows:

- Tack welds should be on the side to be welded and in the line of the joint.
- Heat a small triangular area with the blowpipe to melt the parent metal where the tack weld is required.
- Add filler metal to the molten pool to make a small but sound weld and then remove the flame.
- Repeat until all tack welds are made, making sure that the gap is kept uniform and of the correct size (where a gap is required).

Closed outside corner joint without filler (flat position)

| | |
|--------------------|--|
| Material | Two pieces of low carbon steel 1.25 mm thick. Minimum sizes 100 mm x 150 mm |
| Preparation | Square edge |
| Assembly | Tack weld with five tacks to give included angle of 90° without gap and no filler metal (see note) |
| Nozzle size | No 2 |
| Regulators | Each 2lb/in ² (0.15 bars) |



Heat the sheet corners at the right hand end of the joint until the tack weld fuses. Immediately progress leftwards along the joint.

Gas Welding & Cutting Basics

The nozzle of the blowpipe should be at an angle of 60° to 70° and directed to secure fusion of both edges of the sheets.

Keep the tip of the white cone about 3 mm above the weld pool.

Adjust the rate of leftwards travel to secure fusion without burning through the sheets.

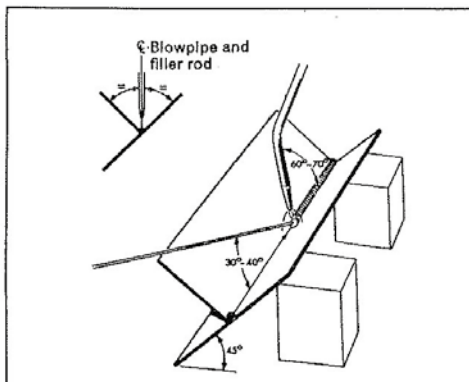
Note: A piece of filler rod may be used to control fusion where necessary.

If the speed of travel has been correct, complete fusion of the fusion faces will be achieved. The underside of the joint will show a descaling line on each sheet near the root of the joint or a slight penetration bead.

If 'holding' of the sheet (burn through) has occurred this will be the result of excess concentration of heat locally and indicates that the speed of leftwards travel has been too slow.

T joint (flat position)

| | |
|--------------------|--|
| Material | Two pieces of low carbon steel 1.5 mm thick. Minimum sizes 100 mm x 150 mm |
| Preparation | Square edge |
| Assembly | Tack weld with three tacks so that the sheets form an inverted T without gap between the sheets. Support the lower sheet so that it is tilted at 45° transversely |
| Nozzle size | No 3 |
| Regulators | Each 2lb/in ² (0.15 bars) |
| Filler | 1.5 mm BS 1453:A1 |



Commence the weld at the right hand end of the joint.

Oxy-acetylene welding (GWI)

The blowpipe nozzle angle should be 60° to 70° and the filler rod held at an angle of 30° to 40° .

When the tack weld fuses, immediately add filler metal to establish a weld pool and commence the leftwards progression.

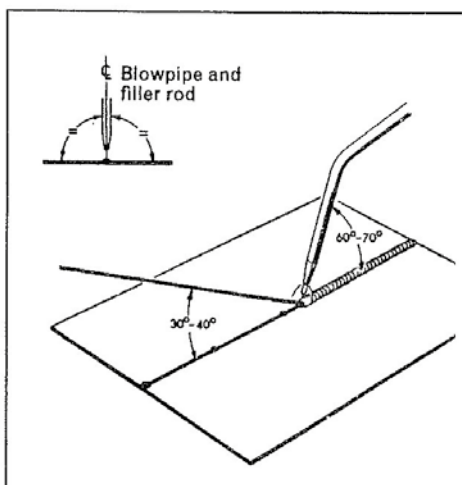
Do not weave blowpipe but add filler metal at front edge of the weld pool.

Adjust the rate of travel to secure even penetration into both sheets and to produce a fillet weld of equal leg lengths.

In a satisfactory weld the profile will be uniform and slightly concave. There should be freedom from undercut at the toes of the weld. The leg lengths should be equal and between 4 mm and 5 mm.

Open square butt joint (flat position)

| | |
|--------------------|--|
| Material | Two pieces of low carbon steel 1.5 mm thick. Minimum sizes 100 mm x 150 mm |
| Preparation | Square edge |
| Assembly | Tack weld with five tacks; gap 1.5 mm. Support assembly about 15 mm above bench surface in flat position |
| Nozzle size | No 2 |
| Regulators | Each 2lb/in ² (0.15 bars) |
| Filler | 1.5 mm BS 1453:A1 |



Commence welding at the right hand end of the joint.

Gas Welding & Cutting Basics

Oxy-acetylene welding (GW1)

Direct the flame centrally into the gap with the blowpipe nozzle at an angle of 60° to 70°.

Hold the filler rod in line with the joint at an angle of 30° to 40°.

When tack weld and parent metal fuse locally, immediately add filler metal to establish weld pool across the gap.

Commence leftwards movement, co-ordinating addition of filler metal and rate of travel.

A slight transverse movement of the filler rod end will help to control the weld pool as the added filler metal flows to the edges, preventing excessive penetration.

Adjust rate of travel to avoid 'burn through' and add filler metal to build up a weld bead proud of the sheet surface, behind the weld pool.

The welded assembly should be examined on the reverse side. Penetration to the full depth of the fusion faces, without excessive penetration bead and without 'burn through' should be achieved.

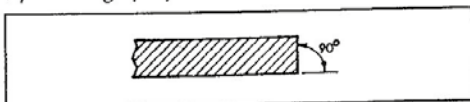
The profile of the weld should be uniform and slightly convex.

Gas Welding & Cutting Basics

Gas cutting (C1 - C2)

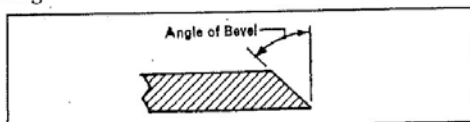
Terminology is as follows:

Square edge preparation



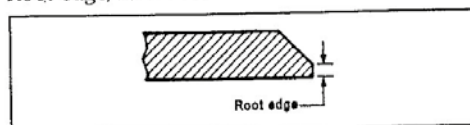
Edges of plate produced at right angles by thermal cutting.

Angle of bevel



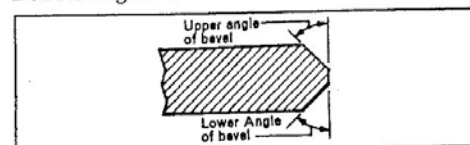
The angle of bevel at which an edge or end is cut or chamfered.

Root edge/root face



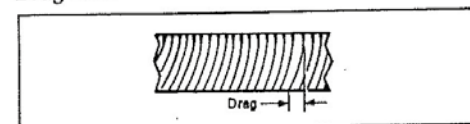
When the angle of bevel is not made to the full depth of the plate thickness that part remaining (of the original 90° edge) becomes the root face. Alternatively, the surface formed by the 'squaring off' of the root edge of the fusion face to avoid a sharp edge at the root of the penetration.

Double angles of bevel



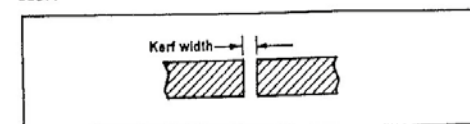
These may be prepared with or without the root face by suitably inclined multicutters used in the line of travel.

Drag lines



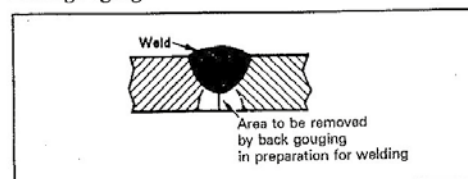
Serrations left on the face of a cut made by thermal cutting. Drag is the projected distance between the two ends of a drag line measured as shown.

Kerf



The gap or void left after metal has been removed in thermal cutting.

Back gouging



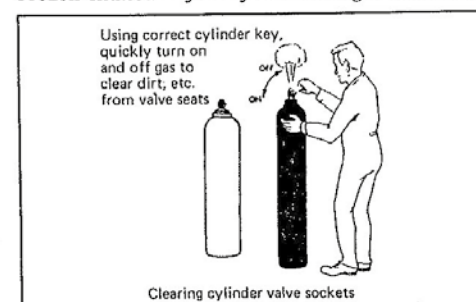
When a fully penetrated weld is not achieved, the area at the root may be prepared by back gouging for a sealing run or root weld.

Cutting allowance

The allowance made for metal removal in relation to specified dimensions when marking out components in preparation for cutting.

Equipment

Special equipment additional to that described in the section entitled Oxy-acetylene welding is as follows:

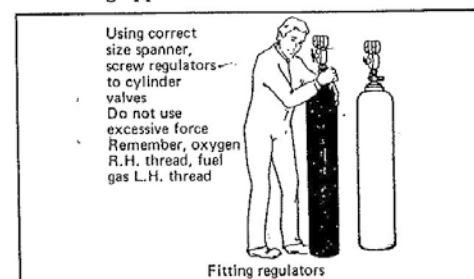


Pressure regulators

The oxygen regulators must be capable of higher outlet pressures than those used for welding. Outlet pressures up to 4.8 bars (70lb/in²) are required for cutting plate up to 150 mm thick. Pressure up to 8.3 bars (120lb/in²) may be required for heavier plate.

Regulators for propane must be capable of an outlet pressure of 2.08 bars (30lb/in²).

Acetylene regulators used for high pressure (dissolved) acetylene are suitable for both welding and cutting applications.

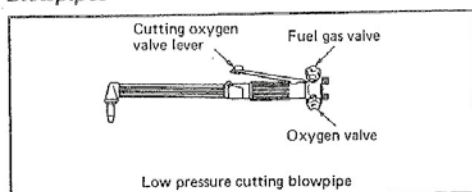


NOTE: Flashback-Arrestors must be fitted between the Regulators and Hoses.

Gas Welding & Cutting Basics

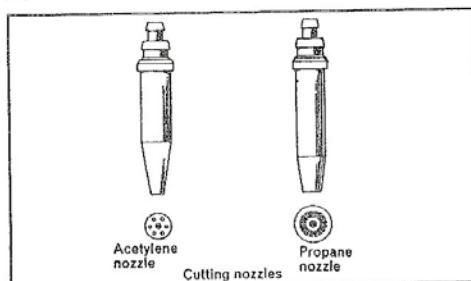
Gas cutting (C1 - C2)

Blowpipes

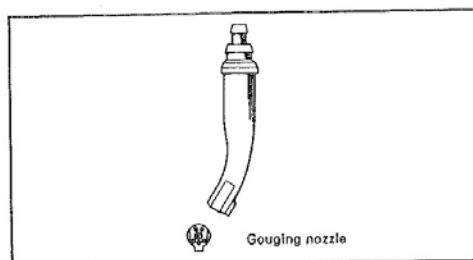


Blowpipes for use with propane or acetylene fuel gas may be either of the injector type or nozzle mixer pattern. Blowpipes may be constructed solely for cutting purposes or the shank of a welding blowpipe may be fitted with a cutting attachment. Oxygen and fuel gas are mixed (as in the welding blowpipe) to produce the pre-heating flame. A separate supply tube conveys the additional oxygen required for the cutting operation. This cutting oxygen supply is controlled by a separate valve on the blowpipe.

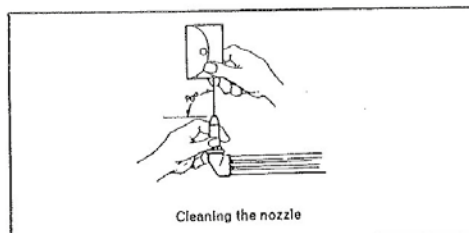
Nozzles



One-piece copper nozzles are used for acetylene. Propane nozzles are usually of two-piece construction: a copper outer with a recessed brass inner portion. The cutting oxygen flows through the large central hole in the nozzle. The pre-heat gases flow through the smaller holes or flutes around the cutting oxygen orifice. Nozzle sizes are indicated by the diameter of the central orifice.

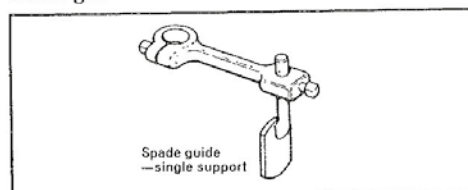


Gouging nozzles are cutting nozzles of a swaged shape appropriate for cutting grooves of the width and depth required.

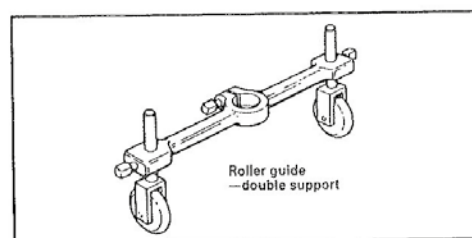


Examine nozzles for damage. Orifices must only be cleaned with a special nozzle cleaner of correct size, used at right angles to the nozzle end. If the end of the nozzle is damaged, rub it with a piece of fine emery paper laid on a piece of plate glass. Hold nozzle at right angles to glass so that edges of orifices are made sharp and square. Clean dirty nozzles by immersion in a solution containing nozzle cleaning compound.

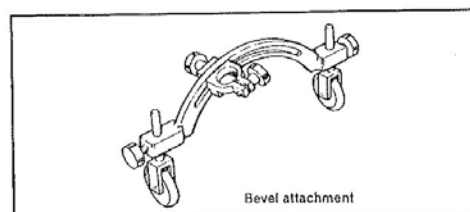
Cutter guides



The single support may be of the spade or wheel type, usually provided with vertical adjustment to obtain correct nozzle-to-plate distance. The support rides on the plate to be cut and may be pressed against a straight edge or template.

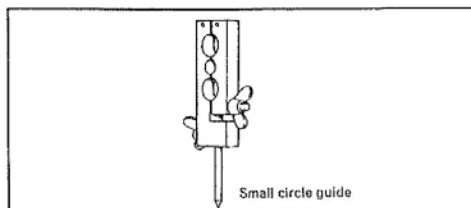


The double support or roller guide is easier to use for long cuts. It also provides vertical adjustment for the nozzle height.

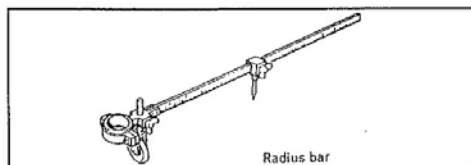


Bevel cutting may be obtained either by setting the wheels of the double support at different levels or by using a slotted clamping attachment.

Gas Welding & Cutting Basics



Small circles may be cut by clamping a pivot on to the gas tubes of the blowpipe.



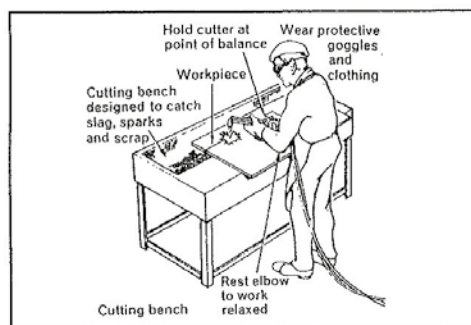
For large circles a radius bar attachment is used on the blowpipe. This bar is fitted with a wheel support and an adjustable pivot.

Operating the equipment

! SAFETY – When cutting material make sure that the detached portion cannot fall and cause personal injury.
Wear safety boots to avoid injury from falling dross and hot metal.

Always:

- Comply with the prescribed safety precautions and fire prevention procedure.
- Check that the hoses are not kinked or otherwise obstructed.
- Check that correct type and size of nozzle is fitted.
- Check that cylinder valves are open.
- Check that regulators are set to correct working pressures.



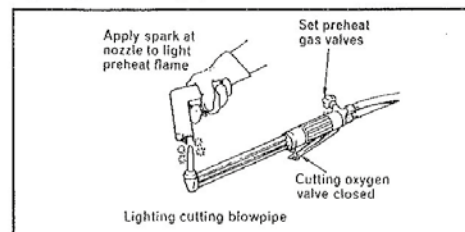
- Use effective protective equipment and any necessary protective clothing.
- Point the blowpipe in a safe direction when lighting and handle the lit blowpipe with due caution.
- Extinguish blowpipe flame when not in use.
- Follow closing down procedure when equipment is not in use.

Gas cutting (C1 - C2)

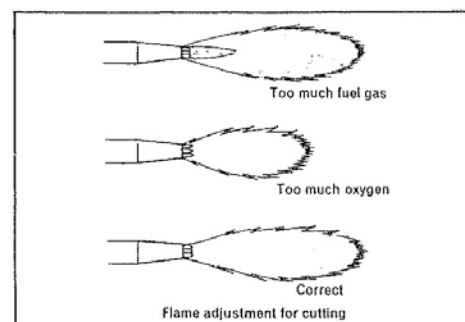
! SAFETY – Do not remove the cylinder key from the fuel gas cylinder. It may be needed urgently for fire prevention purposes.
Keep asbestos gloves available.

The cutting operation results from the reaction of a jet of high purity oxygen upon a ferrous metal that has been pre-heated to ignition temperature. Oxygen rapidly oxidizes the metal in a narrow section that becomes the 'kerf' as the molten oxide and metal are removed.

Lighting the blowpipe



- Close all valves on blowpipe.
- Open cylinder valves slowly by one turn of the spindle.
- Set the fuel gas regulator to correct working pressure.
- Open the cutting oxygen valve and set the oxygen regulator to correct working pressure.
- Close the cutting oxygen valve and open the fuel gas valve on the blowpipe about three-quarter turn.
- Wait a few seconds to flush system with fuel gas, pointing the blowpipe in a safe direction.
- Use a spark lighter to light fuel gas and adjust gas supply until flame ceases to smoke.



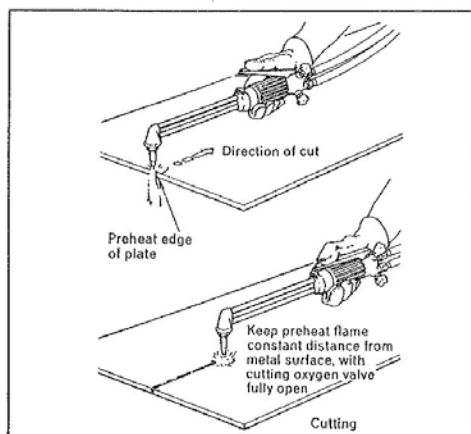
- Open the heating oxygen valve and adjust until white inner cones in the flame are fairly sharply defined with slightly rounded tips.
- Open the cutting oxygen valve and again adjust the heating gas controls to give a neutral flame. Close the cutting oxygen valve and the cutting blowpipe is ready for use.
- To extinguish the flame turn off the cutting oxygen, close the fuel gas control valve and close the heating oxygen control valve.

Note: Always follow the procedure in the order stated above.

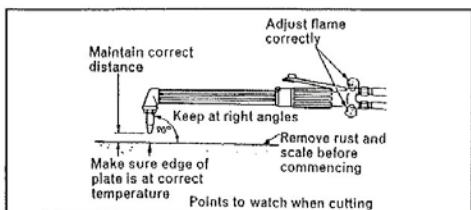
Gas Welding & Cutting Basics

Freehand cutting

Blowpipe control



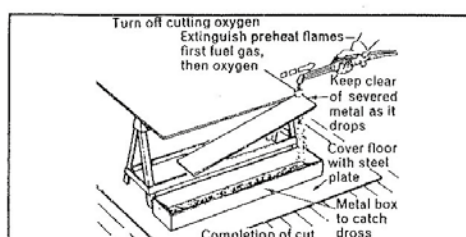
| | |
|--------------------|---|
| Material | 12.5 mm thick low carbon steel |
| Preparation | Clean surface where cut is to be made. Mark the line of cut |
| Assembly | Place plate in flat position on supports with metal box below line of cut to catch dross |
| Nozzle | $\frac{3}{64}$ " (1.25 mm) |
| Oxygen | 30-36 lb/in ² (2.08-2.42 bars) |
| Fuel gas | Acetylene 2-3 lb/in ² (0.14-0.21 bars) Propane 3 lb/in ² (0.21 bars) |



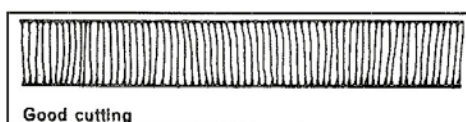
- Using a neutral pre-heating flame pre-heat the edge of the plate at the point where cut is to start.
- Aim the flame vertically downwards with the tips of the white cones 3 to 5 mm above the surface of the plate.
- Hold the handle of the blowpipe so that it lies in the direction of the cut.

Gas cutting (C1 - C2)

- When the wedge is locally heated to dull red (with a small white hot spot) open the cutting oxygen valve slowly until full flow is obtained.



- Move the blowpipe at a uniform speed along the line to be cut with the nozzle held at a constant distance from the plate surface. Focus the eyes on a point just in advance of the nozzle.
- The cutting speed is correct when the dross sprays straight downwards.
- Too slow a speed will cause the dross to spray forward in the direction of cutting.
- If the blowpipe is moved too fast the white hot spot will disappear and the cut may fail to penetrate the plate. Apply the pre-heating flame until the ignition temperature has again been obtained. Re-open the cutting oxygen valve and continue cutting.

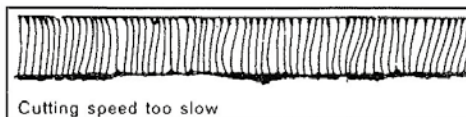


A satisfactory cut has the following characteristics:

- Sharp top edge.
- Almost vertical drag lines, but not too pronounced.
- Square face with only a light and easily removable oxide scale.
- Sharp bottom edge with no adhering dross.
- Cut edge true to planned line of cut with uniform kerf width.

Examine the cut edge and consider the 'effects of variation in procedure'. Repeat the procedure until good quality cuts are readily obtained.

The effects of variation in procedure are as follows:



Indications:

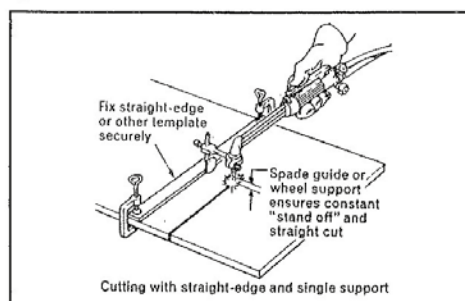
- Melted and rounded top edge.
- Lower part of cut face fluted or gouged very irregularly.
- Bottom edge rough.
- Heavy scale on cut face.
- Dross congealed on underside and difficult to remove.

Gas Welding & Cutting Basics

Gas cutting (C1 - C2)

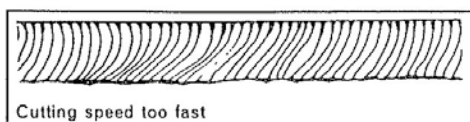
Square edge cutting

| | |
|--------------------|--|
| Material | 25 mm thick low carbon steel |
| Preparation | Clean surface and mark line of cut |
| Assembly | Place plate in flat position on supports. Fix straight edge securely with clamps, parallel to and at the correct distance from line of cut |
| Nozzle | $\frac{1}{16}$ " (1.5 mm) |
| Oxygen | 40-45 lb/in ² (2.76-3.10 bars) |
| Fuel gas | Acetylene 2-3 lb/in ² (0.14-0.21 bars) Propane 3-4 lb/in ² (0.21-0.28 bars) |



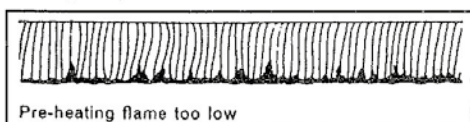
- Fit single support cutter guide to blowpipe and adjust to correct height.
- Check that nozzle is centred over line of cut when cutter guide is in contact with straight edge.
- Light blowpipe and adjust to neutral pre-heating flame.
- Pre-heat at point where cut is to start.
- Open cutting oxygen valve and start cutting.
- Keep the cutter guide resting on the surface of the plate and pressed sideways in light contact with the straight edge.
- Adjust cutting speed so that the dross spray is about vertical.

Examine the cut edges and note the effects of variation in procedure previously described. Repeat until good quality cuts are obtained.



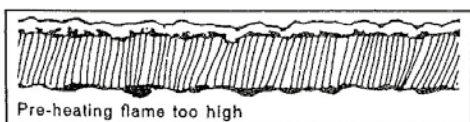
Indications:

- Top edge not sharp and may be undercut.
- Drag lines very marked and uneven, sloping backwards.
- Irregular cut edge.
- Slightly rounded bottom edge which may not be completely severed at end of cut.



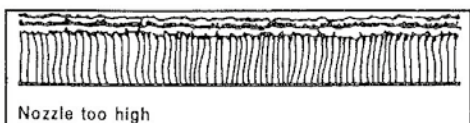
Indications:

- Slow cutting speed.
- Bad gouging of lower part of cut face.



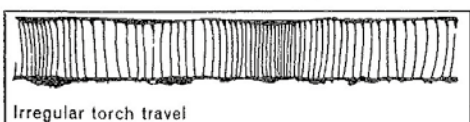
Indications:

- Rounded top edge with melted metal falling into kerf.
- Cut edge irregular.
- Excessive amount of tightly adhering dross on lower edge.



Indications:

- Excessive melting of top edge.
- Undercut at top of cut face.

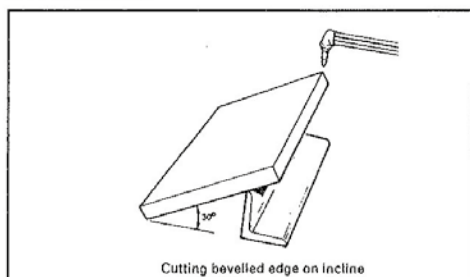


Indications:

- Uneven drag lines.
- Wavy cut edge.

Gas Welding & Cutting Basics

Bevel cutting

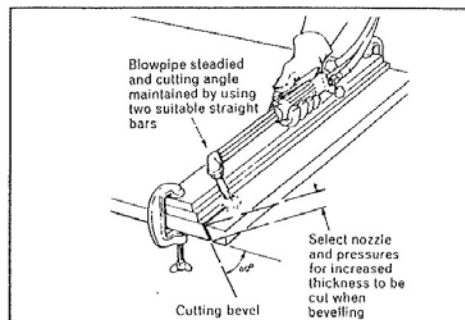


Effective bevel cutting depends upon the accuracy of edge preparation. Small pieces may be inclined at the appropriate angle and cut from the back. The most common practice is to keep the plate in the flat position and angle the cutting nozzle by means of an adjustable cutter guide. Alternatively, two straight edges offset to give appropriate inclination can be used as a direct guide for the cutting nozzle.

30° Bevel cutting

| | |
|--------------------|--|
| Material | 10 mm thick low carbon steel |
| Preparation | Clean surface and mark line of cut at 10 mm distance from edge to be bevelled |
| Assembly | Place plate in flat position on supports. Fix two straight bars, parallel to and at the correct distance from the line of cut. Check that the offset of the bars is such that when the blowpipe nozzle is in contact with the top edge of each bar it is inclined at 60° |
| Nozzle | $\frac{3}{8}$ " (1.25 mm) |
| Oxygen | 35–40 lb/in ² (2.42–2.76 bars) |
| Fuel gas | Acetylene 2–3 lb/in ² (0.14–0.21 bars) Propane 3 lb/in ² (0.21 bars) |

Gas cutting (C1 – C2)



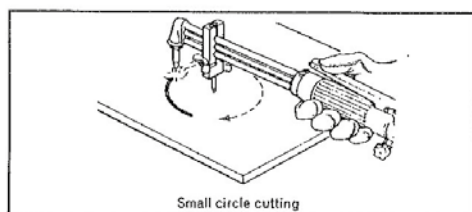
- Check that the nozzle is positioned so that its centre line (or longitudinal axis) intersects the line of cut when the nozzle is in contact with the offset bars.
- Pre-heat at point where cut is to start and proceed with the cutting operations.
- Adjust rate of travel so that the dross spray is almost in line with the longitudinal axis of the nozzle.

Gas Welding & Cutting Basics

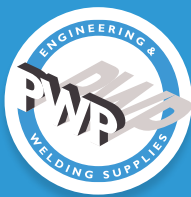
Gas cutting (C1 - C2)

Circle cutting

| | |
|--------------------|--|
| Material | 12.5 mm thick low carbon steel |
| Preparation | Clean surface and make well defined centre punch mark for centre of circle to be cut |
| Assembly | Place plate in flat position on supports; check that the cutting of the circle can be completed without obstruction to movement or damage to hoses |
| Nozzle | $\frac{3}{8}$ " (1.25 mm) |
| Oxygen | 30-35 lb/in ² (2.08-2.42 bars) |
| Fuel gas | Acetylene 2-3 lb/in ² (0.14-0.21 bars) Propane 3 lb/in ² (0.21 bars) |



- Fit small circle cutting attachment to blowpipe and adjust to correct height.
- Check that the nozzle-to-pivot distance is correct.
- Light blowpipe and adjust to neutral pre-heating flame.
- Pre-heat at point on circumference where cut is to start, until a local white hot spot is developed.
- Open the cutting oxygen valve slowly until fully open.
- As soon as hole is pierced maintain the pivot in the centre punch mark and continue cutting action as blowpipe is moved in a circular path.



**MAKE SOMETHING
BETTER**

**ANY QUESTIONS?
CONTACT US!**

Tel: 01234 345111
Email: info@pwpind.com