Trade of Sheet Metalwork	
Module 3:	**Thermal Processes**
Unit 2:	**Oxy-acetylene Welding Feather-Edge Weld**
	Phase 2

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Document Release History

Date	Version	Comments
06/09/06	First draft	
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Module 3 – Thermal Processes

Unit 2 – Oxy-acetylene Welding Feather-Edge Weld

Duration – 7 Hours

Learning Outcome:

By the end of this unit each apprentice will be able to:

- Read and interpret drawing and weld symbol
- Select suitable nozzle, set gas pressures, light the torch and adjust the flame to the neutral condition
- Tack weld the plates to form a close joint
- Complete the welded joints without the use of filler rod in 0.8 mm, 1.0 mm and 1.2 mm mild steel sheet

Key Learning Points:

Rk D	Weld symbol.
Rk	Nozzle size and gas pressures.
Rk	Neutral flame.
Rk Sk	Taking procedure - joint set-up.
Rk	Welding technique - fusion weld.
Rk Sk	Torch angle - torch manipulation.
Rk H	Safety precautions - hot handling of materials.

Training Resources:

- Oxy-Acetylene welding equipment
- Drawing & Hand-outs
- Safety clothing and equipment
- Material 0.8 mm, 1.0 mm and 1.2 mm mild steel sheet

Key Learning Points Code:

M = Maths D= Drawing RK = Related Knowledge Sc = Science
P = Personal Skills Sk = Skill H = Hazards

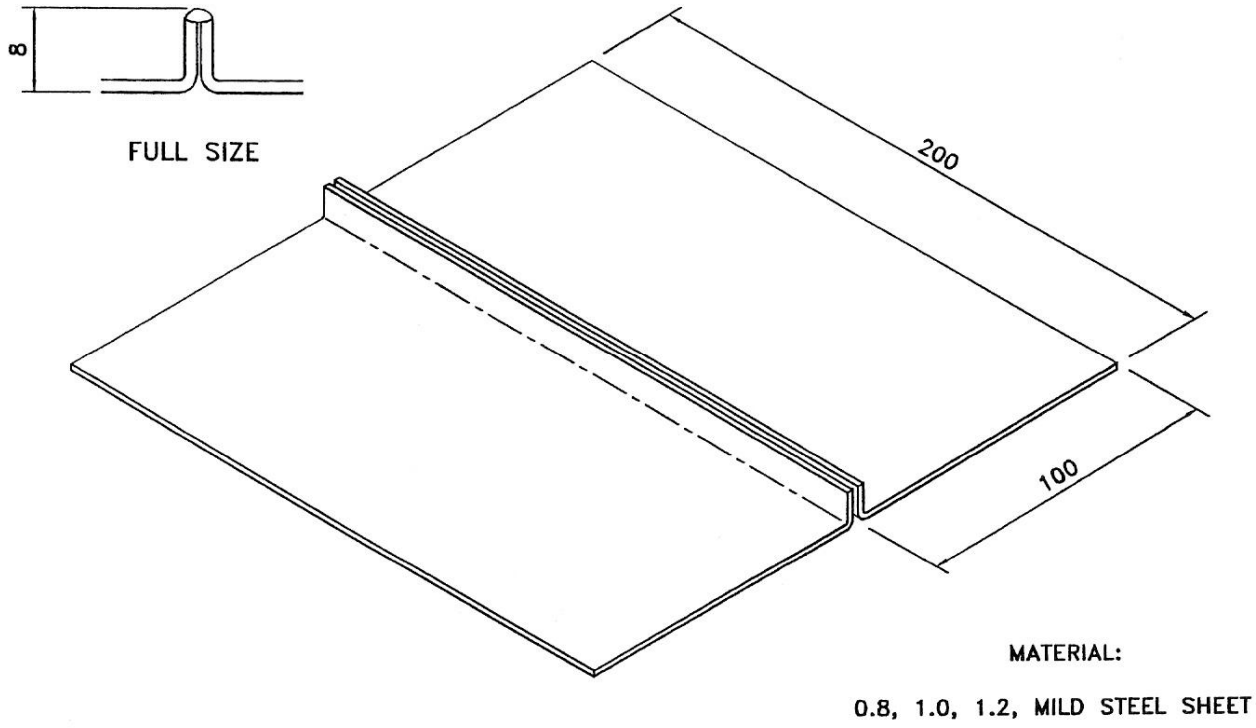


Figure 1 - Feather-Edge Welding

Weld Symbols on Drawings

Engineering drawings are descriptions of manufactured objects in terms of shape, surface, finish and material. In many industries it is customary to draw the shape of the component without indicating how that shape is achieved. The drawing is a description of a requirement produced by the designer for the instruction of the manufacturer. In theory, the manufacturer knows best how to produce an object with the resources he has. In practice, of course, the designer compromises and produces designs which are capable of production by the techniques of which he is aware. For example, a round hole can be drilled, bored or punched and can be finished by reaming, but whichever method is used, the lines on the drawing are the same and whichever method is used, the material is not changed in its characteristics.

A welded joint offers a range of considerations which do not arise in other forms of manufacture. Firstly, there are far more techniques for making a welded joint than in many other manufacturing operations. This means that the designer has far less chance of foreseeing the manufacturer's methods. Secondly, the properties and integrity of the joint will depend on the manner in which the weld is made. Despite this, the designer can still indicate the type of joint he requires, provided that he is prepared to accept that he may not be able to completely define the joint in the earlier stages of a design.

In some industries it is customary for the manufacturer to produce shop drawings which contain details of weld preparations and reference to established welding procedures not shown in detail on the designer's drawings. The range of British Standard symbols which can be used on a drawing to indicate a weld detail are described here.

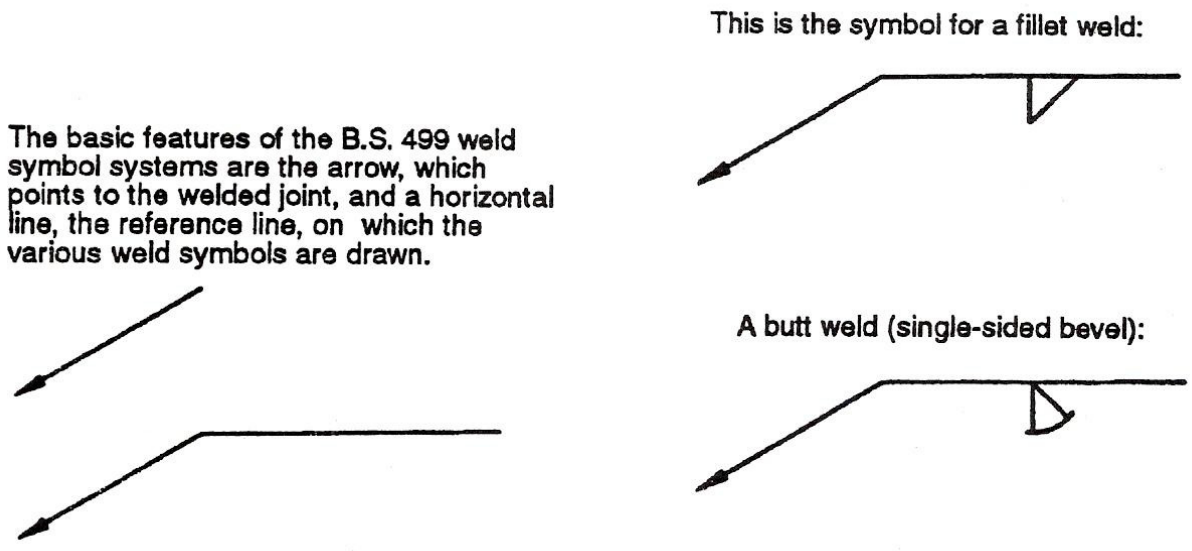


Figure 2 - Weld Symbols

In practice, the two symbols shown in Figure 2 on the right would be used as follows:

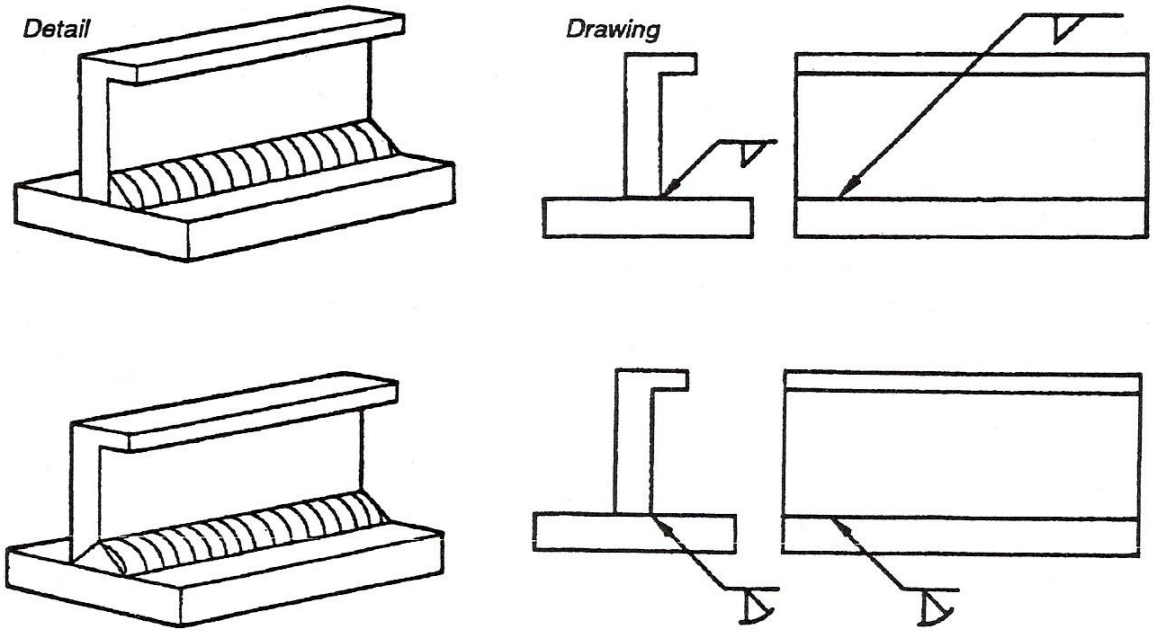


Figure 3 - Use of Weld Symbols

Note: The arrow points towards the prepared edge.

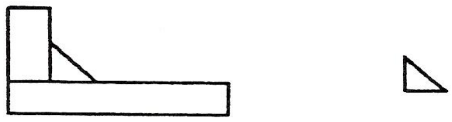
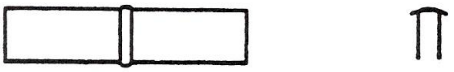
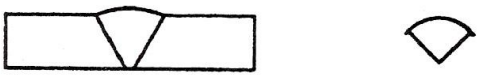
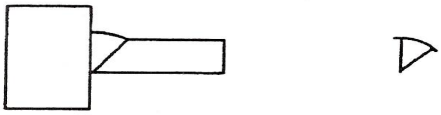
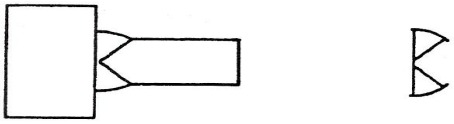
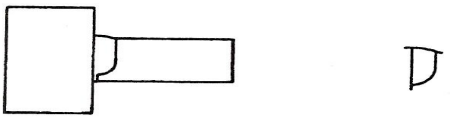
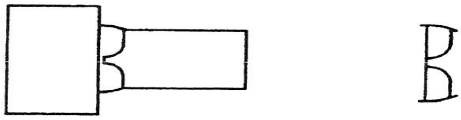
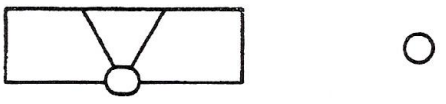
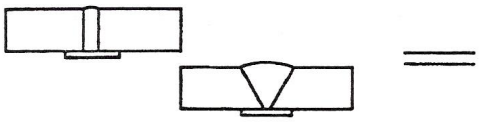
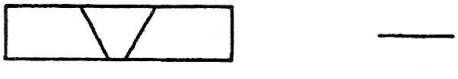
Fillet	
Square butt	
Single-V butt	
Double-V butt	
Single-bevel butt	
Double-bevel butt	
Single-J butt	
Double-J butt	
Sealing run	
Backing strip	
Dressed flush	
And a very useful symbol. Full penetration butt weld by a welding procedure to be agreed.	

Table 1 - B.S. Symbols for a variety of Weld Types

The weld symbol is always drawn the same way round regardless of the layout of the arrow and the reference line. The position of the symbol on the reference line has significance. A symbol below the reference lien means that the weld is made from that side of the joint indicated by the arrow. A symbol above the reference line means that the weld is made from the opposite side of the joint to the arrow.

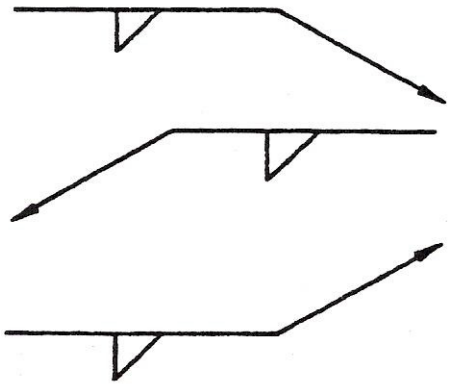


Figure 4 - Weld Symbol Position

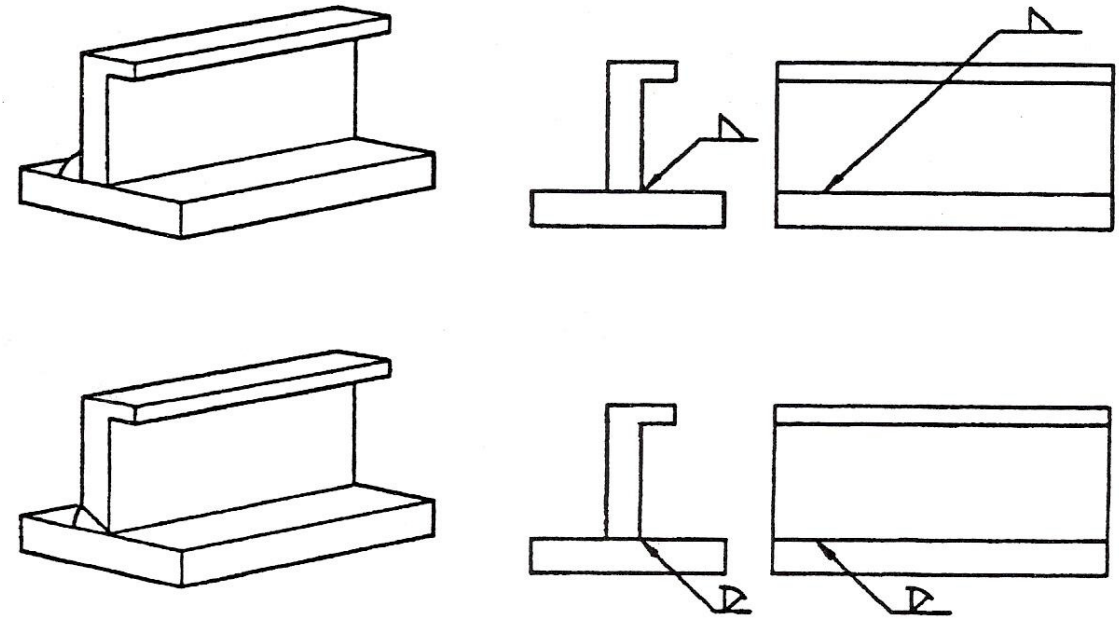


Figure 5 - Position of the Arrow

Note: The arrow points toward a prepared edge.

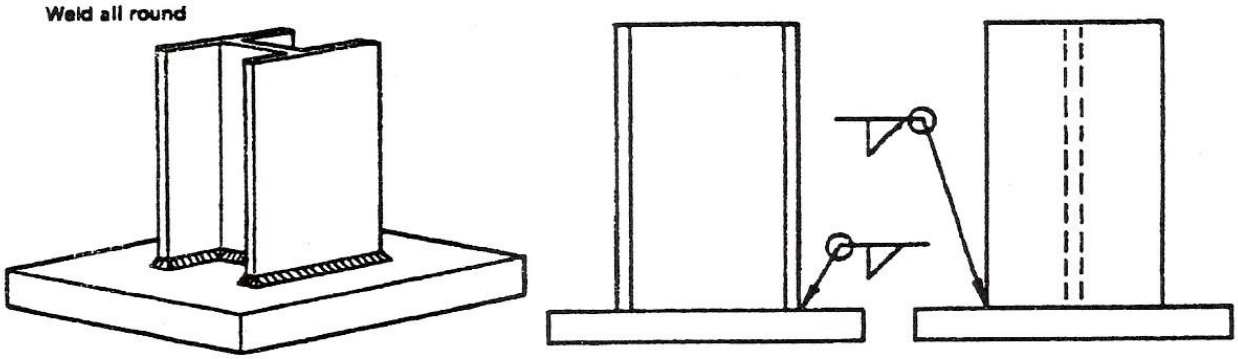


Figure 6 - Weld All Round

A joint made from both sides has a symbol on each side of the reference line.

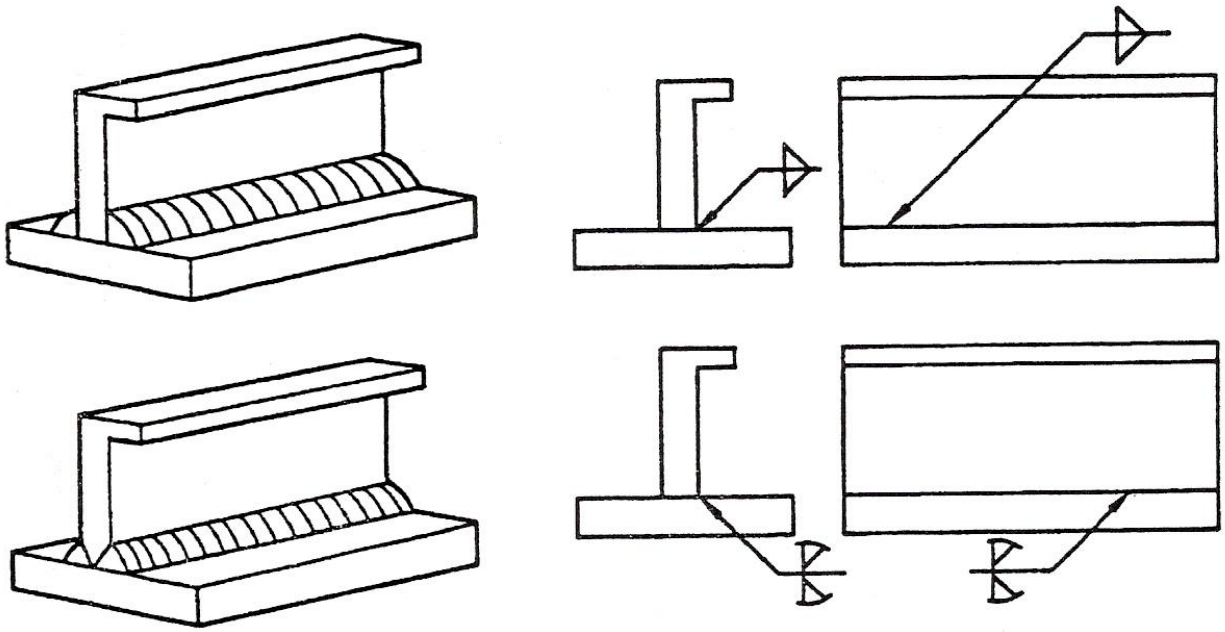
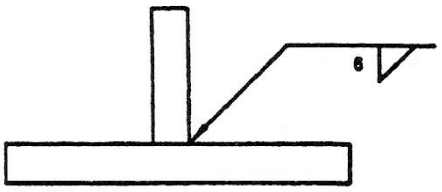
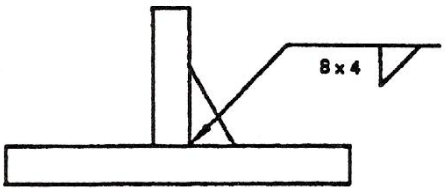


Figure 7 - Joint made from Both Sides

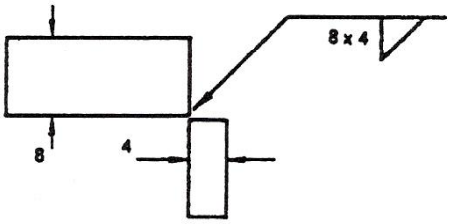
Weld size can be indicated on the symbol, 6mm fillet weld. The drawing must state whether a throat or leg dimension is quoted.



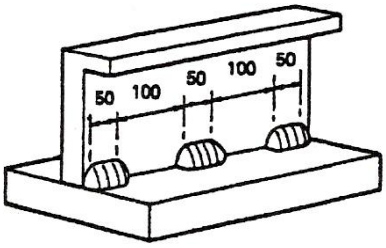
Unequal leg fillet weld. This must be defined by leg length. A diagram of weld shape is required here.



A diagram is not required here because the size of the member indicates the weld orientation.

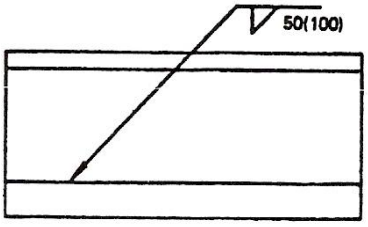


Information other than weld size may be written to the right of the symbol.



Intermittent Welds

The figure in brackets is the space length. 50 before (100) indicates that the weld is at the beginning. (100) 50 would indicate a space first then a weld although such an arrangement would not represent good practice.



Nozzle Sizes

The capacity of a nozzle (the power) is recognised by the amount of acetylene it consumes per hour at the recommended gas pressures: this is usually expressed in cubic feet or litres. Manufacturers usually mark their nozzles with a number, indicating the capacity in cubic feet or litres.

Always check the manufacturer's recommended flame setting for specific nozzles.

For any metal, and welding technique employed, the flame required has a definite relationship to the type of metal and thickness.

PLATE THICKNESS		NOZZLE SIZE	
INCHES	**MM**	**FT3**	**LITRES**
1/32	0.8	1	50
3/64	1.2	2	75
1/16	1.6	3	100
3/32	2.4	5	150
1/8	3.2	7	225
5/32	4.0	10	350
3/16	4.8	13	350

Table 2 - Plate Thickness and Nozzle Size

High Pressure or Mixer Type Blowpipes

Examples of nozzle sizes for various metal thicknesses are shown in the table above.

(a) Nozzle sizes indicate the approximate consumption of each gas in cubic feet (or litres) per hour using a neutral flame.

(b) The size of nozzle for a particular thickness of steel is for general guidance only, and will vary according to the skill of the welder, mass of metal, etc. The capacity of each nozzle overlaps the capacities of those next in size to it. The examples given are for butt welds in mild steel in the flat position.

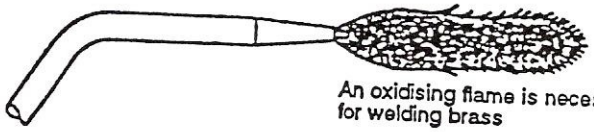
Gas Welding

If the two gases are not mixed in equal proportions then combustion will not be completed. If excess oxygen is used then an oxidising flame will result.

If excess acetylene is used then a carburising flame is formed. For the welding of most metals a neutral flame is required. This is obtained when the gases are mixed in equal proportions.

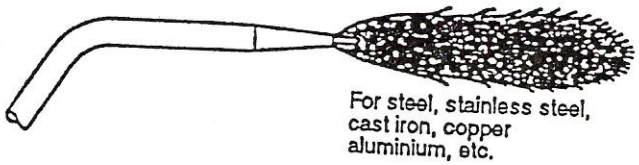
Oxidising Flame

(excess oxygen)



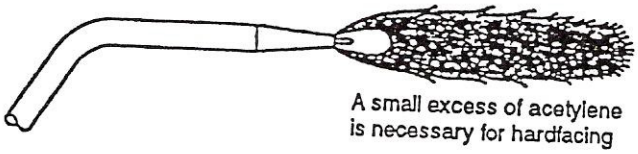
Neutral Flame

(equal quantities oxygen and acetylene)



Carburising Flame

(excess acetylene)



Atmosphere Composition (Approximately)

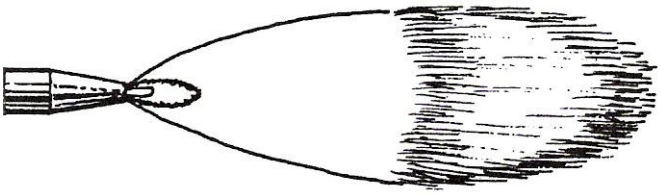
Nitrogen	78%
Oxygen	21%
Argon	1%
Carbon Dioxide	0.03%
Hydrogen	0.00005%
Helium	0.000052%

Use of Flames

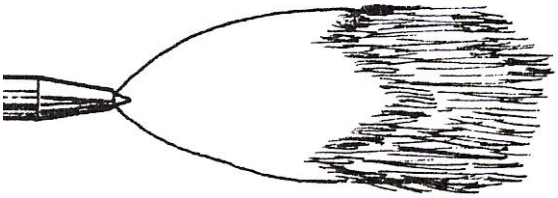
Neutral	- used on steels and stainless
Oxidising	- used on brass and bronze
Carburising	- used on cast iron and hard surfaces

1. Neutral Flame
   (equal quantities of oxygen and acetylene)

2. Carburising Flame
   (excess acetylene)
   Note: feather at cone.



3. Oxidising Flame
   (excess oxygen)



Welding Methods

Always

Comply with the prescribed safety precautions and fire prevention procedures.

Use effective protective equipment and wear the necessary protective clothing.

Carefully segregate different types and sizes of filler rod. Ensure that they are protected from moisture.

Place the welding torch in a safe place when not in use. Ensure complete removal of flux residue after welding. Ensure the gas supplies are turned off at the torch when the welding torch is not in use.

Ensure the main gas supplies are turned off at source at the end of the work period.

Leave the work area in an orderly manner. Ensure that equipment is properly stored. Return unused filler rods to store in their original package and ensure that flux tin lids are replaced and sealed.

Before leaving the work area ensure freedom from burning or smouldering materials. Avoid leaving any form of fire risk.

Leftward Welding

This technique is used for welding plate thicknesses up to and including 3/16". Above this thickness a multi-run deposit made by the leftward technique could be used, but rightward welding is recommended as being more efficient.

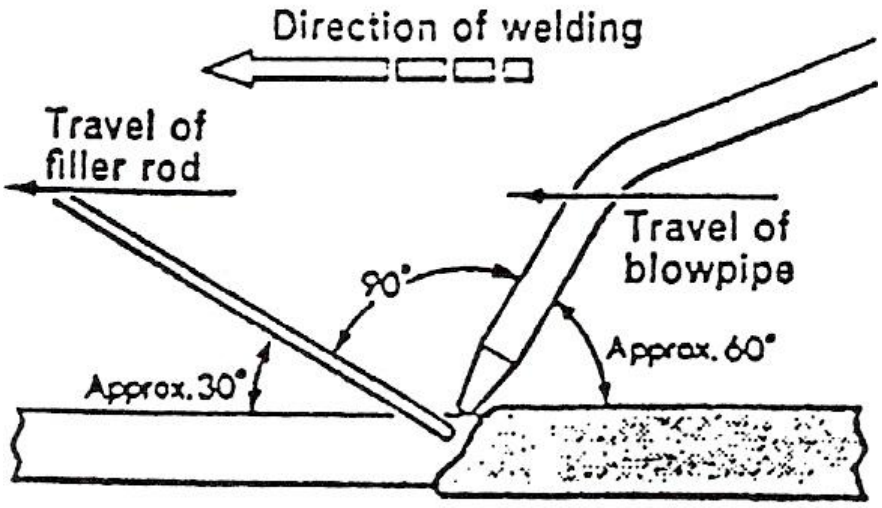


Figure 8 - Leftward Welding

General Procedure

The prepared plates should be correctly set-up in the welding position and suitably tack welded. Before tack welding taper space the plates 3/16" per 12" run (6mm per 40cm) irrespective of plate thickness. The joint is set up to give the correct gap at the point where the first tack weld is made. As the tacks are progressively made contraction will bring the plates together to the correct gap setting.

Fix the assembly securely in the welding position.

Commence to fuse the tack at the beginning of the joint.

Pause to allow the metal to be heated sufficiently to ensure full penetration at the commencement of the joint.

When the molten pool has formed commence to travel, adding the filler rod.

Hold the filler rod and the blowpipe at the recommended angles. The angle of the flame to the workpiece governs the heat build-up and thus the amount of melting and penetration.

Carefully control the lateral movement of the blowpipe. Excessive sideways movement or too slow speed of travel along the line of weld will enlarge the molten pool and cause overheating with possible burn-through.

Terminate the weld carefully by manipulating the blowpipe to reduce heat whilst controlling the deposit of filler metal.

On completion, carefully examine the weld and see that there is:

(A) Uniform reinforcement, making due allowance for positional joints:

(B) Freedom from blowholes, undercut, overlap, cracks, porosity and other defects:

(C) In the case of butt joints, adequate root penetration and so burn through of the plates.

Parent Metal Preparation

Surface Condition

The surface of the parent metal must be cleaned in the vicinity of the fusion faces and free from contaminants. For lap joints and tee fillet joints any contamination present on contacting surfaces must be removed. Care should be taken that moisture or other contaminants are not trapped between the abutting surfaces. Neglect of this precaution will produce porosity in the weld deposit.

Edge Preparation

May be carried out by cutting, shearing, planing, chipping, grinding or filing. Keep fusion faces free from irregularities to ensure accurate alignment and uniform gap dimensions.

Filler Rods

IMPORTANT

ALWAYS PLACE A HOT FILLER ROD WHERE IT CANNOT BE ACCIDENTALLY TOUCHED OR HANDLED.

ALWAYS POSITION THE FILLER ROD TO AVOID PERSONAL INJURY WHILST 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.

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 silicagel) for moisture may be used in the storage area.

Figure 9 - Handling and Storage

Selection of Correct Filler Rod

Filler rods are (a) drawn, (b) cast.

Ensure the composition of filler rod is suitable to weld the parent metal.

The filler rod diameters to be used depend upon the thickness to be welded and the welding position.

Select a filler rod:

(a) of suitable composition

(b) of correct diameter.

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

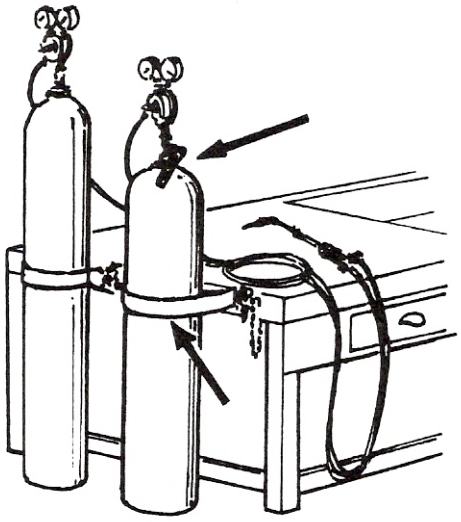
Ensure the rod is free from contamination such as rust, scale, oil, grease and moisture.

Ensure the rod is reasonably straight to assist manipulation during welding.

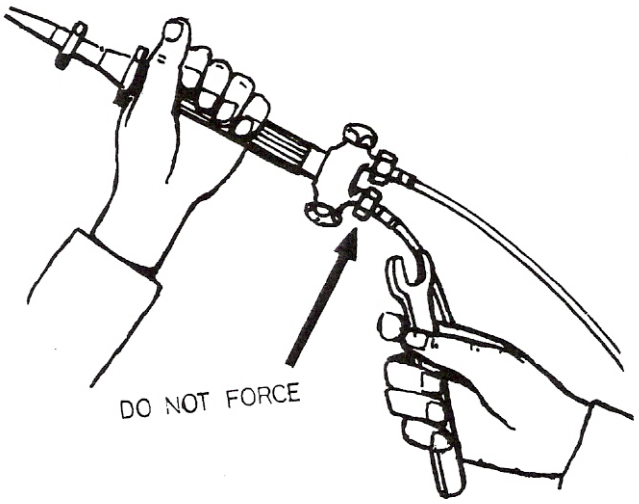
Safety Precautions

1. (a) Make certain that cylinders are well fastened in position so that they will not fall.

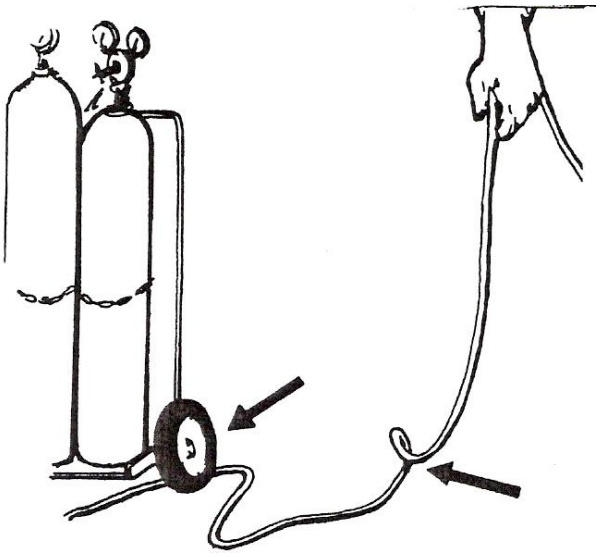
   (b) Always keep cylinder key in position on acetylene cylinder when welding.



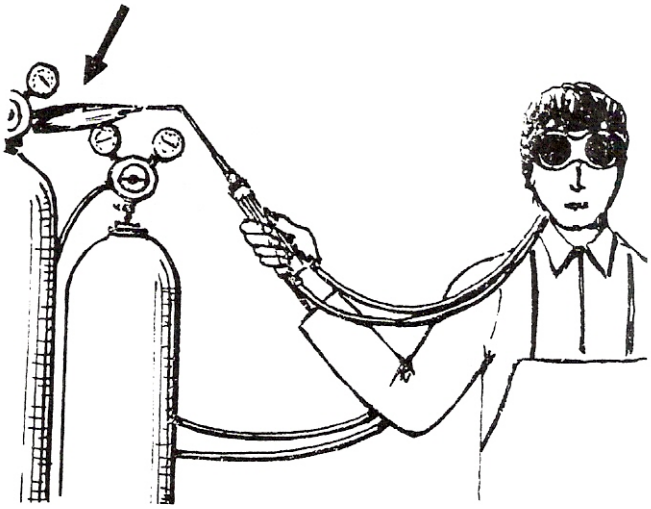
2. Never force connections that do not fit.



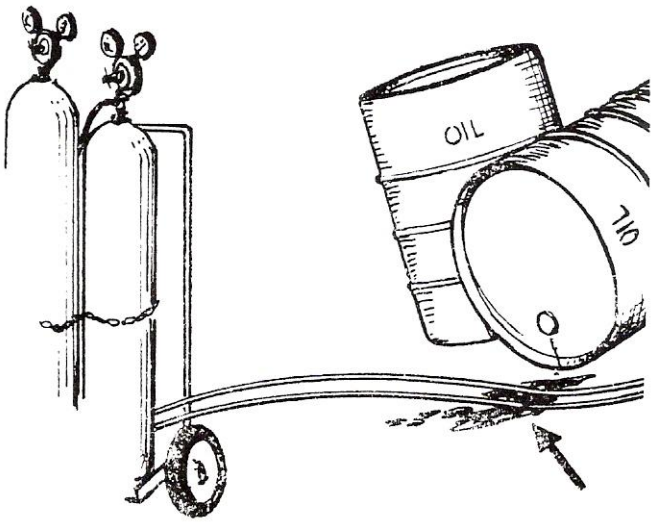
3. Always protect hoses from being walked on or run over. Avoid kinks in hoses.



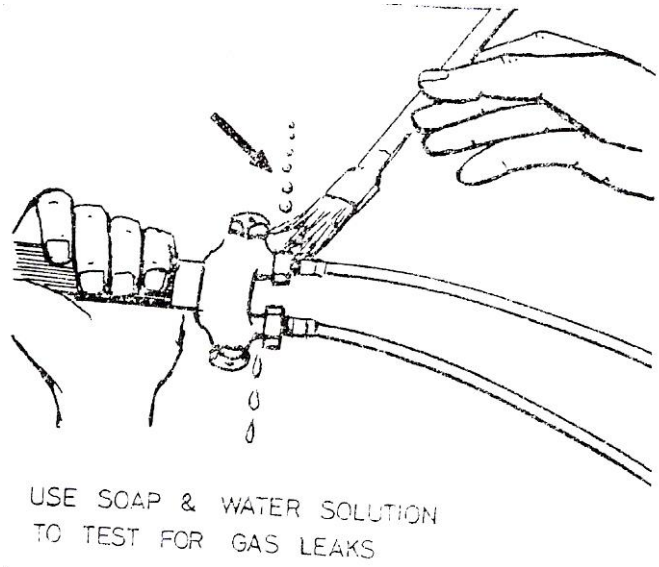
4. Protect hoses and cylinders from flying sparks, hot slag, hot objects and open flame.



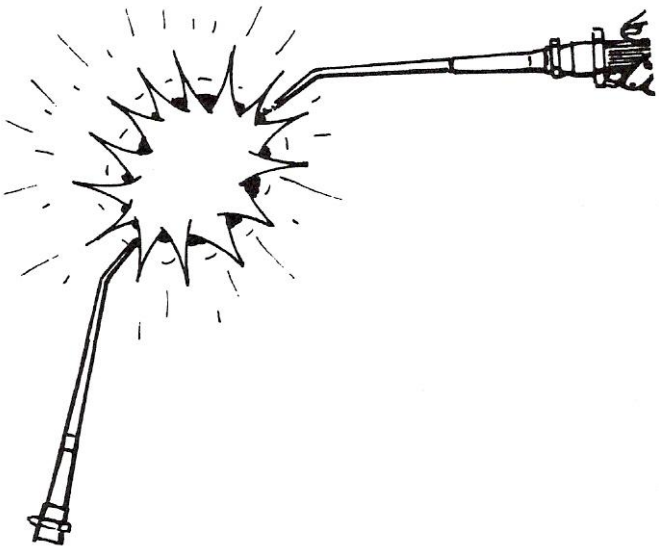
5. Never allow the hoses to come into contact with oil or grease as these will damage the rubber.



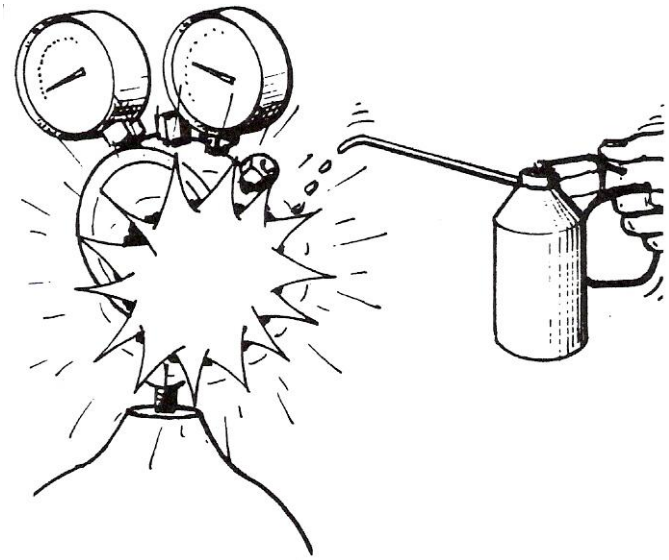
6. Be sure that all connections between regulators, adaptors and valves are gas tight.



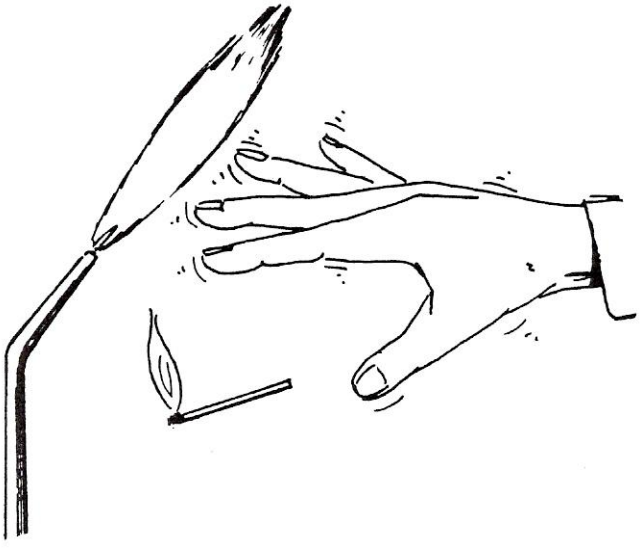
7. Do not light one torch from another.



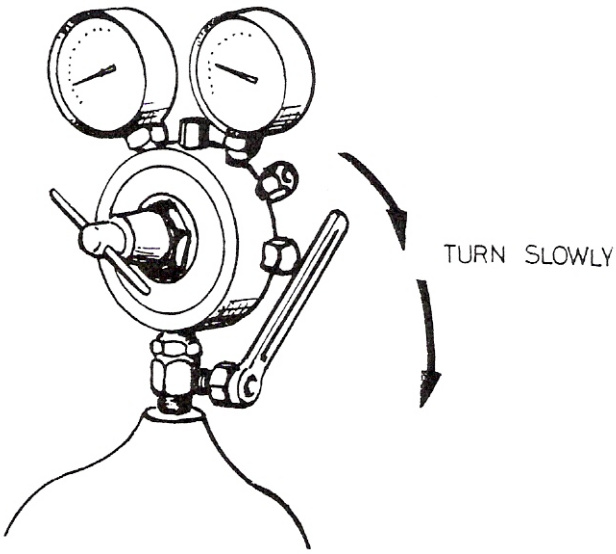
8. Never lubricate regulators.



9. If you use a match to light your torch be extra careful to avoid burns.



10. When opening cylinders turn key slowly.



11. When welding is finished for a long time (during lunch or overnight) close the cylinder valves and then release all gas pressure from the regulators and hoses by opening the torch valves. Close the torch valves and release the pressure adjusting screws.

12. In case of burns or accidents always turn off torch first.

13. Do not fool around with torch flame.

14. Remember to wear goggles at all times when welding.

15. Always blow out hoses before fitting.

16. Never joint hoses with copper pipe.

These are the most important safety precautions to remember, but if you have any doubts or worries about any others call your instructor.

Self Assessment

Questions on Background Notes – Module 3.Unit 2

1. Why is it dangerous to weld a petrol can?

2. Why are cylinders chained in position?

3. Where should the cylinder key be when welding?

4. Would you use a vice grips to tighten connections on a welding plant?

5. What effect will oil or grease have on hoses?

6. How would you test for leaks on a welding plant?

7. How would you lubricate regulators?

8. What is the first thing you should do if you get a burn while welding?

9. Is copper piping a good joining metal for hoses?

Answers to Questions 1-9. Module 3.Unit 2

1.

Its dangerous to weld a petrol can as the fumes may cause the can to explode.

2.

Cylinders are chained in position to prevent them from falling.

3.

Always have the key nearby or in the bottle itself. One in each bottle is preferable.

4.

No. The vice grips would over time cause damage to the outer connections.

5.

Grease or oil will damage the rubber.

6.

Use a soap and water solution. If there is a leak bubbles will appear. There are also aerosol sprays on the market which will detect leaks.

7.

Never lubricate regulators.

8.

Turn off the torch first.

9.

Never use copper piping.

When combined with acetylene it forms a explosive compound. Copper also absorbs impurities and may release them at will to contaminate other gases.

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