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Module 3 – Thermal Processes

Unit 3 – Oxy-acetylene Welding Open Corner Joint

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 torch and adjust flame to the neutral position
- Arrange and tack weld the plates to form an open corner joint
- Complete the welded joints with and without the use of filler rod in 1.0 mm, 1.5 mm and 2.0 mm mild steel sheet

Key Learning Points:

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<tr>
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<td>Effect of heat on metals, distortion controls/prevention.</td>
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Training Resources:

- Oxy-Acetylene welding equipment
- Drawing and hand-outs
- Material 1.0 mm, 1.5 mm and 2.0 mm mild steel sheet
- Safety clothing and equipment

Key Learning Points Code:

- M = Maths
- D = Drawing
- RK = Related Knowledge
- SC = Science
- P = Personal Skills
- SK = Skill
- H = Hazards
Figure 1 - Oxy-Acetylene Welding - Open Corner Joint
Distortion during Welding

Causes of Distortion

(a) Longitudinal Contraction
   If a deposit is made on one side of a flat strip thin plate the plate bends upwards as it cools.

(b) Transverse Contraction
   If a butt weld is made between two thin plates that are free to move, the plate edges will be drawn together. The plate edges in advance of the weld may ‘scissor’ or overlap.
(c) Angular Distortion

If a fillet weld is deposited between two plates in a tee joint the angle between the plates will be reduced as the weld cools. Similarly, angular distortion occurs in a butt joint as contraction of the weld metal pulls the plates out of alignment. Angular distortion increases with the number of runs deposited.

![Angular Distortion Diagram]

Figure 4 - Angular Distortion

![Distortion Diagram]

Distortion in single-sided welding of an unrestrained butt joint with several small runs

Figure 5 - Distortion
Control of Distortion

1. Design

Reduce distortion by using:

(a) Minimum number of suitably arranged joints.
(b) Readily accessible joints.
(c) Correct weld sizes for the strength required.
(d) Balanced welding about neutral axis.

![Figure 6 - Effects of Unbalanced Welding About the Neutral Axis](image)

2. Parent Metal

Reduce distortion by using:

(a) Correct procedure according to type of metal.
(b) Deposition technique which ensures minimum heat input.

![Figure 7 - Sequence of Welding Fillet Welds on Either Side of a Vertical Member: One Welder](image)
3. Joint Preparation and Set-up

Reduce distortion by using:

(a) Smallest suitable angle of preparation.
(b) Smallest suitable root gap.
(c) Smallest suitable joint preparation and set up wherever possible.

Figure 8 - Joint Preparation and Set-up

4. Assembly Procedure

Reduce distortion by:

(a) Pre-setting or pre-cambering components, to anticipate distortion pulling components into correct alignment.
(b) Restraining components with suitable slippage where necessary to control the distortion within prescribed limits.
(c) Using effective symmetrical tack welding, to hold components in alignment and maintain root gap.

Figure 10 - Pre-setting to Compensate for Angular Distortion
5. Welding Process

In general, the greater the heat build-up produced by the process the greater will be the distortion.

The lower the heat build-up the less will be the distortion.

6. Deposition Technique

Reduce distortion by:

(a) Deposition the weld with the minimum number of runs.

(b) Balancing the welding about the neutral axis of the fabrication. (Note that if a weld is made on one side of an unrestrained joint and allowed to cool, it will require approximately twice the amount of welding on the opposite side of the joint to eliminate the distortion caused by the first weld).

(c) Not exceeding the specified size of weld.

(d) Use the correct procedure and technique to give maximum welding speed.

![Step-back method for welding long butt joint with two welders; one each side of centre after first deposit](Figure 11 - Deposition Technique 1)
Order of welding in a circular patch, showing sequence of welds

Figure 12 - Deposition technique 2

Note: It is essential to dish or pre-set the insert before tack welding in position

Sequence for welding in patches

Figure 13 - Deposition Technique 3
7. Welding Sequence

Reduce distortion by:

(a) Welding away from the point of restraint towards a free end.
(b) Progressing welding symmetrically about the neutral axis of the fabrication, to give a balanced procedure.
(c) Using ‘Doubling Up’ method of welding to counteract angular distortion.
(d) Using ‘Planned Wandering’ or ‘Step Back’ methods of welding.
(e) Using correct sequence when welding sections so that severe restraint in one direction does not cause distortion elsewhere.

Figure 14 - Sequence of Welding
Fitting of New Cylinders

When you are fitting new cylinders you should remember the following safety points:

1. Keep eyes clear when cracking cylinders.
2. Do not smoke.
3. Crack acetylene cylinder outside if possible.
4. Use open spanner (Do not over tighten).
5. Blow out hoses before connecting up.
6. Turn cylinder key half turn.
7. Report any leaks to your instructor.
1. Blow out the cylinder valve socket by opening the valve about a ¼ turn. Close immediately.
   This is called cracking open the cylinder valve.
   Do not crack acetylene bottles in case of fire.

   Figure 15 – Cracking Open the Cylinder Valve

2. Make sure valve socket is clean before screwing the regulator into the valve socket. Tap spanner sharply to ensure a gas-tight sealing.

   Figure 16 - Tap Spanner Sharply
3. Slacken the regulator pressure control screw so that there is no pressure on the gauge.

Figure 17 - Slacken Regulator Pressure Control Screw

4. Fit hoses. Tighten up using correct spanner. Remember:
   RH   OXYGEN
   LH   ACETYLENE

Figure 18 - Fit Hoses
5. Fit blow pipe.
   Tighten up using correct size spanner.

Figure 19 - Fit Blow Pipe

6. You are now ready to pressurise the system. That means to let gas into the system.
   (a) Open blow pipe valves.

Figure 20 - Pressurise the System
7. Turn on gas, i.e. turn key half turn.

![Image: Figure 21 - Turn on Gas]

8. Set correct pressures by adjusting regulator controls.

![Image: Figure 22 - Set Correct Pressures]


Figure 23 - Shut Blow Pipe Valves

Figure 24 - Keep Empty and Filled Cylinders Separate
11. Check system for leaks. These can be directed by feel and by smell or by painting a soapy solution into the connections.

![Check System for Leaks](image1)

**Figure 25 - Check System for Leaks**

12. Rectify leaks immediately.

![Rectify Leaks](image2)

**Figure 26 - Rectify Leaks**
The Welding Flame

The following procedures should be followed when lighting and adjusting the blowpipe flame.

1. Open all the blowpipe valves.

2. Open cylinder valves slowly by one turn of the spindle.

3. Set the regulators to the correct working pressure.
   Close blow pipe valves.

4. Open the acetylene control valve on the blow pipe about ½ - ¾ of a turn.

5. Using a pilot light or spark lighter, light the acetylene.
   (Ensure that the flame points away from you).

6. Reduce or increase the gas supply by operating the blow pipe valve until the flame just ceases to smoke.

7. Open the oxygen control valve on the blow pipe until the white inner cone in the flame is clearly visible.
   THIS IS THE CORRECT FLAME FOR WELDING MILD STEEL.

8. To extinguish the flame, close the acetylene valve and then the oxygen valve on the blow pipe.
Self Assessment

Questions on Background Notes – Module 3.Unit 3

1. What causes Longitudinal Distortion?

2. What causes Angular Distortion?
3. How can we reduce distortion?

4. What safety points should you observe when fitting new cylinders.
1.

**Longitudinal Distortion:**

If a deposit is made on one side of a flat strip of thin plate, the plate will bend upwards as it cools.

2.

**Angular Distortion:**

If a fillet weld is deposited between two plates in a tee joint the angle between the two plates will be reduced as the metal cools. Similarly angle distortion occurs in a butt joint as contraction of the weld metal pulls the plates out of alignment.
3.

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<td>Use open spanner (no vice grip)</td>
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<td>e.</td>
<td>Blow out hoses before connecting.</td>
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<tr>
<td>f.</td>
<td>Turn cylinder key half turn.</td>
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