

# SEMPEO2-30- SQA Unit Code H2M5 04

## Preparing and using manual oxy/fuel gas welding equipment



### Overview

This standard covers a broad range of basic oxy/fuel gas welding equipment competences that will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or that will provide a basis for the development of additional skills and occupational competences in the working environment.

You will be expected to prepare the welding equipment to ensure that the regulators, hoses, check valves, flashback arrestor and welding torch are securely connected and are free from leaks or damage. You will also need to obtain and check that all the workholding equipment is in a safe and usable condition.

In preparing to weld, you will need to set and adjust the gas pressures/welding conditions, in line with instructions and/or the welding procedure specification. You must operate the equipment safely and correctly, and make any necessary adjustments to settings, in line with your permitted authority, in order to produce the welded joints to the required specification.

On completion of the welding operations, you will be expected to check the quality of the welds using measuring equipment, visual examination and destructive testing techniques, as appropriate to the aspects being checked. You will need to be able to recognise welding defects, to take appropriate action to limit any faults that occur and to ensure that the finished workpiece is within the specification requirements. On completion of the welding activities, you will be expected to return all tools, equipment and workholding devices to their designated location, and to leave the welding equipment and work area in a safe and tidy condition.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the welding activities undertaken. You will need to take account of any potential difficulties or problems that may arise with the welding activities, and to seek appropriate help and advice in determining and implementing a suitable solution. You will work under a high level of supervision, whilst taking responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide an understanding of your work, and will enable you to apply appropriate oxy/fuel gas welding techniques safely. You will understand the gas welding process, and its application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for carrying out the activities to the required

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specification. You will understand the safety precautions required when working with the oxy-fuel gas welding equipment, and with its associated tools and equipment. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

#### **Specific Standard Requirements**

Welded joints must be at least 150mm long, using single or multi-run welds (as appropriate), with at least one stop and start included.

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#### Performance criteria

- You must be able to:*
- P1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
  - P2 plan the welding activities before you start them
  - P3 obtain and prepare the appropriate welding equipment and welding consumables
  - P4 prepare and support the joint, using the appropriate methods
  - P5 tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding
  - P6 weld the joint to the specified quality, dimensions and profile
  - P7 use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification
  - P8 deal promptly and effectively with problems within your control, and seek help and guidance from the relevant people if you have problems that you cannot resolve
  - P9 shut down and make safe the welding equipment on completion of the welding activities

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### Knowledge and understanding

*You need to know and understand:*

- K1 the safe working practices and procedures to be followed when preparing and using manual gas welding equipment (such as general workshop safety; appropriate personal protective equipment (PPE); fire and explosion prevention, protecting other workers, safety in enclosed/confined spaces; fume extraction/control)
- K2 the hazards associated with manual oxy/fuel gas welding (such as naked flames, fumes and gases, explosive gas mixtures, oxygen enrichment, spatter, hot metal, elevated working, welding in enclosed spaces, slips trips and falls), and how they can be minimised
- K3 the personal protective equipment to be worn for the welding activities (such as correctly fitting overalls; leather aprons, welding gloves/gauntlets; safety boots; head/eye shield with correct grade of filter)
- K4 the correct handling and storage of gas cylinders (such as manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features)
- K5 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken
- K6 the manual gas welding process (such as basic principles of gas welding and related equipment; care of the equipment)
- K7 the consumables associated with gas welding (such as types of filler wire, fluxes, the types of gas and its supply and control)
- K8 preparing the welding equipment, and the checks to be made to ensure that it is safe and ready to use (such as connection of hoses, torch, flashback arrestors, hose check valves and regulators)
- K9 checking connections for leaks, and the methods that are used
- K10 setting gas working pressures; reading the gauges to establish content and pressures
- K11 the types of welded joints to be produced (such as lap joints, corner joints, tee joints and butt welds)
- K12 terminology used for the appropriate welding positions
- K13 how to prepare the materials in readiness for the welding activity (such as ensuring that the material is free from excessive surface contamination - such as rust, scale, paint, oil/grease and moisture; ensuring edges to be welded are correctly prepared - such as made flat, square or bevelled)
- K14 how to set up and restrain the joint, and the tools and techniques to be used (such as the use of jigs and fixtures, restraining devices - such as clamps and weights/blocks; setting up the joint in the correct position and

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- alignment)
- K15 tack welding size and spacing (in relation to material thickness)
  - K16 the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as selection of nozzle, lighting and adjusting the flame, correct manipulation of torch and filler rods)
  - K17 the safe and correct sequence for shutting down the equipment (such as sequence of turning off the gases, extinguishing the flame and closing valves on the gas supply/cylinders)
  - K18 control of heat input to prevent filler material and parent material faults (such as welding sequence; deposition technique)
  - K19 problems that can occur with the welding activities (such as causes of distortion and methods of control; effects of welding on materials and sources of weld defects), and how these can be overcome
  - K20 the safe working practices and procedures to be adopted when preparing the welds for examination (such as handling hot materials, using chemicals for cleaning and etching, using equipment to fracture welds)
  - K21 how to prepare the welds for examination (such as removing surface irregularities; cleaning the weld, polishing and making saw cuts on welds to be break tested)
  - K22 how to check the welded joints for uniformity, alignment, position, weld size and profile
  - K23 the various procedures for visual examination of the welds for cracks, porosity and inclusions (such as dye penetrant, fluorescent penetrant; magnetic particle testing)
  - K24 the various procedures for carrying out destructive tests on the welds (such as macroscopic examination, bend tests, nick break tests)
  - K25 methods of removing a specimen of weld from a suitable position in the joint (such as a stop/start position), using a non thermal process (such as hand saws, power saws, abrasive discs)
  - K26 how to examine the welds after the tests, and how to check for such defects as the degree of penetration and fusion, inclusions, porosity, cracks
  - K27 when to act on your own initiative and when to seek help and advice from others
  - K28 the importance of leaving the work area and equipment in a safe condition on completion of the gas welding activities (such as isolation of gas cylinders; safely storing cylinders, hoses and torches; storing filler rods; removing and disposing of waste)

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### Additional Information

#### Scope/range related to performance criteria

*You must be able to:*

1. Prepare for the gas welding process by carrying out **all** of the following:
  - 1.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
  - 1.2 check regulators, hoses and check that valves are securely connected and free from leaks and damage
  - 1.3 check/fit the correct gas nozzle to the torch
  - 1.4 check that a flashback arrestor is fitted
  - 1.5 set appropriate gas pressures
  - 1.6 use the correct procedure for lighting, adjusting and extinguishing the welding flame
  - 1.7 use appropriate and safe procedures for handling and storing of gas cylinders
  - 1.8 prepare the work area for the welding activities (such as positioning welding screens and fume extraction)
  - 1.9 prepare the materials and joint in readiness for welding (such as cleaning of joint faces, grinding weld preparations, setting up the joint, supporting the joint)
  - 1.10 make sure the work area is maintained and left in a safe and tidy condition
  
2. Produce **three** of the following welded joints of at least 150mm long, by single or multi-run (as appropriate), with at least one stop and start included:
  - 2.1 fillet lap joints
  - 2.2 butt joints
  - 2.3 Tee fillet joints
  - 2.4 welds made without filler wire (autogenously)
  - 2.5 corner jointsUsing **one** of the following methods:
  - 2.6 with filler wire
  - 2.7 without filler wire (autogenously)
  
3. Produce joints in **one** form of material from the following:
  - 3.1 sheet (less than 3mm)
  - 3.2 section
  - 3.3 pipe/tube

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- 3.4 plate
  - 3.5 other forms
4. Weld joints in good access situations in **two** of the following BS EN ISO 6947 positions:
- 4.1 Flat (PA)
  - 4.2 Horizontal vertical (PB)
  - 4.3 Horizontal (PC)
  - 4.4 Vertical upwards (PF)
  - 4.5 Vertical downwards (PG)
5. Check that the welded joint conforms to the specification, by checking **all** of the following:
- 5.1 dimensional accuracy
  - 5.2 size and profile of weld
  - 5.3 number of runs
  - 5.4 alignment/squareness
6. Carry out non-destructive testing of the welds, using **one** of the following:
- 6.1 dye penetrant
  - 6.2 fluorescent penetrant
  - 6.3 magnetic particle
7. Carry out destructive tests on weld specimens using **one** of the following:
- 7.1 macroscopic examination
  - 7.2 nick break test
  - 7.3 bend tests (such as face, root or side, as appropriate)
8. Identify **all** of the following weld defects:
- 8.1 lack of continuity of the weld
  - 8.2 uneven and irregular ripple formation
  - 8.3 incorrect weld size or profile
- Plus **four** more of the following:
- 8.4 undercutting
  - 8.5 surface cracks
  - 8.6 overlap
  - 8.7 internal cracks
  - 8.8 inclusions
  - 8.9 lack of fusion
  - 8.10 porosity
  - 8.11 lack of penetration
9. Produce welded joints which meet **all** of the following (with reference to BS 4872 Part 1 Weld test requirements):
- 9.1 welds meet the required dimensional accuracy
  - 9.2 fillet welds are equal in leg length and slightly convex in profile

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- (where appropriate), with the size of the fillet equivalent to the thickness of the material welded
- 9.3 the weld contour is linear, of uniform profile, free from excessive undulations, with regular and even ripple
  - 9.4 the welds are adequately fused, and there is minimal undercut and overlap
  - 9.5 weld finishes are built up to the full section of the weld
  - 9.6 joins at stop/start positions merge smoothly, with no pronounced hump or crater in the weld surface
  - 9.7 tack welds are blended in to form part of the finished weld, without excessive hump
  - 9.8 corner joints have minimal burn through to the underside of the joint or, where appropriate, penetration is present to a maximum depth of 3mm for at least 75% of the joint
  - 9.9 the weld surface is free from cracks, and substantially free from porosity, shrinkage cavities and trapped slag
  - 9.10 the weld surface and adjacent parent metal is substantially free from spatter or chipping marks



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