

## Unit 007

## Forming and assembling pipework systems

**Level:** 2

**Credit value:** 14

**NDAQ number:** 500/9514/6

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to cover a broad range of basic pipe fitting activities that will prepare the learner 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.

The learner will be expected to prepare for the pipe fitting activities by obtaining all the necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required pipe fitting activities and the sequence of operations they intend to use. The learner will be expected to select the appropriate equipment to use, based on the operations to be carried out and the accuracy required.

In producing the pipework systems, the learner will be expected to select and use a range of hand tools, pipe bending and forming equipment and pipe assembly techniques, appropriate to the type of material and operations being performed. Activities will include cutting the pipes to the required lengths using hand saws, power saws or pipe cutters; bending pipes using hand bending machines, springs, fillers or heating techniques; and the use of templates or set wires to check bend profiles which will include angular bends, offsets, bridge sets and expansion loops. The learner will then be expected to assemble the pipes, using a range of different connectors such as straight connectors, elbows, tee pieces, reducers, tank connectors and valves.

During, and on completion of, the pipe fitting operations, the learner will be expected to check the quality of the work, using measuring equipment appropriate to the aspects being checked and the tolerances to be achieved. The learner will need to be able to recognise pipe bending and fitting defects, to take appropriate action to remedy any faults that occur and to ensure that the finished system is within the drawing requirements. On completion of the pipe fitting activities, the learner will be expected to return all tools and equipment to the correct locations, and to leave the work area in a safe and tidy condition.

The learner's responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the pipe bending, forming and fitting activities undertaken. The learner will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. The learner will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide an understanding of their work, and will enable them to apply appropriate pipe bending, forming and fitting techniques safely. The learner will understand the pipe bending, forming and fitting equipment and techniques, and their 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 specification.

The learner will understand the safety precautions required when carrying out the pipe bending, forming and fitting activities, and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Form and assemble pipework systems
2. Know how to form and assemble pipework systems

### **Guided learning hours**

It is recommended that **64** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from national occupational standard Performing Engineering Operations Unit No. 7: Forming and assembling pipework systems (Suite 2).

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Performing Engineering Operations Level 2 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

### **Unit specific additional assessment requirements:**

In order to prove their ability to combine different pipe assembly operations, at least one of the pipe assemblies produced must be of a significant nature, and must have a minimum of five of the fittings listed in assessment criteria 1.13.

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### Outcome 1

### Form and assemble pipework systems

#### Assessment Criteria

##### Practical skills

The learner will be able to:

1. work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
2. carry out all of the following during the pipe bending, forming and fitting activities:
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
  - check that the bending and forming equipment is in a safe and usable condition
  - return all tools and equipment to the correct location on completion of the pipe fitting activities
  - apply safe working practices at all times
3. plan the pipe fitting activities before they start them
4. produce pipework assemblies using two of the following types of pipe:
  - carbon steel
  - stainless steel
  - copper
  - brass
  - aluminium
  - plastic
5. mark out pipework, using the following method:
  - direct marking using tapes and markers
  - plus one more from the following:
    - set-outs of pipework using templates
    - producing set wires
    - set-outs of pipework onto floor
6. cut the pipes to the appropriate lengths making allowances for bending and attachment of fittings
7. cut and prepare the pipes for forming and assembly, to include carrying out all of the following:
  - cutting pipes to length with appropriate allowance for fittings
  - removing all external and internal burrs
  - cleaning pipe ends for soldering or gluing (where appropriate)
  - cutting threads on pipe ends to the appropriate length (where appropriate)
  - checking that prepared pipes are the correct length

8. cut and prepare pipework using the following:
  - saws (hand or power)plus two more from the following:
  - pipe/tube cutter
  - de-burring reamers
  - abrasive cloth
  - wire pipe cleaners
9. bend and form the pipes using the appropriate tools and equipment for the types and sizes of pipe
10. bend and form pipe using the following method:
  - hand operated pipe benderplus one more of the following:
  - bending springs
  - hydraulic pipe bending equipment
  - pipe expander
  - heating methods
  - swaging kit
  - fillers
11. produce pipework bends/forms that include both of the following:
  - angular bends
  - offsetsplus one more from the following:
  - bridge sets
  - expansion loops
  - radii
  - external swaged ends
  - internal swaged ends
12. assemble and secure the pipework, using the correct fittings and joining techniques
13. produce pipework assemblies which combine a range of different fittings, covering all of the following:
  - straight couplings
  - elbows
  - tee piecesplus three more from the following:
  - flanges
  - unions
  - reduction pieces
  - valves
  - drain/bleeding devices
  - blanking caps
  - screwed fittings (such as tank, tap, pump, gauges)
14. assemble pipes using three of the following methods:
  - compression fittings
  - snap-on/push fittings

- screwed connections
  - soldered fittings
  - brazed fittings
  - cemented/glued fittings
  - welded joints
15. assemble pipework using all of the following methods and techniques:
- securing pipework supports to structures
  - fitting pipework supports
  - connecting pipe-to-pipe
  - connecting pipe-to-equipment
  - using gaskets, seals/sealing tapes or jointing compounds
  - alignment/levelling equipment
16. produce pipework assemblies which comply with all of the following:
- pipes are bent to the appropriate shape/form and position
  - all pipe bends are free from buckling or deformation
  - appropriate fittings are used, and are secure and leak free
  - soldered and glued fittings are free from excessive residues
  - the completed assembly meets the specific system requirements
17. check the completed assembly to ensure that all operations have been completed and that the finished pipe assembly meets the required specification
18. test the completed pipe assembly, using the appropriate techniques, tools and equipment
19. carry out tests on the assembled pipework, to include one of the following:
- hydraulic pressure testing
  - water testing
  - soap and water bubble test
20. deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
21. leave the work area in a safe and tidy condition on completion of the assembly activities

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### Outcome 2

### Know how to form and assemble pipework systems

#### Assessment Criteria

#### Underpinning knowledge

The learner will be able to:

1. describe the health and safety requirements, and safe working practices and procedures required for the pipe fitting activities undertaken
2. describe the importance of wearing appropriate protective clothing and equipment, and keeping the work area safe and tidy
3. describe the hazards associated with the pipe fitting activities (such as handling long pipe lengths, using damaged or badly maintained tools and equipment, using pipe bending equipment, using heating and soldering equipment), and how they can be minimised
4. describe the procedure for obtaining the required drawings, job instructions and other related specifications
5. explain 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
6. explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
7. describe the principles and methods of marking out pipework, and the type of equipment used (such as direct marking, use of templates, use of set wires)
8. explain how to prepare the pipes in readiness for the marking out activities (visually checking for defects, cleaning the materials, removing burrs and sharp edges)
9. explain how to determine the overall length of the pipework required, taking into account allowances for pipe fittings and (where appropriate) screwed connections
10. describe the tools and equipment used in the cutting and preparing the pipes (such as saws, pipe and tube cutters)
11. describe the characteristics of the various materials that are to be used with regard to the bending operations, and why some materials may require the addition of heat/hot air to aid the bending process
12. describe the methods used to hand bend and form the pipe (including the use of bending springs, hand bending machines, fillers, heating methods)
13. explain how to produce the various bends required (such as angled bends, dog-leg sets, bridge sets and expansion loops)
14. describe the reasons for incorporating expansion loops in a system, and where they should be positioned
15. explain how to prepare pipework and fittings for the assembly operation (such as checking for damage, removing foreign objects, dirt and swarf from bore of pipe, removing burrs)
16. describe the range of pipe fittings that can be used, and how to identify them (such as straight connectors, elbows, tee pieces, reduction pieces, flanged fittings, valves, blanking pieces/cap ends)
17. describe the different types of fittings available, such as screwed fittings, soldered fittings, compression fittings, push fit fittings and glued/cemented fittings
18. explain how to produce screw threads on the pipe ends, and the tools and equipment that can be used (such as stocks and dies, pipe threading machines)
19. describe the methods used to seal screwed joints (such as tapes and sealing compounds)
20. describe the use of flanges to connect pipes; use of gaskets; and torque loading of flange bolts

21. describe the methods used to prepare pipe ends and fittings for soldering or brazing, and why it is necessary to ensure that these preparations are carried out
22. describe the various types of soldered connectors available (such as solder ring types and capillary fittings)
23. describe the methods used to solder the joints, and how to recognise when the fitting is correctly soldered
24. describe the precautions to be taken when using gas torches to form the joint, and the effect of overheating the joint
25. describe the methods used to prepare pipe ends and fittings when using adhesives, and why it is necessary to ensure that these preparations are carried out
26. describe the methods used to glue the joints, and how to recognise when the fitting is correctly secured
27. describe the various adhesives and sealing compounds that are used on non-metallic pipework
28. describe the precautions to be taken when using the adhesives and sealing compounds (such as adequate ventilation, away from naked flames, avoiding skin contact)
29. describe the use of compression fittings; how the pipes are sealed; and the effects of over tightening the fittings
30. describe the use of push-fit connectors, and their advantages and disadvantages
31. explain how to identify the correct orientation of fittings with regard to flow, and the consequences of incorrect orientation
32. describe the supporting methods that are used when assembling pipework, and the type of fittings that are used
33. describe the methods of testing pipework systems for leaks (using air, water or hydraulic testing methods)
34. describe the extent of their own responsibility and whom they should report to if they have problems that they cannot resolve
35. describe the importance of leaving the work area in a safe and clean condition on completion of the pipework assembly activities (such as removing and storing power leads, returning hand tools and equipment to its designated location, cleaning the work area and removing and disposing of waste)