

Unit 022

Producing sheet metal components and assemblies

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 sheet (up to and including 3 mm) metalworking 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 sheet metalworking activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required cutting, forming and assembly activities, and the sequence of operations they intend to use.

The learner will be required to select the appropriate equipment to use, based on the type and thickness of material, the operations to be carried out and the accuracy to be achieved. In carrying out the cutting and shaping activities, the learner will need to use a range of hand tools, portable power tools and simple machines to produce a variety of shapes, profiles and forms. The learner will also be expected to produce simple sheet metal assemblies, using self-secured joints, thermal methods or mechanical fastening devices.

The learner's responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the sheet metalworking 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 sheet metalworking techniques and procedures safely. The learner will understand the cutting, forming and assembly process, and its application, and will know about the tools and equipment used, 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 sheet metalworking activities, and when using the various tools and equipment, especially with the use of guillotines and bending/forming 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. Produce sheet metal components and assemblies
2. Know how to produce sheet metal components and assemblies

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. 22: Producing sheet metal components and assemblies (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

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

Unit specific additional assessment requirements:

In order to prove their ability to combine different sheet metal cutting and forming operations, at least one of the jobs produced must be of a significant nature, and must contain a minimum of three of the features listed in assessment criteria 1.13 plus three of the features listed in assessment criteria 1.15.

Unit 022

Producing sheet metal components and assemblies

Outcome 1

Produce sheet metal components and assemblies

Assessment Criteria

Practical knowledge

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 sheet metalworking activities:
 - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
 - ensure that all power tool cables, extension leads or air supply hoses are in a serviceable condition
 - return all tools and equipment to the correct location on completion of the sheet metalworking activities
 - check that all measuring equipment is within calibration date
3. plan the sheet metalworking activities before they start them
4. use sheet metal (up to and including 3 mm) in two different materials from the following:
 - black mild steel
 - bright mild steel
 - coated mild steel (such as tinned, galvanised)
 - stainless steel
 - aluminium
 - brass
 - copper
 - lead
 - titanium
5. obtain the appropriate tools and equipment for the sheet metalworking operations, and check that they are in a safe and usable condition
6. use a range of marking out equipment, to include all of the following:
 - scribe
 - punch
 - rule or tape
 - straight edge
 - square
 - protractor
 - dividers or trammels
 - chalk, blueing or paint
7. mark out the components for the required operations, using appropriate tools and techniques
8. use marking out methods and techniques, including:
 - direct marking using instruments

plus one more from the following:

- use of templates
- tracing/transfer methods

9. mark out material, to include all of the following features:

- datum and centre lines
- square/rectangular profiles
- angles
- circles
- curved profiles
- cutting and bending detail (including allowances)
- hole centring and outlining (such as circular or linear)

10. cut and shape the materials to the required specification, using appropriate tools and techniques

11. cut and finish material to the marked out shape, using both of the following hand tools:

- tin snips
- bench shears

plus two more from the following:

- hacksaw
- hand power tools (such as drill, nibbling, saw)
- trepanning
- files
- pneumatic tools
- plasma burner

12. cut and finish material to the marked out shape, using the following machine tool:

- guillotine

plus two more of the following:

- pillar drill
- bench saw
- punch/cropping machine
- nibbling machine
- trepanning machine
- band saw

13. perform cutting operations to produce components with all three of the following shapes:

- square or rectangular profiles
- angled profiles
- external curved profiles

plus two more from the following:

- notches
- internal curved contours
- round holes
- square holes

14. use both of the following types of forming equipment/techniques:

- bending machine (hand or powered)
- rolling machine (hand or powered)

plus two more from the following:

- hammers/panel beating equipment
- stakes and formers
- presses
- jenny/wiring machine
- wheeling machine
- swaging machine
- shrinking techniques
- stretching techniques

15. carry out forming operations which produce components having all of the following shapes:

- bends/upstands
- folds/safe edges
- tray/box sections
- cylindrical sections

plus one more from the following:

- wired edges
- swages
- curved panels
- ribbed components
- cowlings and rounded covers
- square to round trunking
- lobster-back trunking
- concertina ducting or trunking

16. use the appropriate methods and techniques to assemble and secure the components in their correct positions

17. assemble sheet metal components, using two of the following methods:

- temporary tack welding
- soldering or brazing
- resistance spot welding
- riveting (such as hollow or solid)
- adhesive bonding
- flanged and mechanically fastened (such as bolts, screws)
- self securing joints (such as knocked up, paned down, swaged, joggled)

18. measure and check that all dimensional and geometrical aspects of the component are to the specification

19. produce sheet metal components which meet all of the following:

- all dimensions are within $\pm 3.0\text{mm}$ or $\pm 0.125''$
- finished components meet the required shape/geometry (square, straight, angles free from twists)
- completed components are free from excessive tooling marks, deformation, cracking, sharp edges, slivers or burrs
- all components are correctly assembled and have secure and firm joints

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 fitting activities

Unit 022

Producing sheet metal components and assemblies

Outcome 2

Know how to produce sheet metal components and assemblies

Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements, and safe working practices and procedures required for the sheet metalworking activities undertaken
2. describe the personal protective clothing and equipment to be worn when carrying out the sheet metal activities (such as leather gloves, eye protection, ear protection), and the importance of keeping the work area safe and tidy
3. describe the correct methods of moving or lifting sheet materials
4. describe the safe working practices and procedures to be observed when using manual and power operated tools
5. describe the hazards associated with carrying out sheet metalworking activities (such as handling sheet materials, using dangerous or badly maintained tools and equipment, operating guillotines and bending machines, and when using hand and bench shears), and how they can be minimised
6. describe the procedure for obtaining the required drawings, job instructions and other related specifications
7. 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
8. explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
9. explain how to prepare the materials in readiness for the marking out activities, in order to enhance clarity, accuracy and safety (such as visually checking for defects, cleaning the materials, removing burrs and sharp edges, applying a marking out medium)
10. explain how to select and establish a suitable datum; the importance of ensuring that marking out is undertaken from the selected datum, and the possible effects of working from a different datum
11. describe the use of marking out conventions when marking out the workpiece (including datum lines, cutting guidelines, square and rectangular profiles, circular and radial profiles, angles, holes linearly positioned, boxed and on pitch circles)
12. describe the ways of laying out the marking-out shapes or patterns to maximise use of materials
13. describe the tools and techniques available for cutting and shaping sheet metal (such as tin snips, bench shears, guillotines, portable power tools, bench drills, saws)
14. describe the use and care of tools and equipment (including checks that must be made to ensure that the tools are fit for purpose - such as sharp, undamaged, plugs and cables secure and free from damage, machine guards or safety devices operating correctly)
15. describe the hand tools used in sheet metal forming activities (such as range of hammers, stakes, formers, sand bags), and typical operations that they are used for
16. describe the various machine tool forming equipment that can be used to produce a range of shapes (such as bends, box sections, cylinders and curved sections, wired edges and swages)
17. describe the methods of stretching and shrinking materials, and the tools, equipment and techniques used for this
18. explain how to set up the various machines to produce the required forms (setting up of rolls; setting fingers on bending machines; setting forming tools for swaging)

19. describe the ways of limiting distortion, marking, creases, flats (in curved sections)
20. describe the characteristics of the various materials used (with regard to the bending and forming process)
21. explain how the materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming
22. describe the importance of using tools or equipment only for the purpose intended; the care that is required when using the tools or equipment; the proper way of preserving tools or equipment between operations
23. describe the various methods of securing the assembled components, and the range of mechanical fastening devices that are used (such as nuts and bolts, rivets, screws, special fasteners), resistance and tack welding methods and techniques, adhesive bonding of components and self secured joints (such as knocked up, paned down, swaged and joggled)
24. describe the preparations to be carried out on the components prior to assembling them
25. explain how to set up and align the various components, and the tools and equipment that are used for this
26. describe the methods of temporarily holding the joints together to aid the assembly activities (such as clamps, rivet clamps)
27. describe the inspection techniques that can be applied to check that shape (including straightness) and dimensional accuracy are to specification and within acceptable limits
28. describe the problems that can occur with the sheet metalworking activities (such as defects caused by incorrectly set or blunt shearing blades), and how these can be overcome
29. explain when to act on their own initiative and when to seek help and advice from others
30. describe the importance of leaving the work area and equipment in a safe and clean condition on completion of the sheet metal activities (such as storing power leads, isolating machines, cleaning the equipment and removing and disposing of waste)