SEMPEO2-22 - SQA Unit Code FP2X 04
Producing sheet metal components and assemblies

Overview

This standard covers a broad range of basic sheet (up to and including 3 mm) metalworking 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 for the sheet metalworking activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how you intend to carry out the required cutting, forming and assembly activities, and the sequence of operations you intend to use.

You 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, you will need to use a range of hand tools, portable power tools and simple machines to produce a variety of shapes, profiles and forms. You will also be expected to produce simple sheet metal assemblies, using self-secured joints, thermal methods or mechanical fastening devices.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the sheet metalworking activities undertaken. You 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. 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 sheet metalworking techniques and procedures safely. You 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.

You 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. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

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Specific Standard Requirements

In order to prove your 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 scope 7 plus **three** of the features listed in scope 9.

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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 sheet metalworking activities before you start them

P3 obtain the appropriate tools and equipment for the sheet metalworking operations, and check that they are in a safe and usable condition

P4 mark out the components for the required operations, using appropriate tools and techniques

P5 cut and shape the materials to the required specification, using appropriate tools and techniques

P6 use the appropriate methods and techniques to assemble and secure the components in their correct positions

P7 measure and check that all dimensional and geometrical aspects of the component 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 leave the work area in a safe and tidy condition on completion of the fitting activities

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Knowledge and understanding

You need to know and understand:

K1 the health and safety requirements, and safe working practices and procedures required for the sheet metalworking activities undertaken

K2 the personal protective clothing and equipment (PPE)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

K3 the correct methods of moving or lifting sheet materials

K4 safe working practices and procedures to be observed when using manual and power operated tools

K5 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

K6 the procedure for obtaining the required drawings, job instructions and other related specifications

K7 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

K8 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

K9 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)

K10 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

K11 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)

K12 ways of laying out the marking-out shapes or patterns to maximise use of materials

K13 the tools and techniques available for cutting and shaping sheet metal (such as tin snips, bench shears, guillotines, portable power tools, bench drills, saws)

K14 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, PAT tested, machine guards or safety devices operating correctly)

K15 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

K16 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)

K17 methods of stretching and shrinking materials, and the tools, equipment and techniques used for this

K18 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)

K19 ways of limiting distortion, marking, creases, flats (in curved sections)

K20 the characteristics of the various materials used (with regard to the bending and forming process)

K21 how the materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming

K22 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

K23 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)

K24 the preparations to be carried out on the components prior to assembling them

K25 how to set up and align the various components, and the tools and equipment that are used for this

K26 methods of temporarily holding the joints together to aid the assembly activities (such as clamps, rivet clamps)

K27 inspection techniques that can be applied to check that shape (including straightness) and dimensional accuracy are to specification and within acceptable limits

K28 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

K29 when to act on your own initiative and when to seek help and advice from others

K30 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)

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Additional Information

Scope/range related to performance criteria

You must be able to:

1. Carry out **all** of the following during the sheet metalworking activities:
   - 1.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE)and other relevant safety regulations
   - 1.2 ensure that all power tool cables, extension leads or air supply hoses are in a tested and serviceable condition
   - 1.3 return all tools and equipment to the correct location on completion of the sheet metalworking activities
   - 1.4 check that all measuring equipment is within calibration date

2. Use marking out methods and techniques, including:
   - 2.1 direct marking using instruments

   Plus **one** more from the following:
   - 2.2 use of templates
   - 2.3 tracing/transfer methods

3. Use a range of marking out equipment, to include **all** of the following:
   - 3.1 scriber
   - 3.2 rule or tape
   - 3.3 square
   - 3.4 dividers or trammels
   - 3.5 punch
   - 3.6 straight edge
   - 3.7 protractor
   - 3.8 chalk, blueing or paint

4. Mark out material, to include **all** of the following features:
   - 4.1 datum and centre lines
   - 4.2 curved profiles
   - 4.3 square/rectangular profiles
   - 4.4 cutting and bending detail (including allowances)
   - 4.5 angles
   - 4.6 hole centring and outlining (such as circular or linear)
   - 4.7 circles

5. Cut and finish material to the marked out shape, using **both** of the following hand tools:

5.1 tin snips
5.2 bench shears
Plus **two** more from the following:
5.3 hacksaw
5.4 files
5.5 hand power tools (such as drill, nibbling, saw)
5.6 pneumatic tools
5.7 trepanning
5.8 thermal device
5.9 other specific tool

6. Cut and finish material to the marked out shape, using the following machine tool:
6.1 guillotine
Plus **two** more of the following:
6.2 pillar drill
6.3 punch/cropping machine
6.4 trepanning machine
6.5 bench saw
6.6 nibbling machine
6.7 band saw

7. Perform cutting operations to produce components with **all three** of the following shapes:
7.1 square or rectangular profiles
7.2 angled profiles
7.3 external curved profiles
Plus **two** more from the following:
7.4 notches
7.5 internal curved contours
7.6 round holes
7.7 square holes

8. Use **both** of the following types of forming equipment/techniques:
8.1 bending machine (hand or powered)
8.2 rolling machine (hand or powered)
Plus **two** more from the following:
8.3 hammers/panel beating equipment
8.4 wheeling machine
8.5 stakes and formers
8.6 swaging machine
8.7 presses
8.8 shrinking techniques
8.9 jenny/wiring machine
8.10 stretching techniques

9. Carry out forming operations which produce components having **all** of the following shapes:
   - 9.1 bends/upstands
   - 9.2 tray/box sections
   - 9.3 folds/safe edges
   - 9.4 cylindrical sections

   Plus **one** more from the following:
   - 9.5 wired edges
   - 9.6 cowlings and rounded covers
   - 9.7 swages
   - 9.8 square to round trunking
   - 9.9 curved panels
   - 9.10 lobster-back trunking
   - 9.11 ribbed components
   - 9.12 concertina ducting or trunking

10. Assemble sheet metal components, using **two** of the following methods:
    - 10.1 temporary tack welding
    - 10.2 adhesive bonding
    - 10.3 soldering or brazing
    - 10.4 flanged and mechanically fastened (such as bolts, screws)
    - 10.5 resistance spot welding
    - 10.6 self securing joints (such as knocked up, paned down, swaged, joggled)
    - 10.7 riveting (such as hollow or solid)

11. Use sheet metal (up to and including 3 mm) in **two** different materials from the following:
    - 11.1 hot rolled mild steel
    - 11.2 cold rolled mild steel
    - 11.3 coated mild steel (such as primed, tinned, galvanised)
    - 11.4 copper
    - 11.5 brass
    - 11.6 lead
    - 11.7 stainless steel
    - 11.8 titanium
    - 11.9 aluminium

12. Produce sheet metal components which meet **all** of the following:
    - 12.1 all dimensions are within +/- 2.0mm or +/- 0.079”
    - 12.2 finished components meet the required shape/geometry (square, straight, angles free from twists)
    - 12.3 completed components are free from excessive tooling marks, deformation, cracking, sharp edges, slivers or burrs
    - 12.4 all components are correctly assembled and have secure and firm joints

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Developed by	SEMTA
Version number	2
Date approved	December 2011
Indicative review date	December 2016
Validity	Current
Status	Original
Originating organisation	SEMTA
Original URN	22
Relevant occupations	Engineering and manufacturing technologies; Engineering;
Suite	Performing Engineering Operations Suite 2
Key words	engineering, engineering operations, sheet metal components, sheet metal assemblies, metalworking, manufacturing, cutting, shaping, profiles, forms