SEMPEO2-66
General fabrication and welding applications

Overview

This standard covers a broad range of basic fabrication, assembly and welding 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 carry out practical exercises in order to gain an understanding of how these fabrication, assembly and welding activities are undertaken, the type of equipment used and the manufacturing techniques and operating and safety procedures that are required.

In carrying out the activities, you will use appropriate tools and equipment, based on the type and thickness of material and the operations to be carried out. You will need to mark out the material for the features to be produced, and then to use hand tools, portable power tools and machines to produce a variety of shapes, profiles and forms. You will also be expected to produce fabrication assemblies using mechanical fastening devices; self secured joints, and thermal joining methods.

During, and on completion of, the operations, you will be expected to check the quality of the workpiece, using measuring equipment appropriate to the aspects being checked and the tolerances to be achieved. You will need to be able to recognise when the activities are not meeting the required specification, and to discuss/determine what action needs to be taken to remedy any faults that occur, in order to ensure that the finished workpiece is within the specification requirements. On completion of the activities, you will be expected to return all tools and equipment that you have used to the correct location, and to leave the 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 fabrication, assembly and welding 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 fabrication, assembly and welding techniques and procedures safely. You will understand the cutting, forming,

assembly and welding processes, and their 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 the fabrication activities, and when using the various tools and equipment, especially those involved in using 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.

SEMPEO2-66
General fabrication and welding applications

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 determine what has to be done and how you are going to do it

P3 obtain the appropriate tools and equipment for the fabrication and welding operations

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 manufacturing activities

SEMPEO2-66
General fabrication and welding applications

Knowledge and understanding

You need to know and understand:

K1 the health and safety requirements, and safe working practices and procedures required for the fabrication and welding activities undertaken

K2 the personal protective clothing and equipment (PPE) to be worn when carrying out the fabrication and welding activities (such as leather gloves, eye protection, ear protection), and the importance of keeping the work area safe and tidy

K3 the hazards associated with carrying out fabrication and welding activities (such as handling sheet materials; using dangerous or badly maintained tools and equipment; operating guillotines and bending machines; using hand and bench shears; the electric arc; fumes and gases; spatter; hot slag and metal), and how they can be minimised

K4 how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

K5 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

K6 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)

K7 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

K8 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)

K9 the tools and techniques available for cutting and shaping sheet materials (such as tin snips, bench shears, guillotines, portable power tools, bench drills, saws)

K10 the use and care of tools and equipment (including checks that must be made to ensure that the tools are fit for purpose and tested - such as sharp, undamaged, plugs and cables secure and free from damage, machine guards or safety devices operating correctly)

K11 hand tools used in fabrication forming activities, and typical operations that they are used for (such as hammers, stakes, formers, sand bags)

K12 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)

K13 how to set up the various machines to produce the required forms (such as setting up of rolls; setting fingers on bending machines; setting forming tools for swaging)

K14	the characteristics of the various materials used, with regard to the bending and forming process
K15	how the materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming
K16	the various methods of securing the assembled components (the range of mechanical fastening devices that are used (such as nuts and bolts, 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)
K17	the preparations to be carried out on the components prior to assembling them
K18	how to set up and align the various components, and the tools and equipment to be used
K19	methods of temporarily holding the joints together to aid the assembly activities (clamps, rivet clamps)
K20	basic principles of fusion welding and the types of welded joints to be produced (such as lap joints, corner joints, tee joints and butt welds)
K21	the various welding techniques that can be used, and their typical applications (such as manual metal arc (MMA), MIG/MAG, TIG and manual oxy/fuel gas welding)
K22	types, selection and application of filler wires and welding electrodes
K23	inspection techniques that can be applied to check that shape (including straightness) and dimensional accuracy are to specification and within acceptable limits
K24	the problems that can occur with the fabrication and welding activities (such as defects caused by incorrectly set or blunt shearing blades), and how these can be overcome
K25	when to act on your own initiative and when to seek help and advice from others
K26	the importance of leaving the work area and equipment in a safe and clean condition on completion of the fabrication and welding activities (such as isolating machines, cleaning the equipment, and removing and disposing of waste)

SEMPEO2-66
General fabrication and welding applications

Additional Information

Scope/range related to performance criteria

You must be able to:

1. Carry out **all** of the following during the fabrication and welding 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 hand tools and equipment used are in a safe and serviceable condition including PAT tested (such as extension leads, powered hand tools and welding equipment cables, welding plant hoses, the striking faces of chisels and hammers, guillotines, shears and forming machines)
   - 1.3 check that all measuring equipment to be used is within calibration date
   - 1.4 return all tools and equipment to the correct location on completion of the fabrication activities

2. Use **two** appropriate materials from the following:
   - 2.1 hot rolled mild steel
   - 2.2 stainless steel
   - 2.3 copper
   - 2.4 cold rolled mild steel
   - 2.5 aluminium
   - 2.6 lead
   - 2.7 coated mild steel (such as primed, tinned, galvanised)
   - 2.8 brass
   - 2.9 titanium

3. Mark out materials, using methods and techniques which include **all** of the following:
   - 3.1 preparing/determining suitable datums from which to mark out
   - 3.2 applying a marking medium to enhance clarity of the marking out (such as chalk, bluing or paint)
   - 3.3 using an appropriate method of marking out (such as direct marking using instruments, use of templates or tracing/transfer methods)
   - 3.4 using a range of marking-out equipment (such as rules/tapes, straight edge, squares, scribers, dividers or trammels, protractors, punch)
   - 3.5 marking out a range of features (such as datum/centre lines, square/rectangular profiles, circles/radial profiles, hole positions,

cutting and bending detail)

4. Cut and form material to the marked-out shape, using **six** of the following hand tools:
   - 4.1 tin snips
   - 4.2 stakes and formers
   - 4.3 bench shears
   - 4.4 trepanning
   - 4.5 saws (such as hand, mechanical, band)
   - 4.6 files
   - 4.7 hand power tools (such as drill, nibbling, saw)
   - 4.8 pneumatic tools
   - 4.9 hammers/panel beating equipment
   - 4.10 free hand thermal cutting (such as gas or plasma)

5. Cut and form material to the marked-out shape, using **all** of the following machine tools:
   - 5.1 guillotine
   - 5.2 pillar or bench drill
   - 5.3 bending machine (hand or powered)

   Plus **two** more from the following:
   - 5.4 press
   - 5.5 trepanning machine
   - 5.6 punch/cropping machine
   - 5.7 wheeling machine
   - 5.8 nibbling machine
   - 5.9 jenny/wiring machine
   - 5.10 rolling machine (hand or powered)
   - 5.11 swaging machine

6. Perform cutting and forming operations to produce **four** of the following shapes:
   - 6.1 straight cuts
   - 6.2 external curved contours
   - 6.3 round holes
   - 6.4 cut-ins (straight and curved)
   - 6.5 internal curved contours
   - 6.6 square holes
   - 6.7 notches

   Plus **four** of the following:
   - 6.8 bends/upstands
   - 6.9 swages
   - 6.10 square-to-round trunking
   - 6.11 folds/safe edges
   - 6.12 curved panels
   - 6.13 ribbed components

6.14 tray/box sections
6.15 cylindrical sections
6.16 wired edges

7. Assemble fabricated components, using **four** of the following methods:
   7.1 temporary tack welding
   7.2 adhesive bonding
   7.3 soldering or brazing
   7.4 mechanically fastened (such as bolts, screws)
   7.5 resistance spot welding
   7.6 self securing joints (such as knocked up, paned down, swaged, joggled)
   7.7 riveting (such as hollow or solid)

8. Use manual welding and related equipment, to include **one** of the following welding processes:
   8.1 manual metal-arc (MMA)
   8.2 MIG/MAG
   8.3 TIG
   8.4 manual oxy/fuel gas welding

9. Produce **two** of the following welded joints of at least 150mm long, with at least one stop and start included:
   9.1 fillet lap joints
   9.2 corner joints
   9.3 Tee fillet joints
   9.4 butt joints

10. Produce fabricated components and assemblies which meet **all** of the following:
   10.1 all dimensions are within +/- 3.0mm or +/- 0.125”
   10.2 finished components meet the required shape/geometry (such as squareness, straightness, angularity and being free from twists)
   10.3 completed components are free from excessive tooling marks, deformation, cracking, sharp edges, slivers or burrs
   10.4 all components are correctly assembled, and have secure and firm joints
   10.5 welds are adequately fused and have a uniform profile, free from excessive undulations, with regular and even ripple formation
   10.6 the weld surface is free from cracks and substantially free from porosity, shrinkage cavities and trapped slag

SEMPEO2-66
General fabrication and welding applications

Developed by	SEMTA
Version number	2
Date approved	December 2011
Indicative review date	December 2016
Validity	Current
Status	Original
Originating organisation	SEMTA
Original URN	66
Relevant occupations	Engineering and manufacturing technologies; Engineering; Blacksmith
Suite	Performing Engineering Operations Suite 2; Craft (Blacksmithing)
Key words	engineering, engineering operations, fabrication, welding applications, manufacturing, hand tools, power tools, shapes, profiles, forms, Blacksmithing;