

SEMPEO2-65 - SQA Unit Code F3BM 04

General machining, fitting and assembly applications



Overview

This standard covers a broad range of basic machining, fitting and assembly 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 machining, fitting and assembly activities are undertaken, the types of equipment used, the manufacturing techniques, and the operating and safety procedures that are required.

In carrying out the activities, you will use appropriate tools and equipment to mark out the material for the features to be produced, and then to use hand tools, portable power tools, machine tools and shaping, fitting and assembly techniques appropriate to the operations being performed. These activities will include sawing, filing, drilling, turning, milling and assembly.

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 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 machining, fitting and assembly techniques and procedures safely. You will understand the machining, fitting and assembly processes, 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.

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You will understand the safety precautions required when carrying out the various machining, fitting and assembly techniques, and when using hand tools and machinery. 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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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 manufacturing 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 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

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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 machining, fitting and assembly activities undertaken (such as wearing appropriate protective clothing and equipment (PPE), using machine guards, and of keeping the work area safe and tidy)
- K2 the hazards associated with the activities (such as use of power tools, trailing leads or hoses, damaged or badly maintained tools and equipment, using files with damaged or poor fitting handles, using machine tools), and how they can be minimised
- K3 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
- K4 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- K5 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)
- K6 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
- K7 use of marking-out conventions when marking out the workpiece (such as datum lines, cutting guidelines, square and rectangular profiles, circular and radial profiles, angles, holes linearly positioned, boxed and on pitch circles)
- K8 the various fitting activities to be carried out (such as how to file flat, square and curved surfaces and achieve a smooth surface finish; how to select saw blades for different materials, and how to set the saw blades for different operations; how to produce screw threads on workpieces using hand dies; how to determine the drill size for tapped holes, and the importance of using the taps in the correct sequence)
- K9 how to prepare drilling machines for operations (such as adjustment of table height and position; mounting and securing drills, in chucks or Morse taper sockets; setting and adjusting spindle speeds; setting and adjusting guards/safety devices)
- K10 methods of holding the workpiece for the hand fitting, turning and milling activities (such as in a bench vice, machine vice, chuck, collets or clamped directly to the machine table)
- K11 the assembly methods, techniques and procedures to be used; how the components are to be aligned, adjusted and positioned prior to securing

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- them, and the tools and equipment that is used
- K12 the various mechanical fastening devices that are used (such as nuts, bolts, machine screws, cap screws, clips, pins, locking and retaining devices)
 - K13 the various turning operations that can be performed (such as parallel, stepped and tapered external diameters, drilled, bored and reamed holes, internal and external screw threads, special profiles)
 - K14 the various milling operations that can be performed (such as flat, parallel, square and angled surfaces; open ended and enclosed slots, special forms, drilled and bored holes)
 - K15 how to mount and secure the cutting tools in the tool holding devices (such as front or rear tools posts; mounting cutters on long or stub arbors; mounting drills in chucks or by the use of morse taper sockets; the need to ensure that the tool is sharp and secure)
 - K16 the techniques of taking trial cuts and checking dimensional accuracy; the application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy
 - K17 factors that affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as type of material, size of material, operations being performed, workholding method/security of workpiece, condition of machine, finish and tolerance required)
 - K18 the application of cutting fluids and compounds with regard to a range of different materials, and why some materials do not require cutting fluids to be used
 - K19 how to check the workpiece and the measuring equipment that is used (such as rules, micrometers, Verniers, gauges and surface finish comparison equipment)
 - K20 the need to check that the measuring equipment is within current calibration dates, and that the instruments are correctly zeroed; measuring internal and external dimensions (such as lengths, diameters, depths, slots, hole positions, angles, profiles); measuring geometric features (such flatness, squareness, parallelism, concentricity, ovality); how to check surface finish (such as by using comparison blocks or instruments)
 - K21 when to act on your own initiative and when to seek help and advice from others
 - K22 the importance of leaving the work area and equipment in a safe and clean condition on completion of the machining and fitting activities (such as isolating machines, removing and returning cutting tools, 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 machining, fitting and assembly 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 (such as cables to hand tools and extension leads, file handles, hammer striking faces)
 - 1.3 ensure that all machine tools are correctly guarded at all times
 - 1.4 check that all measuring equipment is within calibration date
 - 1.5 return all tools and equipment to the correct location on completion of the fitting activities

 2. Cut and shape **two** different types of material from the following:
 - 2.1 low carbon/mild steel
 - 2.2 stainless steel
 - 2.3 plastic/nylon/synthetic
 - 2.4 high carbon steel
 - 2.5 aluminium/aluminium alloys
 - 2.6 composite
 - 2.7 cast iron
 - 2.8 brass/brass alloys
 - 2.9 other specific material

 3. Use **three** of the following workholding devices:
 - 3.1 bench vice
 - 3.2 three-jaw chuck
 - 3.3 collet chuck
 - 3.4 machine vice
 - 3.5 four-jaw chuck
 - 3.6 drive plate and centres
 - 3.7 clamps (such as toolmaker's)

 4. Use marking out methods and techniques which include **all** of the following:
 - 4.1 preparing/determining suitable datums from which to mark out (such as choosing a machine face or filing a flat face as a datum)

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- 4.2 applying a marking medium to enhance clarity of the marking out
 - 4.3 using an appropriate method of marking out (such as direct marking using instruments, use of templates or tracing/transfer methods)
 - 4.4 using a range of marking out equipment (such as rules, squares, scribes, Vernier instruments)
 - 4.5 marking out a range of features (such as datum/centre lines, square/rectangular profiles, circles/radial profiles, hole positions)
5. Use a range of hand fitting methods, to include **all** of the following:
- 5.1 cutting out the rough profile using saws (such as hacksaw, band saw)
 - 5.2 filing flat and square
 - 5.3 filing a curved profile
 - 5.4 drilling holes
 - 5.5 cutting a screw thread (such as by tapping or dieing)
6. Produce mechanical assemblies, using **six** of the following methods and techniques:
- 6.1 assembling components having interference fits (such as by pressure, expansion or contraction)
 - 6.2 securing components using threaded fasteners (such as nuts, bolts, machine screws, cap screws)
 - 6.3 securing components using spring clips (such as external circlips, internal circlips, special clips)
 - 6.4 using locking and retaining devices (such as tab washers, locking nuts, wire locks, special purpose types)
 - 6.5 securing components using rivets (such as countersunk, roundhead, blind, special purpose types)
 - 6.6 applying sealing compounds or adhesives
 - 6.7 electrical bonding of components
 - 6.8 setting and adjusting components to give correct working parameters (such as shimming and packing)
 - 6.9 torque setting of nuts and bolts
7. Carry out turning operations to include **all** of the following:
- 7.1 mounting the workpiece in an appropriate workholding device
 - 7.2 mounting cutting tools in tool holders to give the correct centre height
 - 7.3 selecting and setting appropriate feeds and speeds
 - 7.4 facing off
 - 7.5 producing tapered diameters
 - 7.6 producing parallel diameters
 - 7.7 centre drilling and drilling a hole
 - 7.8 producing stepped diameters
 - 7.9 reaming or boring a hole

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8. Carry out milling operations, to include **all** of the following:
 - 8.1 mounting the workpiece in an appropriate workholding device
 - 8.2 mounting cutting tools on appropriate arbors or direct to the machine spindle
 - 8.3 selecting and setting appropriate feeds and speeds
 - 8.4 producing flat and square faces
 - 8.5 producing an enclosed slot
 - 8.6 producing parallel faces
 - 8.7 producing an open ended slot
 - 8.8 producing angular faces

9. Carry out the necessary checks for accuracy, to include **all** of the following:
 - 9.1 linear dimensions (such as lengths, depths)
 - 9.2 profiles
 - 9.3 diameters (such as external, internal)
 - 9.4 hole size and position
 - 9.5 flatness
 - 9.6 thread size and fit
 - 9.7 squareness
 - 9.8 surface finish
 - 9.9 angles

10. Use the following measuring equipment during the checking activities:
 - 10.1 external micrometers
 - 10.2 surface finish equipment (such as comparison plates, machines)
 - 10.3 Vernier/digital/dial calliperPlus **four** more of the following:
 - 10.4 rules
 - 10.5 bore/hole gauges
 - 10.6 squares
 - 10.7 slip gauges
 - 10.8 protractors
 - 10.9 radius/profile gauges
 - 10.10 depth micrometers
 - 10.11 thread gauges
 - 10.12 depth Verniers
 - 10.13 dial test indicators (DTI)
 - 10.14 feeler gauges
 - 10.15 coordinate measuring machine (CMM)

11. Produce components within **all** of the following standards, as applicable to the process:
 - 11.1 components to be free from false tool cuts, burrs and sharp edges
 - 11.2 dimensional tolerance +/- 0.25mm or +/- 0.010"

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- 11.3 flatness and squareness 0.05mm per 25mm or 0.002" per inch
- 11.4 angles within +/- 1 degree
- 11.5 screw threads to BS Medium fit
- 11.6 reamed holes within H8
- 11.7 surface finish 63µin or 1.6 µm

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