

SEMPEO1-04 - SQA Unit Code H021 04

Making components using hand tools and fitting techniques



Overview

This standard covers a range of basic hand fitting 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 hand fitting activities by obtaining all the necessary job instructions, materials, tools, equipment and any documentation that may be required.

In producing the components, you will be expected to use appropriate tools and equipment to mark out the material for a range of features to be produced, and then to use hand tools, portable power tools, shaping and fitting techniques appropriate to the type of material and operations being performed. These activities will include hand sawing, band sawing, filing, drilling, chiselling, threading, scraping, lapping and off-hand grinding. The components produced will have features that include flat, square, parallel and angular faces, radii and curved profiles, drilled holes, internal and external threads, and sliding or mating parts.

During, and on completion of, the fitting 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 fitting defects, to take appropriate action to put right any faults that occur, and to ensure that the finished workpiece is within the drawing requirements. On completion of the fitting activities, you will be expected to return all tools and equipment 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 fitting activities undertaken. You will need to report any difficulties or problems that may arise and carry out any agreed actions. 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 hand fitting techniques safely. You will understand the hand fitting process, and its 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 using hand fitting techniques, and when using hand and power tools. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

Specific Standard Requirements

At least one of the workpieces produced must combine different features and techniques, for example: by producing a component which involves rough sawing to size, filing flat and square edges, producing a simple profile, and drilling and tapping a hole.

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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 obtain the appropriate tools and equipment for the hand fitting operations, and check that they are in a safe and usable condition
 - P3 mark out the components for the required operations, using appropriate tools and techniques
 - P4 cut and shape the materials to the required specification, using appropriate tools and techniques
 - P5 check that the finished components meet the standard required
 - P6 report any difficulties or problems that may arise with the fitting activities, and carry out any agreed actions
 - P7 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 hand fitting activities undertaken
- K2 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy
- K3 the hazards associated with the hand fitting 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), and how they can be minimised
- K4 the procedure for obtaining the required drawings, job instructions and other related specifications
- K5 how to use and extract information from engineering drawings and related specifications (to include BS or ISO standard symbols and abbreviations, 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 methods of holding and supporting the workpiece during the marking out activities, and the equipment that can be used for this (such as surface plates, angle plates, vee blocks and clamps, parallel bars)
- K9 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 which are linearly positioned, boxed and on pitch circles)
- K10 the cutting and shaping methods to be used, and the sequence in which the operations will be carried out
- K11 the various types of file that are available, the cut of files for different applications, and the importance of ensuring that file handles are secure and free from embedded foreign bodies or splits
- K12 the use of vice jaw plates to protect the workpiece from damage
- K13 how to file flat, square and curved surfaces and achieve a smooth surface finish (such as by draw filing, the use of abrasive cloth, lapping using abrasive pastes)
- K14 how to select saw blades for different materials, and how to set the saw blades for different operations (such as cutting externally and internally)
- K15 how to cut external threads (using hand dies), and the method of fixing and adjusting the dies to give the correct thread fit

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- K16 how to determine the drill size for tapped holes, and the importance of using the taps in the correct sequence
- K17 how to prepare drilling machines for operations (such as adjustment of table height and position; mounting and securing drills, reamers, countersink and counterbore tools in chucks or morse taper sockets; setting and adjusting spindle speeds; setting and adjusting guards/safety devices)
- K18 how to mount the workpiece (such as in a machine vice, clamped to table, clamped to angle brackets; techniques of positioning drills to marking out, use of centre drills, and taking trial cuts and checking accuracy, how to correct holes which are off centre)
- K19 the problems that can occur with the hand fitting activities, and how these can be overcome (such as defects caused by incorrectly ground drills, inappropriate speeds, damage by workholding devices)
- K20 when to act on your own initiative and when to seek help and advice from others
- K21 the importance of leaving the work area in a safe and clean condition on completion of the activities (such as removing and storing power leads, isolating machines, removing and returning drills, 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 hand fitting 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 follow job instructions, assemblies drawings and procedures
 - 1.3 ensure that all power tool cables, extension leads or air supply hoses are in a serviceable condition
 - 1.4 check that all measuring equipment is within calibration date
 - 1.5 apply safe and appropriate hand fitting techniques and procedures at all times
 - 1.6 return all tools and equipment to the correct location on completion of the fitting activities

2. Mark out material forms, to include **one** of the following:
 - 2.1 square/rectangular (such as bar stock, sheet material, machined components)
 - 2.2 circular/cylindrical (such as bar stock, tubes, turned components, flat discs)
 - 2.3 sections (such as angles, channel, tee section, joists, extrusions)
 - 2.4 irregular shapes (such as castings, forgings, odd shaped components)

3. Use marking out methods and techniques, including **one** of the following:
 - 3.1 direct marking using instruments
 - 3.2 use of templates
 - 3.3 tracing/transfer methods

4. Use a range of marking out equipment, to include **five** of the following:
 - 4.1 rules/tapes
 - 4.2 scribes
 - 4.3 scribing blocks
 - 4.4 dividers/trammels
 - 4.5 punches
 - 4.6 squares
 - 4.7 protractor
 - 4.8 Vernier instruments

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5. Mark out workpieces, to include **five** of the following features:
 - 5.1 datum/centre lines
 - 5.2 circles
 - 5.3 square/rectangular profiles
 - 5.4 radial profiles
 - 5.5 angles/angular profiles
 - 5.6 linear hole positions
 - 5.7 radial hole positions

6. Use a range of hand fitting activities, to include **five** of the following:
 - 6.1 filing
 - 6.2 power sawing
 - 6.3 chiselling
 - 6.4 hand sawing
 - 6.5 off hand grinding
 - 6.6 lapping
 - 6.7 drilling
 - 6.8 scraping
 - 6.9 producing external threads
 - 6.10 producing internal threads

7. Produce components which combine different fitting operations and cover **six** of the following:
 - 7.1 flat datum faces
 - 7.2 reamed holes
 - 7.3 faces which are square to each other
 - 7.4 internal threads
 - 7.5 faces which are parallel to each other
 - 7.6 external threads
 - 7.7 faces angled to each other
 - 7.8 counterbore, countersink, or spot face
 - 7.9 curved profiles
 - 7.10 sliding or mating parts
 - 7.11 drilled holes (through or to a depth)

8. Cut and shape **one** type of material from the following:
 - 8.1 low carbon/mild steel
 - 8.2 stainless steel
 - 8.3 plastic/nylon/synthetic
 - 8.4 high carbon steel
 - 8.5 aluminium/aluminium alloys
 - 8.6 composite
 - 8.7 cast iron
 - 8.8 brass/brass alloys
 - 8.9 other specific material

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9. Carry out checks for accuracy, to include **five** of the following:
 - 9.1 linear dimensions
 - 9.2 hole position
 - 9.3 flatness
 - 9.4 hole size/fit
 - 9.5 squareness
 - 9.6 thread size and fit
 - 9.7 angles
 - 9.8 surface finish
 - 9.9 profiles

10. Use **all** of the following measuring equipment during the hand fitting and checking activities:
 - 10.1 rules
 - 10.2 external micrometers
 - 10.3 squares
 - 10.4 surface finish equipment (such as comparison plates, machines)

11. Produce components to **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 $\pm 0.25\text{mm}$ or $\pm 0.010''$
 - 11.3 flatness and squareness 0.1mm per 25mm or $0.004''$ per inch
 - 11.4 angles within ± 1 degree
 - 11.5 surface finish $63\mu\text{in}$ or $1.6\ \mu\text{m}$

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