



Unit title	Producing Components using Hand Fitting Techniques
SQA code	HC3E 04
SCQF level	5
SCQF credit points	22

History of changes

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Title	Producing Components using Hand Fitting Techniques		
Level	5		
Credit value	22		
Learning Outcomes		Assessment Criteria	
The learner will:		The learner can:	
1	Produce components using hand fitting techniques.	1.1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines.
		1.2	Carry out all of the following during the hand fitting activities: <ul style="list-style-type: none"> ◆ adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations ◆ follow job instructions, assembly drawings and procedures ◆ ensure that all power tool cables, extension leads or air supply hoses are in a serviceable condition ◆ check that all measuring equipment is within calibration date ◆ ensure that the components used are free from foreign objects, dirt or other contamination ◆ return all tools and equipment to the correct location on completion of the fitting activities
		1.3	Plan the fitting activities before they start them.
		1.4	Obtain the appropriate tools and equipment for the hand fitting operations, and check that they are in a safe and usable condition.
		1.5	Mark out the components for the required operations, using appropriate tools and techniques.

Learning Outcomes	Assessment Criteria
<p>The learner will:</p>	<p>The learner can:</p> <p>1.6 Mark out a range of material forms, to include two of the following:</p> <ul style="list-style-type: none"> ◆ square/rectangular (such as bar stock, sheet material, machined components) ◆ circular/cylindrical (such as bar stock, tubes, turned components, flat discs) ◆ sections (such as angles, channel, tee section, joists, extrusions) ◆ irregular shapes (such as castings, forgings, odd shaped components) <p>1.7 Use marking out methods and techniques, to include:</p> <ul style="list-style-type: none"> ◆ direct marking using instruments <p>Plus one more of the following:</p> <ul style="list-style-type: none"> ◆ use of templates ◆ tracing/transfer methods <p>1.8 Use a range of marking out equipment, to include all of the following:</p> <ul style="list-style-type: none"> ◆ rules/tapes ◆ dividers/trammels ◆ scribes ◆ punches ◆ scribing blocks ◆ squares ◆ protractor ◆ vernier instruments <p>1.9 Mark out workpieces which include all of the following features:</p> <ul style="list-style-type: none"> ◆ datum/centre lines ◆ square/rectangular profiles ◆ circles ◆ radial profiles ◆ linear hole positions <p>Plus one more from the following:</p> <ul style="list-style-type: none"> ◆ angles/angular profiles ◆ radial hole positions ◆ allowances for bending ◆ simple pattern development

Learning Outcomes	Assessment Criteria
<p>The learner will:</p>	<p>The learner can:</p> <p>1.10 Cut and shape the materials to the required specification, using appropriate tools and techniques.</p> <p>1.11 Cut and shape two different types of material from the following:</p> <ul style="list-style-type: none"> ◆ low carbon/mild steel ◆ high carbon steel ◆ cast iron ◆ stainless steel ◆ aluminium/aluminium alloys ◆ brass/brass alloys ◆ plastic/nylon/synthetic ◆ composite ◆ other specific material <p>1.12 Use both of the following hand fitting activities:</p> <ul style="list-style-type: none"> ◆ filing ◆ hand sawing <p>Plus one more from the following:</p> <ul style="list-style-type: none"> ◆ power sawing ◆ off hand grinding ◆ scraping ◆ chiselling ◆ lapping <p>1.13 Produce components which combine different operations and have features that cover all of the following:</p> <ul style="list-style-type: none"> ◆ flat datum faces ◆ faces which are square to each other ◆ curved profiles ◆ drilled through holes ◆ reamed holes ◆ internal threads ◆ external threads

Learning Outcomes	Assessment Criteria
<p>The learner will:</p>	<p>The learner can:</p> <p>Plus three more from the following:</p> <ul style="list-style-type: none"> ◆ faces that are parallel to each other ◆ faces angled to each other ◆ holes drilled to a depth ◆ chamfers and radii ◆ counterbore, countersink, or spot face ◆ sliding or mating parts <p>1.14 Measure and check that all dimensional and geometrical aspects of the component are to the specification.</p> <p>1.15 Use all of the following measuring equipment during the hand fitting and checking activities:</p> <ul style="list-style-type: none"> ◆ external micrometers ◆ Vernier calliper ◆ surface finish equipment (such as comparison plates, machines) <p>Plus four more of the following:</p> <ul style="list-style-type: none"> ◆ rules ◆ squares ◆ callipers ◆ protractors ◆ depth micrometers ◆ depth verniers ◆ feeler gauges ◆ bore/hole gauges ◆ slip gauges ◆ radius/profile gauges ◆ thread gauges ◆ dial test indicators (DTI) ◆ coordinate measuring machine (CMM)

Learning Outcomes	Assessment Criteria
<p>The learner will:</p>	<p>The learner can:</p> <p>1.16 Carry out the necessary checks for accuracy, to include all of the following:</p> <ul style="list-style-type: none"> ◆ linear dimensions ◆ flatness ◆ squareness ◆ angles ◆ profiles ◆ hole position ◆ hole size/fit ◆ depths ◆ thread size and fit ◆ surface finish <p>1.17 Produce components to all of the following standards, as applicable to the process:</p> <ul style="list-style-type: none"> ◆ components to be free from false tool cuts, burrs and sharp edges ◆ general dimensional tolerance +/- 0.25mm or +/- 0.010" ◆ there must be one or more specific dimensional tolerances within +/- 0.1mm or +/- 0.004" ◆ flatness and squareness 0.05mm per 25mm or 0.002" per inch ◆ angles within +/- 1 degree ◆ screw threads to BS Medium fit ◆ reamed and bored holes within H8 ◆ surface finish 63 µm or 1.6 µm <p>1.18 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.</p> <p>1.19 Leave the work area in a safe and tidy condition on completion of the fitting activities.</p>

Learning Outcomes	Assessment Criteria
The learner will:	The learner can:
<p>2 Know how to produce components using hand fitting techniques.</p>	<p>2.1 Describe the health and safety requirements and safe working practices and procedures required for the hand fitting activities undertaken.</p> <p>2.2 Describe the importance of wearing appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy.</p> <p>2.3 Describe 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.</p> <p>2.4 Describe the procedure for obtaining the required drawings, job instructions and other related specifications.</p> <p>2.5 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.</p> <p>2.6 Explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing.</p> <p>2.7 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).</p>

Learning Outcomes	Assessment Criteria
<p>The learner will:</p>	<p>The learner can:</p> <p>2.8 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.</p> <p>2.9 Describe the methods of holding and supporting the workpiece during the marking out activities, and equipment that can be used (such as surface plates, angle plates, vee blocks and clamps, parallel bars, screw jacks).</p> <p>2.10 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 which are linearly positioned, boxed and on pitch circles).</p> <p>2.11 Describe the ways of laying out the marking out shapes or patterns to maximise use of materials.</p> <p>2.12 Describe the need for clear and dimensional accuracy in marking out to specification and drawing requirements.</p> <p>2.13 Explain how to set and adjust tools (such as squares, protractors and Verniers).</p> <p>2.14 Describe the importance of using tools only for the purpose intended; the care that is required when using the equipment and tools; the proper way of storing tools and equipment between operations.</p> <p>2.15 Describe the cutting and shaping methods to be used, and the sequence in which the operations are to be carried out.</p>

Learning Outcomes The learner will:	Assessment Criteria The learner can:
	<p>2.16 Describe the various types of file that are available, and the cut of files for different applications.</p> <p>2.17 Describe the importance of ensuring that file handles are secure and free from embedded foreign bodies or splits.</p> <p>2.18 Explain how to prepare the components for the filing operations (cleaning, de-burring, marking out).</p> <p>2.19 Describe the use of vice jaw plates to protect the workpiece from damage.</p> <p>2.20 Explain how to file flat, square and curved surfaces, and how to achieve a smooth surface finish (such as by draw filing, the use of abrasive cloth, lapping using abrasive pastes).</p> <p>2.21 Explain how to select saw blades for different materials, and how to set the saw blades for different operations (such as cutting externally and internally).</p> <p>2.22 Explain how to cut external threads using hand dies, and the method of fixing and adjusting the dies to give the correct thread fit.</p> <p>2.23 Explain how to determine the drill size for tapped holes, and the importance of using the taps in the correct sequence.</p> <p>2.24 Explain 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).</p>

Learning Outcomes	Assessment Criteria
<p>The learner will:</p>	<p>The learner can:</p> <p>2.25 Explain 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, and how to correct holes which are off centre.</p> <p>2.26 Explain how to produce a sliding or mating fit using filing, scraping and lapping techniques.</p> <p>2.27 Describe 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).</p> <p>2.28 Explain when to act on their own initiative and when to seek help and advice from others.</p> <p>2.29 Describe the importance of leaving the work area in a safe and clean condition on completion of the fitting activities (such as removing and storing power leads, isolating machines, removing and returning drills, cleaning the equipment and removing and disposing of waste).</p>

Additional information about the Unit

Unit purpose and aim(s)

This Unit covers the skills and knowledge needed to prove the competences required to cover a broad range of basic hand fitting activities that will prepare the learner for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or 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 hand fitting activities by obtaining all the necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required fitting 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 operations to be carried out and the accuracy required.

In producing the components, the learner 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, and 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, the learner 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. The learner will need to be able to recognise fitting defects, to take appropriate action to remedy any faults that occur and to ensure that the finished workpiece is within the drawing requirements. On completion of the fitting activities, the learner will be expected to return all tools and equipment to the correct locations, and to leave the work area in a safe and tidy condition.

The learner's responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the fitting activities undertaken. The learner will need to take account of any potential difficulties or problems that may arise with the fitting 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 hand fitting techniques safely. The learner 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.

The learner will understand the safety precautions required when using hand fitting techniques, and when using hand and power tools. 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.

Additional information about the Unit (cont)
Details of the relationship between the Unit and relevant national occupational standards (if appropriate)
This Unit has been derived from national occupational standard Performing Engineering Operations Unit No 5: Producing components using hand fitting techniques (Suite 2).
Details of the relationship between the Unit and other standards or curricula (if appropriate)
C31 — Contribute to maintenance of vessel mechanical equipment. C34 — Carry out maintenance of vessel mechanical equipment and systems.
Assessment requirements specified by a sector or regulatory body (if appropriate)
This Unit to be assessed in accordance with the Maritime Skills Alliance Assessment Strategy. Unit specific additional assessment requirements: In order to prove their ability to combine different fitting operations, at least one of the components produced must be of a significant nature, and must have a minimum of five of the features listed in Assessment Criteria 1.13.

Assessment (evidence) Requirements

The following evidence is required to demonstrate that learners have the appropriate level of knowledge to undertake Producing components using Hand Fitting Techniques. All Learning Outcomes and Assessment Criteria must be achieved.

Written and/or recorded oral evidence produced either on or off-the-job is required for the following:

Learning Outcome 2

Performance evidence in the workplace or in an appropriate simulated environment is required for the following:

Learning Outcome 1

This could be achieved through the observation of learners undertaking practical exercises.

An approved Maritime Skills Alliance (MSA) approved Training Record Book (TRB) should be used to record evidence of achievement.

Guidance on Instruments of Assessment

Performance evidence can be generated using an approved Maritime Skills Alliance (MSA) approved Training Record Book (TRB) and/or practical exercises.

Short answer written questions and/or oral interview could be used for the other Learning Outcomes and Assessment Criteria.