Higher National Unit Specification

General information for centres

Unit title: Metal Component Manufacture

Unit code: DT5Y 34

Unit purpose: This Unit is designed to enable candidates to gain knowledge and understanding of primary and secondary forming processes used within local/national industry. In addition the Unit gives the candidate the opportunity to relate these processes to a particular product or products.

On completion of the Unit the candidate should be able to:

1 Classify primary forming processes used to manufacture metal components.
2 Classify secondary processes used to manufacture metal components.
3 Analyse and select primary and secondary processes for metal products.

Credit points and level: 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 8*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: Candidates should have some knowledge and understanding of engineering drawing, engineering materials, economics, and engineering processes. This may be evidenced by the possession of the following Higher National Units: Engineering Drawing, Material Selection, Economics of Manufacture, Process and Equipment Selection.

Core Skills: There may be opportunities to gather evidence towards the following listed Core Skills components in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Written Communication	Higher
Oral Communication	Higher
Using Graphical Information	Higher
Critical Thinking	Higher

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

General information for centres (cont)

Assessment: Outcome 1 should be assessed by means of a written report based on the study of a manufacturing company, or companies, covering five primary manufacturing processes or source materials.

Outcome 2 should be assessed by a written report based on a study of a company, or companies, covering five secondary manufacturing processes. Ideally the company, or companies, in Outcomes 1 and 2 should be the same.

Outcome 3 should be assessed by means of an oral presentation lasting at least 10 minutes on the selection of primary and secondary processes.

Higher National Unit specification: statement of standards

Unit title: Metal Component Manufacture

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Classify primary forming processes used to manufacture metal components

Knowledge and/or skills

- Hot and cold rolling
- Forging
- Sand casting
- Die casting
- Direct and indirect extrusion
- Drawing
- Pressing

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific questions. Each candidate must demonstrate that they can answer questions based on a sample of the items shown above. In any assessment of the Outcome **five out of seven** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee which items they will be questioned on, a different sample of five out of seven knowledge and /or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all five items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- identify the various forms of supply of metals used within five local/national companies — metals should be steel and at least one other metal
- explain the advantages of the identified forms of supply within each company relative to a product produced by the company
- describe the production method for each identified form of supply

- describe the capability and capacity of the identified forms of supply
- compare the relative cost of each form of supply
- compare the surface finish and accuracy of the metal for each of the identified forms of supply.

The assessment of this Outcome should be in the form of a short report on the final product produced by a company, or companies, involved in the five primary manufacturing processes. Candidates should be provided with the details of the required report format and should include, as a minimum, the items listed under the bullet points in the Evidence Requirements. While candidates are not required to prepare their report under controlled, supervised conditions, centres should make every reasonable effort to ensure that reports are the candidates' own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Assessment guidelines

Reports, which should include sketches or diagrams or pictures, should contain a minimum of 400 words per company. Candidates should be encouraged to visit the companies selected and talk to their engineers, use their literature/manuals where possible and any other means of getting information on the materials from which their products are manufactured. If they so desire, candidates should be permitted to use software packages to produce documentation for their report.

Outcome 2

Classify secondary processes used to manufacture metal components

Knowledge and/or skills

- Machining — turning, milling and grinding
- Piercing, blanking, bending, pressing and shearing
- Electric discharge machining (EDM)
- Electro chemical machining (ECM)
- Welding and fabrication
- Heat treatments
- Adhesives
- Plating

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific questions. Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above. In any assessment of the Outcome **four out of eight** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee which items they will be questioned on, a different sample of four out of eight knowledge and /or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all four items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- classify the processes — cutting, joining, addition or property change
- explain the operation of each process
- describe the capability and capacity of each process
- compare the relative cost of each process ie use of standard equipment or specialist equipment eg gauges, jigs, fixtures, etc.
- describe inspection methods
- compare the surface finish and accuracy produced in each process
- compare the manufacture of components by two alternative methods, eg solid and/or fabrication.

The assessment of this Outcome should be in the form of a short report on the types of products produced by the company, or companies, involved in the five secondary processes. Candidates should be provided with the details of the required report format and should include, as a minimum, the items listed under the bullet points in the Evidence Requirements. While candidates are not required to prepare their report under controlled, supervised conditions, centres should make every reasonable effort to ensure that reports are the candidates' own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Assessment guidelines

Reports, which should include sketches or diagrams or pictures, should contain a minimum of 400 words per company. Candidates should be encouraged to visit the companies selected and talk to their engineers, use their literature/manuals where possible and any other means of getting information on the materials from which their products are manufactured. If they so desire, candidates should be permitted to use software packages to produce documentation for their report.

Centres can choose to combine the assessments for Outcomes 1 and 2 into one project report covering the sampled knowledge and / or skills items for the two Outcomes.

Outcome 3

Analyse and select primary and secondary processes for metal products

Knowledge and/or skills

- Material and form of supply
- Cost effective methods of manufacturing
- Tools/equipment to manufacture
- Measuring techniques

Higher National Unit specification: statement of standards (cont)

Unit title: Metal Component Manufacture

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific questions.

Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above. In any assessment of the Outcome **three out of four** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee which items they will be questioned on, a different sample of three out of four knowledge and /or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all three items.

Each candidate will need to demonstrate that they can answer questions based on one or more components involving a minimum of ten different types of operations.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- identify appropriate raw material(s)
- identify the material form of supply
- explain the specifications of the chosen processes
- explain the capability and capacity of the chosen processes
- list the types of tooling required for the chosen processes
- state the inspection equipment to be used during each process
- explain the cost implications in each process

Candidates should provide evidence in the form of an oral presentation lasting a minimum of ten minutes to an audience of at least four people. Candidates should only be assessed on the technical content of their presentation. Presentation software must be used in delivering the talk. Candidates should be provided with details of the required presentation format which should include, as a minimum, the items listed under the bullet points in the Evidence Requirements. Candidates should answer questions raised by the audience.

Assessment guidelines

Three hours should be allocated for the preparation and delivery of the presentation.

Candidates should be encouraged to use relevant company handbooks, manuals, textbooks and reference material.

Centres are encouraged to develop a checklist to assess candidate oral presentation which should include quantity, quality, cost and function.

Administrative Information

Unit code: DT5Y 34

Unit title: Metal Component Manufacture

Superclass category: WB

Date of publication: August 2005

Version: 01

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Metal Component Manufacture

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit has been written in order to allow candidates to develop knowledge, understanding and skills in the following areas:

1 The forms of supply of metals and the advantages gained by these forms.
2 Commonly used processes to shape these metals into components.
3 The various manufacturing methods used within industry to produce components.

In designing this Unit, the Unit writer has identified the range of topics that they would expect to be covered by lecturers. Recommendations are also given as to how much time should be spent on each Outcome. This has been done to help lecturers to decide what depth of treatment should be given to the topics attached to each of the Outcomes. Whilst it is not mandatory for centres to use this list of topics, it is recommended that they do so as the assessment exemplar pack for this Unit is based on the knowledge and/or skills and list of topics in each of the Outcomes.

A list of topics for each Outcome is given below.

1 Classify primary forming processes used to manufacture metal components. (10 hours)

It is intended that each candidate would identify five local companies (National companies where this is not possible) and investigate their metal form of supply relative to the product or products they manufacture. This should allow candidates to relate these primary processes to a product.

- explain the grain structure of each forming process
- surface finish produced by each forming process
- accuracy produced by each forming process
- describe the production methods of each process
- examples of the various shapes produced by each forming process
- metals used in each forming process
- the capability and capacity of each forming process
- relative cost of equipment to produce components by each forming process
- reason for using each forming process
- advantages of each forming process

Higher National Unit specification: support notes (cont)

Unit title: Metal Component Manufacture

2 Classify secondary processes used to manufacture metal components (10 hours)

It is intended that the following topics be undertaken using the components identified in Outcome 1. A wide range of components should be studied.

- secondary process and/or processes to be used in the manufacture
- reason for choice
- order of manufacture
- reason for this order
- work holding devices — chucks, vices, jigs and fixtures
- tools to be used — lathe tools, milling cutters etc
- surface finish
- inspection equipment to be used
- advantage of solid as against fabricated or visa versa

3 Analyse and select primary and secondary processes for metal products (15 hours)

The following topics are general in nature but should be put into the context of components to be manufactured using metal within local/national companies. Wherever possible, comparison should be made of the various production methods used within these companies and the implications this would have on the cost of the finished component/s.

- purpose of the chosen components
- properties requirements of the components
- type of metal
- metal primary processes:
  - bright
  - forged
  - sand casting
  - extruded
  - drawn
  - pressed
  - secondary process/es:
  - machined
  - pierced, blanked and/or sheared
  - special machined process
  - heat treated
  - welded
  - joined using adhesives
  - plated
- accuracy — this can determine machining process
- surface finish requirements — decides production method
- process planning — operation sheets
- additional tools — to include hand and machine
- additional equipment — jigs, fixtures etc

Higher National Unit specification: support notes (cont)

- speeds and feeds calculations
- cost implications — difference between single and quantity production
- inspection techniques — standard and special
- documentation requirements
- testing and verification

Unit assessment

Outcome 1 — Short report
Outcome 2 — Short report
Outcome 3 — Presentation — preparation 3 hours — delivery 10 minutes minimum

Guidance on the delivery and assessment of this Unit

It is intended that this Unit is delivered in a local industry context, where possible, but if that is not possible national companies could be used.

In the delivery of the Unit, candidates should be encouraged to visit their chosen companies and receive as much information on the product produced from the people 'on the shop floor' and the use of company literature.

It is not intended that the candidates have the ability to operate the equipment but have a basic knowledge of the operation of the equipment and understand the reason behind the choice of production method.

Candidates should also understand the cost implications of not using standard equipment and tools.

Different processes can be used to produce the same or a similar component leading to the final selection being made on which process to use, being based on the requirements of the component.

A simple example of using the same range of components to develop selection skills is a hinge. This can be forged in medium carbon steel for use on a door of stout construction such as a vehicle access door at a warehouse or factory. Hinges of all sizes and shapes are produced in pressed steel for wide applications and general use, whilst smaller sized hinges used on windows and internal doors of module design are often made in die cast alloy. Other components that can be treated in this way are pulleys, shafts, wheels, gears etc.

Opportunities for developing Core Skills

There may be opportunities to gather evidence towards the following Core Skills components in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Written Communication	Higher
Oral Communication	Higher
Using Graphical Information	Higher
Critical Thinking	Higher

Higher National Unit specification: support notes (cont)

Unit title: Metal Component Manufacture

Open learning

This Unit could be delivered by distance learning, which may incorporate some degree of online support. The candidate would require access to companies for assessment purposes. With regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that the written assessment was conducted under controlled, supervised conditions. Arrangements would also need to be made for the candidate to deliver his/her presentation.

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality Assurance of Open and Distance Learning* (SQA 2000)

Candidates with additional support needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs,* which is available on the SQA website **www.sqa.org.uk.**

General information for candidates

Unit title: Metal Component Manufacture

This Unit has been designed to provide you with knowledge and understanding of primary and secondary forming processes used within local and/or national engineering production companies.

This Unit will give you the opportunity to study the methods used to produce raw materials into their initial shape using five of the following primary processes, hot and cold rolling, forging, sand casting, die casting, direct and indirect extrusion, drawing and pressing.

In addition you will study the reason for the use of these primary processes relative to a particular component being manufactured by each of these companies.

The Unit will also give you the opportunity to study the secondary processes used to manufacture the components and the reasons for using this particular method of manufacture. Some of the evidence should include cost considerations, surface finish, accuracy, quantity to be produced, inspection methods etc.

Consideration should also be given to the primary and secondary processes used to produce components of various quantities and materials to be used in different situations and conditions.

At the end of the Unit you will be expected to have gained knowledge of the reason for the material used for the components, their form of supply, manufacturing process and the grounds for using these production processes.

At the end of each Outcome you will be assessed as follows:

Outcome 1 — a short report on the types of and reasons for the primary processes used by each company.

Outcome 2 — a short report on the types of and reasons for the secondary processes used by each company.

Outcome 3 — a 10 minute presentation on the manufacture of the same type of component used in a variety of circumstances. The report should include: material, primary process/es, secondary process/es and the reason for chosen method. Consideration should also be given to the quantity to be produced.