

Higher National Unit Specification

General information for centres

Unit title: Design for Manufacture

Unit code: DR3M 35

Unit purpose: The Unit is designed to enable candidates to develop their knowledge and understanding of engineering design for manufacture processes. Candidates will also be provided with an opportunity to develop an engineering design (preferably working in a team) based on customer requirements and to present the final design solution to the customer both in a portfolio and as an oral presentation.

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

- 1 Describe the design/manufacture interface.
- 2 Design a product for manufacture.
- 3 Present the final design solution to the customer.

Credit points and level: 1 HN Credit at SCQF level 8: (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: It would be an advantage if candidates had a basic knowledge and understanding of graphical engineering communication, design studies, engineering materials and manufacturing processes. However, this knowledge and understanding is not absolutely essential as these concepts are revised in Outcomes 1 and 2.

Possession of a basic knowledge and understanding maybe evidenced by possession of the following National Qualification units: Design and Make, Graphical Engineering Communications, Design Studies, Basic Engineering Materials and Engineering Materials Properties and Treatments and/or possession of the following HN units: Metal Component Manufacture and Plastic Component Manufacture.

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
Critical Thinking	Higher
Planning and Organisation	Higher
Reviewing and Evaluating	Higher
Working with Others	Higher

General information for centres (cont)

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.

Assessment: Outcome 1 should be assessed by means of one single assessment paper taken at a single assessment event that should last one hour. This assessment should be conducted under closed-book, controlled, supervised conditions and candidates should not be allowed to bring any notes, text books or other materials into the assessment.

Outcome 2 should be assessed by candidates undertaking an assignment in which they design a product for manufacture based on a customer's requirements. It is strongly recommended that candidates should be formed into a design team to develop the design solution. Candidate evidence should be presented in the form of a written report.

Centres should make every reasonable effort to ensure the assignment solution is the candidate's 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.

Candidate evidence for Outcome 3 should be presented in two parts: a portfolio of evidence providing details of the final design solution and a presentation where the candidate provides information on the final design solution to the customer.

Higher National Unit specification: statement of standards

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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

Describe the design/manufacture interface

Knowledge and/or skills

- ◆ Design process
- ◆ Specification
- ◆ Design factors
- ◆ Traditional design approaches
- ◆ Life cycle engineering
- ◆ Concurrent Engineering
- ◆ Economies of scale
- ◆ Standardisation (parts / materials)
- ◆ Manufacturing capability
- ◆ CAD/CAM/CIM
- ◆ Documentation requirements
- ◆ Product quality
- ◆ Design for All (DFX)

Evidence Requirements

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

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of eight out of thirteen knowledge and/or skills items are required each time the Unit is assessed.

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:

Higher National Unit specification: statement of standards (cont)

Unit title: Design for Manufacture

- ◆ outline the overall design process
- ◆ state what is meant by the term specification
- ◆ identify typical design factors
- ◆ explain traditional approaches to engineering design
- ◆ state what is meant by life cycle engineering
- ◆ state what is meant by Concurrent Engineering
- ◆ explain the importance of economies of scale
- ◆ explain standardisation within the design process (standard parts/materials/modular components)
- ◆ explain manufacturing capability in relation to the design process
- ◆ explain the role of CAD/CAM/CIM in modern design for manufacture processes
- ◆ outline the types of documents required to support the design process
- ◆ identify issues pertaining to product quality and design for all

This Outcome should be assessed by means of one single assessment paper taken at a single assessment event that should last one hour. This assessment should be conducted under closed-book, controlled, supervised conditions and candidate should not be allowed to bring any notes text books or other materials into the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer and restricted response questions.

Outcome 2

Design a product for manufacture

Knowledge and/or skills

- ◆ Customer requirements
- ◆ Specification
- ◆ Dimension requirements
- ◆ Finishing requirements
- ◆ Realistic tolerances
- ◆ Process capabilities
- ◆ Materials and/or parts availability
- ◆ Standardisation and rationalisation
- ◆ Resource availability
- ◆ Simulation
- ◆ Rapid modelling
- ◆ Project management
- ◆ Team working

Higher National Unit specification: statement of standards (cont)

Unit title: Design for Manufacture

Evidence Requirements

Evidence for the knowledge and/or skills items in this Outcome will be provided on a sample basis. Each candidate will need to demonstrate that she/he can provide responses based on a sample of the items shown above. In any assessment of this outcome **eight out of thirteen** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of eight out of thirteen knowledge and/or skills items are required each time the Unit is assessed.

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 customer requirements
- ◆ outline design specification including dimensional and finishing requirements with realistic tolerances
- ◆ identify manufacturing capabilities (process capabilities, materials and/or parts availability, standardisation and rationalisation and resource availability)
- ◆ undertake and report on benefits of simulation within the design process
- ◆ report on rapid prototyping of design models
- ◆ provide project schedule
- ◆ evaluate the benefits of a team approach to the solution of the design task

Candidate evidence should be provided in the form of a written report. Each candidate will need to demonstrate that she/he can correctly discuss and evaluate the processes involved in arriving at a satisfactory design solution.

Written reports should contain as a minimum the following sections:

- 1 Customer requirements.
- 2 Design Specification.
- 3 Manufacturing considerations (materials and/or parts availability, standardisation and rationalisation, and resource availability).
- 4 Simulation/Modelling.
- 5 Details of final design.
- 6 Benefits of team approach.
- 7 Evaluation of design process.

Assessment guidelines

It is strongly recommended that candidates are formed into design teams to carry out this assessment so that candidates can undertake the assessment under conditions they are likely to find in industrial design situation (eg a team based approach to the design process). The report **may** be 1,200 to 1,500 words in length plus appendices, diagrams etc. Project schedules may be presented in the form of a Gantt chart.

Higher National Unit specification: statement of standards (cont)

Unit title: Design for Manufacture

Outcome 3

Present the final design solution to the customer

Knowledge and/or skills

- ◆ Specifications
- ◆ Drawings for design
- ◆ Bill of materials
- ◆ Cost estimates
- ◆ Process plan
- ◆ Presentation materials

Evidence Requirements

All knowledge and/or skills items in this Outcome should be assessed. Candidate evidence for this Outcome should be presented in the following two parts: a portfolio containing the information covered by the first five bullet points and a presentation to the customer on the final design solution.

Centres should provide candidates with details of the structure the portfolio should take. While candidates can work together in preparing their portfolios each candidate must submit her/his own portfolio for assessment. Centres should develop a checklist to assess candidate portfolios.

With regard to the presentation, candidates should be assessed against the following criteria:

- ◆ the clarity and conciseness with which the presentation is introduced
- ◆ the audibility, pitch and pace of the presentation
- ◆ the presentation of the final design solution (or the part of the design solution the candidate is presenting) to the customer
- ◆ the use of any aids / presentation software to support the presentation
- ◆ the clarity and conciseness with which the presentation is summarised
- ◆ the response to any questions from the customer

Assessment guidelines

It is recommended that where a design team was set up to undertake the assignment in Outcome 2 then the same design team should provide the presentation to its customer. Candidates should be encouraged to use modern presentation technology (eg digital projector plus personal computer) when delivering the presentation to the customer. Centres may choose to allow each candidate to deliver the whole presentation or each member of the design team to deliver part of the presentation. Where the latter option is chosen, Centres must ensure that candidates deliver a sufficient part of the presentation to ensure they can be assessed against the performance criteria outlined under the Evidence Requirements.

Administrative Information

Unit code:	DR3M 35
Unit title:	Design for Manufacture
Superclass category:	VF
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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: Design for 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 is intended to provide candidates with the knowledge and skills in order to relate design principles to the manufacture of products / artefacts through a design team working together in response to a problem. The Unit can be presented without involving the manufacture of the physical parts concerned although it would benefit the candidates' experience if this was integrated with the manufacture of the product.

Guidance on the delivery and assessment of this Unit

It is intended wherever possible that the candidate has access to CAE facilities to aid in the design for manufacture process. This may mean having access to a CAD system or simulation software to help produce designs and test them. It may mean having access to the internet to carry out research as to what is already on the market.

The Unit should draw on the candidates' knowledge and experience gained from other Units they have completed or are taking at the same time as this Unit. It is envisaged that 15% of the time will be spent on Outcome 1 ensuring that the candidate has the knowledge and understanding of what is involved in design for manufacture. 70% of the time will be spent on Outcome 2, as this is the main part of the Unit, with the remaining time spent on Outcome 3 presenting the findings.

Outcome 1

Through lectures and tutorial work candidates will gain knowledge of factors affecting design and how each area interfaces with each other to make the whole. As this part of the Unit will be drawing on knowledge and understanding gained from other areas of the course some of the subject discussed will only be revision, on other areas it may be new knowledge. Through the use of tutorials reinforcement of understanding will take place.

Assessment of Outcome 1

The candidate will be given a written question paper containing a combination of short answer questions and extended question to ascertain their level of knowledge and understanding.

Outcomes 2 and 3

It is suggested that Outcome 2 is combined with Outcome 3. Candidates should work within design teams (suggested number three to four candidates per team) to simulate a realistic way of how designs are developed in to-day's manufacturing organisations. Teams will be allocated a project, which they will produce a solution to and present this solution to the customer. It is envisaged that the team will have to divide the work up amongst themselves, as timescales will be tight. The team are to produce individual written reports, which should be word-processed. A presentation should also be created which all team members will take part in.

Higher National Unit specification: support notes (cont)

Unit title: Design for Manufacture

Opportunities for developing 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
Critical Thinking	Higher
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Open learning

Due to the nature of the unit (ie working in teams) it is unlikely that it will be offered through open learning. However, through the use of ICT some educational establishments might consider offering this unit online. Through the use of asynchronous and synchronous conferences, groups of candidates may be able to pool their talents (not unlike organisations which work worldwide) as a team in producing a design. Should this occur arrangements would require to be put in place to ensure effective collaboration between team members. Effective assessment strategies would also have to be established to ensure unit criteria are met. For presentation it may be that the candidate has to attend the education establishment for a minimum of one hour to present their findings.

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: Design for Manufacture

The Unit has been designed to allow the candidate to explore areas, which are involved in designing new products for manufacture. The Unit should make the candidate aware that world class organisation of to-day does not have one person designing a product but instead involves a team of designers which may cover more than one engineering discipline. In achieving this Unit the candidate will gain knowledge and understanding of what is involved in preparing designs for clients.

The Unit should give the candidate the opportunity to work as part of an effective and efficient design team where each member contributes their knowledge to the design process. The candidate at the end of this process should realise what areas influence the design procedure and how obstacles are overcome in the manufacture of their design. Candidates should realise that designing is an iterative process involving six basic phases:

- 1 Recognition of need
- 2 Definition of the problem
- 3 Analysis and optimisation evaluation
- 4 Synthesis
- 5 Evaluation
- 6 Presentation

These six phases do not progress one step at a time - it may be that at one phase it may have to refer back to an earlier phase. The candidate will be aware of this after studying this Unit.

The assessment of this unit will be carried out using three approaches:

- ◆ short and extended answers for Outcome 1 to test recall and understanding
- ◆ project write up for Outcomes 2 and 3
- ◆ presentation for Outcome 3

As the candidates are likely to be working in a team it is envisaged that one project will be submitted per team and that the presentation will involve all team members. It is anticipated that the presentation will last for at least 15 minutes.

As a major part of this Unit is the project write-up, some education establishments may use this to gather evidence towards the core Communication Unit. Under these circumstances the candidate will be informed in advance.