Specification

Edexcel GCSE in Engineering (Double Award) (2316)

For first award in 2004

May 2002

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Specification summary

GCSEs in vocational subjects

A range of GCSE (Double Award) specifications in vocational subjects has been introduced to replace and extend the range of Part One GNVQ courses at levels 1 and 2 of the National Framework of Qualifications. They can be taken as two-year courses from September 2002 and one-year courses from September 2003 for first awarding in summer 2004.

Edexcel GCSE in Engineering (Double Award)

The Edexcel GCSE in Engineering (Double Award) has been designed to provide a broad educational basis for further training, further education or for moving into employment within the engineering industry. The QCA Qualification Accreditation Number for this title is 100/2062/7.

Specification structure

The specification consists of three compulsory units, which are equally weighted. Two units are internally assessed through the production of portfolios, and one is externally assessed by a written test. The first external assessment opportunity, and the first moderation of internal assessment, will be in June 2004.

Unit content	Assessment
Unit 1: Design and Graphical Communication The design process, client design briefs, design specifications, solutions, scientific principles, using engineering drawings and communication of design solutions.	**Internal assessment** Produce a design specification and design solution for an engineered product.
Unit 2: Engineered Products Understand the process of designing a product and producing it by the use of product specifications, engineering drawing, creation and application of a product plan incorporating tools, materials and equipment and quality and health and safety check.	**Internal assessment** Use a product specification to make an engineered product.

Unit content	Assessment
Unit 3: Application of Technology How technology has developed design and manufacturing processes, improved the quality of products and customer service and the implications of modern technology on the workforce and wider community.	**External assessment** 1½ hour examination. Choice of one from the following six sectors: • printing and publishing, paper and board • food and drink, biological and chemical • textiles and clothing • engineering fabrication • electrical and electronics, process control, computers, telecommunications • mechanical, automotive. Pre-release information on sector-based product will be sent to centres in September for the following June's examination.

Introduction

Rationale

GCSE (Double Awards) in vocational subjects cover both levels 1 and 2 (foundation and intermediate levels) of the National Framework of Qualifications. They replace and extend the range of Part One GNVQs and are at an equivalent level to foundation and intermediate GNVQs and to NVQs at levels 1 and 2.

The aims of these GCSEs are to:

- widen participation in vocationally related learning pre-16
- allow those students to experience vocationally related learning, to see whether it is suitable for them
- enable those students to make valid personal choices on completion of the qualification
- encourage post-16 students to try a vocationally related course, where maybe another programme has previously not proved appropriate for them
- raise attainment at levels 1 and 2/foundation and intermediate levels of the National Framework of Qualifications.

The broad objectives of these GCSEs are to:

- introduce students to work-related learning
- provide students with an overview of the sector
- give students the technical knowledge, skills and understanding associated with the subject at these levels
- equip students with some of the skills they will need in the workplace or in further education or training
- empower students to take charge of their own learning and development
- provide a range of teaching, learning and assessment styles to motivate students to achieve the best they can.

These GCSEs contribute to the quality and coherence of provision nationally, as shown by:

- the consultation undertaken by QCA in autumn 2000
- the positive Ofsted reports relating to Part One GNVQs (on which these GCSEs are based)
- their clear place in the Government's vision for secondary education for the next ten years.

The GCSE (Double Award) in Engineering has been designed to provide a broad educational basis for further training, for further education or for moving into employment within the engineering sector. This is achieved by ensuring that students develop the general skills, knowledge and understanding needed within the sector. This specification conforms to the subject criteria for GCSE specifications in Engineering, which set out the knowledge, understanding, skills and schemes of assessment common to all GCSE specifications in the subject. Subject criteria help ensure consistent and comparable standards in the same subject area across awarding bodies and help further and higher education institutions and employers know what has been studied and assessed.

Aims

The aims of the GCSE specifications in Engineering are to:

- enable students to develop a broad knowledge and understanding of the engineering sector
- allow students to prepare for further study on a vocational course in engineering or in anengineering-related subject or prepare for employment or further training in the engineering sector
- widen participation in vocationally related learning pre-16
- allow students to experience vocationally related learning to see whether it is suitable for them
- enable students to make valid personal choices upon completion of the qualification
- encourage post-16 students to try vocationally related courses
- raise attainment at levels 1 and 2 of the National Framework of Qualifications.

Access

Edexcel's policy concerning access to our qualifications is that:

- they must be available to anyone who is capable of reaching the required standard
- they must be free from barriers that restrict access and progression
- equal opportunities exist for all students.

Required prior learning

Students embarking on a GCSE in Engineering should have achieved a general educational level equivalent to level 3 of the National Curriculum or entry level 3 in the National Qualifications Framework. They would find the following learning, skills and aptitudes helpful:

- basic proficiency in literacy
- basic proficiency in numeracy
- some aptitude for computers
- some motivation to work independently.

Progression

Successful completion of the GCSE in Engineering (Double Award) offers students a variety of routes for progression. These are as follows:

- direct entry into employment within the engineering industry
- further learning opportunities within employment (for example Modern Apprenticeships in engineering-related areas)
- access to occupational standards at the same or next level (eg NVQs in Performing Engineering Operations)

- progression to the next stage of vocationally related qualifications either within the same or in a related area. For example, if students have gained A* to C grades they can progress to VCEs in Engineering, Manufacturing and Information Communication Technology or BTEC Nationals in Manufacturing/Engineering and Information Technology. If students have achieved D to G grades they can progress to, for example, an Intermediate GNVQ in Engineering or a BTEC First in Manufacturing/Engineering
- progression to the next stage of general qualifications within the national framework (Advanced GCEs in Design and Technology (Product Design) and Design and Technology (Systems and Control Technology).

Links with other qualifications, forbidden combinations and classification code

Links with other qualifications

GCSE

Design and technology has a general overlap through the study of the designing and making process to *Unit 1: Design and Graphical Communication* and *Unit 2: Engineered Products*.

It also has specific links through the study of materials, components and processes in:

- GCSE Design and Technology (Systems and Control Technology) to electrical and electronic/computer/process control/telecommunications and mechanical/automotive
- GCSE Design and Technology (Resistant Materials Technology) to engineering fabrication.

NVQs

- Engineering Production level 2
- Performing Manufacturing Operations level 2
- Engineering Manufacture level 2.

GCSE (Double Award)

GCSE in Engineering (Double Award) also shares common links to GCSE in Manufacturing (Double Award) through the following unit content:

GCSE in Engineering units	GCSE in Manufacturing units
Unit 1: Design and Graphical Communication	Unit 1: Designing Products for Manufacture
Unit 2: Engineered Products	Unit 2: Manufactured Products
Unit 3: Application of Technology	Unit 3: Application of Technology

Students entering for this specification may not, in the same series of examinations, enter for:

- Foundation and Intermediate six-unit GNVQs in Engineering and Manufacturing
- GCSE in Manufacturing (Double Award).

Every specification is assigned a national classification code indicating the subject area to which it belongs. The classification code for this specification is 0009.

Centres should be aware that students who enter for more than one level 1 or level 2 qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.

Subject content

Unit titles

The specification consists of three compulsory units:

- Unit 1: Design and Graphical Communication
- Unit 2: Engineered Products
- Unit 3: Application of Technology.

Unit structure

Each unit is made up of a number of sections, some of which are directed at the student while others are directed at the teacher. The sections are:

About this unit

This section provides an introduction to the content of the unit and states its relationship, if any, to other units. It also states the form of assessment for the unit.

What you need to learn

This section states what students need to know and be able to do to achieve the unit.

Assessment evidence (for internally assessed units only)

This section starts with an outline for the students of the tasks they need to carry out and the types of evidence they need to produce. It is followed by the marking grid to be used by the person assessing the evidence. This grid is the only version to be used for assessment purposes, but teachers may prefer to adapt it for students and incorporate it into a centre-produced guidance document.

Guidance for teachers

This section gives suggestions for appropriate delivery strategies, and develops the information in the marking grid to give further guidance on how marks should be allocated. It also gives suggestions for associated resources.

Relationship to National Occupational Standards

Details of how this specification relates to National Occupational Standards can be found on the QCA website, www.qca.org.uk

Assessment

Statutory requirements

All assessment of this specification will be carried out in accordance with the GCSE, GCE, VCE and GNVQ Code of Practice, published annually by the regulatory authorities.

Scheme of assessment

The three units are equally weighted. Students must produce an internally assessed portfolio for each of units 1 and 2, and take an externally assessed test for unit 3.

Unit	Unit code	Weighting	Assessment
Unit 1: Design and Graphical Communication	5316	33.3%	**Internal assessment** Produce a design specification and design solution for an engineered product.
Unit 2: Engineered Products	5317	33.3%	**Internal assessment** Use a product specification to make an engineered product.
Unit 3: Application of Technology	5318/01 5318/02 5318/03 5318/04 5318/05 5318/06	33.3%	**External assessment** Untiered – 1½ hour examination. (Two sections – Section A and B) Choice of one from six sectors. Pre-release information on sector-based product will be sent to centres in September for the following June's examination. • Printing and Publishing, Paper and Board • Food and Drink, Biological and Chemical • Textiles and Clothing • Engineering Fabrication • Electrical and Electronics, Process Control, Computers, Telecommunications • Mechanical, Automotive

Assessment objectives

There are three assessment objectives for GCSEs in Engineering. These detail the knowledge, skills and understanding that the student is required to demonstrate.

Students are required to:

AO1	recall and apply their knowledge, skills and understanding specified in the subject content in a range of vocational situations
AO2	plan and carry out investigations and tasks, using a range of tools, equipment, material, components and processes, in which they analyse vocational issues and problems; and gather, record and analyse relevant information, data and other forms of evidence
AO3	evaluate evidence, make reasoned judgements and present conclusions accurately and appropriately.

For this specification, the weightings for each assessment objective are:

	Unit 1	**Unit 2**	**Unit 3**	**Total for specification**
AO1	32%	35%	45-55%	37-41%
AO2	35%	35%	15-25%	28-32%
AO3	33%	30%	20-30%	27-31%

Grade descriptions

Grade descriptions for this subject are provided in *Appendix B* at the end of this specification. They indicate the level of attainment that is characteristic of grades A, C and F. The actual grade awarded to a student will depend in practice on the extent to which the student has met the assessment objectives overall. Shortcomings in some aspects of assessment may be balanced by better performance in others.

External assessment

Unit 3 is assessed by a single test that will be set and marked by Edexcel. The test is untiered and will be targeted at students across the ability range A*-G.

This unit will be assessed through an external assessment and as such the teacher should ensure that each student is prepared for such an assessment. The student must be entered for an assessment in **one** of the **six** following sectors:

- printing and publishing, paper and board
- food and drink, biological and chemical
- textiles and clothing
- engineering fabrication
- electrical and electronics, process control, computers, telecommunications
- mechanical, automative.

Students are asked to answer a range of questions, which relate to the sector chosen.

Section A questions will relate generally to information about the chosen sector.

Section B will illustrate a product from the chosen sector and questions will relate to that product. The product will be pre-released in September for the following June's examination and will act as a focus for research in preparation for the examination.

Internal assessment

Supervision of students and authentication of work submitted

Students must submit a portfolio of work for each of (units to be specified). Teachers are expected to guide and advise students in the production of their portfolios. Teachers should monitor progress to ensure that the work is appropriate for the requirements of the specification. While some work, particularly in the early planning stages, may take place in groups, the input of the individual student should be clearly identified, and the judgements and conclusions reached must be their own. The GCSE, GCE, VCE and GNVQ Code of Practice requires that assessors record full details of the nature of any assistance given to individual students that is beyond that of the teaching group as a whole, but within the parameters laid down in this specification. The level of assistance should be taken into account when assessing students' work, as indicated in the guidance section that accompanies each internally assessed unit in this specification. In addition, sufficient work must take place under direct supervision to allow the teacher marking the work to authenticate each student's work with confidence.

If students' practical skills are being assessed it is important that witness statements/checklists are completed by assessors to authenticate student work and provide evidence that students have achieved the level of performance required in the assessment grid.

Applying the mark bands

Portfolios will be marked by the centre, and externally moderated by Edexcel. Each of the internally assessed units has a marking grid, divided into three broad mark bands, showing how to award marks in relation to the task and the assessment objectives. The marking grids indicate the required assessment outcomes as well as the quality of the outcomes needed for achievement in each of the mark bands. Mark band 1 relates to the expectations given in the grade description for grade F mark band 2 relates to the expectations for grade C, and mark band 3 relates to the expectations for grade A. For further information on grading, see the section *Grading and aggregation* on page 11.

In general terms, progression across the bands is characterised by:

- increasing breadth and depth of understanding
- increasing coherence, evaluation and analysis
- increasing independence and originality.

The unit marking grid shows the allocation of marks by assessment criterion and by mark band. This grid should be used to determine marks for student achievement in each unit. Students can achieve marks in different bands for each assessment objective. The total mark achieved will depend on the extent to which the student has met the assessment criteria overall.

Within each assessment criterion, it is a general principle that shortcomings in some aspects of the assessment requirements may be balanced by better performance in others. However, it is also important to note that for full marks in any particular assessment criterion, all the requirements should have been met.

Marks should not be awarded on the basis of a 'tick list' of factual content but on the overall response as it relates to the requirements stated within each mark band. Assessors should adopt a holistic approach and apply their professional judgement. The *Guidance for teachers* section in each unit gives specific details of how marks should be allocated.

Marks should be awarded according to the criteria for each strand set out in the marking grid, and assessors should apply their professional judgement where relevant. The *Guidance for teachers* section in each unit gives specific details of how marks should be allocated.

There should be no reluctance to use the full mark range and if warranted assessors should award maximum marks. Students' responses should be considered positively. A mark of 0 should be awarded only where the student's work does not meet any of the required criteria.

The grade descriptions for Engineering refer to the levels of support and guidance required by students in carrying out investigations and tasks. All students are entitled to initial guidance in planning their work. When marking the work, assessors should apply the following guidelines:

- '*Some support and guidance*': The student has to be guided and advised throughout to ensure that progress is made. The student relies on the support of the teacher, who has to assist in most aspects of the work. This level of support restricts the student's mark to band 1, irrespective of the quality of the outcomes.
- '*Limited assistance'*: The teacher supports the student initially in the choice of topic for investigation. Thereafter the teacher reacts to questions from the student and suggests a range of ideas that the student acts on. The student frequently checks matters of detail. The teacher needs to assist in some aspects of the work. This level of support restricts the student's mark to bands 1 or 2, irrespective of the quality of the outcomes.
- '*Independently'*: The teacher supports the student initially in the choice of topic for the investigation or task. Thereafter the teacher occasionally assists the student, and only when asked, but monitors progress throughout. This level of support gives access to all three mark bands.

For internal record-keeping purposes, centres may wish to make a copy of the marking grid for each student and use it to record the mark for that unit. The GCSE, GCE, VCE and GNVQ Code of Practice requires assessors to show clearly how credit has been assigned. Guidance on how this may be done will be included in the separate support material that will accompany this specification.

Standardisation and moderation

Where marking for this specification has been carried out by more than one assessor in a centre, there must be a process of internal standardisation carried out to ensure that there is a consistent application of the criteria laid down in the marking grids.

Marks awarded by the centre will be subject to external moderation by Edexcel. This is to ensure consistency with national standards. A sample of student portfolios will be examined, and marks will be adjusted where they are found to vary from the national standard. If the moderation process reveals an inconsistent application of the assessment criteria by centre assessors, Edexcel reserves the right to return the sample work in order for internal standardisation to be carried out.

External moderation will take place at the end of the course.

Availability of external assessment and moderation

	June 2003	January 2004	June 2004	January 2005	June 2005
Unit 1	✘	✘	✓	✘	✓
Unit 2	✘	✘	✓	✘	✓
Unit 3	✘	✘	✓	✘	✓

Grading and aggregation

The mark bands used for internal assessment do not relate to pre-determined grade boundaries. Following each examination and moderation series Edexcel will set the grade boundaries for the two internally assessed units and the externally assessed unit at an awarding meeting.

The raw mark boundaries will be converted to uniform marks on a scale of 0-100. The final grade for the qualification will be determined by aggregating the uniform marks for the three units. The following table gives details of the uniform mark scales (UMS) used for the units and for the qualifications.

Unit results

The minimum uniform marks required for each grade:

Unit grade	**A***	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Maximum uniform mark = 100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**

Candidates who do not achieve the standard required for a grade G will receive a uniform mark in the range 0-19 and be recorded as U (unclassified).

Qualification results

The minimum uniform marks required for each grade:

Qualification grade	**A*A***	**AA**	**BB**	**CC**	**DD**	**EE**	**FF**	**GG**
Maximum uniform mark = 300	**270**	**240**	**210**	**180**	**150**	**120**	**90**	**60**

Candidates who do not achieve the standard required for a grade GG will receive a uniform mark in the range 0-59 and be recorded as U (unclassified).

Resits

Students may resit each assessment component only once prior to certification. Students may, however, retake the whole qualification more than once.

Individual assessment results, prior to certification of the qualification, have a shelf-life limited only by the shelf-life of the specifications when they are used to contribute to the qualification.

Students with particular requirements

Students with special requirements may need additional support, for example technical aids or specially devised or adapted methods of assessment, with additional time allowed if necessary.

Edexcel will assess whether special considerations or concessions can, or need to be, made for students with particular requirements. Requests should be addressed to:

Special Requirements
Edexcel
Stewart House
32 Russell Square
London WC1B 5DN

Language of assessment

Assessment of this specification will be available in English only. Assessment materials will be published in English only and all written and spoken work submitted for examination and moderation must be produced in English.

The wider curriculum

Key skills

This specification provides opportunities for developing and generating evidence for assessing the key skills listed below:

- application of number
- communication
- information technology
- improving own learning and performance
- problem solving
- working with others.

Appendices C and *D* in this specification map the opportunities available at levels 1 and 2 respectively. Where appropriate, these opportunities should be directly cross-referenced, at specified level(s), to the criteria listed in Part B of the key skills specifications.

Spiritual, moral, ethical, social and cultural (SMESC) links

This specification provides opportunities for developing a range of spiritual, moral, ethical, social and cultural issues, together with citizenship, environmental issues and the European dimension. *Appendix E* maps the opportunities available.

Teacher support

There is a full range of support material designed for each GCSE in a vocational subject. The range includes:

- specimen tests and associated mark schemes
- sample materials for delivering the units – tutor support packs
- sample materials for assessing the internal units
- Chief Examiner reports
- the Edexcel website – www.edexcel.org.uk

Edexcel delivers a full INSET programme to support these GCSEs. This includes generic and subject-specific conferences, seminars, workshops and customised events for individual centres.

Further information on INSET programmes can be obtained from Customer Services on 0870 240 9800.

Information concerning support material can be obtained from:

Edexcel Publications
Adamsway
Mansfield
Notts NG18 4FN

Tel: 01623 467467
Fax: 01623 450481
E-mail: publications@linneydirect.com

Unit 1: Design and Graphical Communication

ABOUT THIS UNIT

There is some element of engineering in virtually everything we use from the clothes we wear, the food we eat to the transport we use, from the micro components in modern electronic devices to the structures in the largest civil engineering projects. This unit is about the process of designing. You will learn about the following aspects of the design process:

- analysing client design briefs
- developing design specifications and solutions
- applying scientific principles
- producing and reading engineering drawings
- selecting appropriate drawing techniques
- communicating a design solution.

Using the design process, you will develop your understanding and skills in design and graphical communication. You will learn to choose appropriate techniques for a given purpose or audience and to present your solutions.

Engineering drawings are used to present information. You will learn about the different engineering drawing techniques used for electrical, electronic and mechanical products and their servicing. You will learn to read engineering drawings and to understand specific engineering sector standards.

This and other units will utilise prior learning in design and technology. This unit links with *Unit 2: Engineered Products* and *Unit 3: Application of Technology* as the design ideas you develop may draw on what you know about making engineered products and on how products and production may use new technology. It will also help you to progress to some units in the Vocational A level in Engineering.

This unit provides some of the underpinning knowledge and understanding for the NVQ in Performing Engineering Operations.

You will also have the opportunity to develop your key skills when you are working towards this unit.

This unit will be internally assessed through a portfolio of evidence. Your result for this unit will be a mark from 0–100 which can be related to an equivalent grade.

WHAT YOU NEED TO LEARN

Design briefs

Before you begin a design, you need to understand what the client wants. You will learn how to analyse the client design brief to identify the key features of an engineered product or an engineering service. The key features are:

- function – where and what the product will be used for
- quality standards – sector and/or client quality standards

- styling aesthetics – the appearance and appeal of the product
- performance – how well the product has to perform
- intended markets – who might use the product, competition with other similar products, client's own customer base
- size – the approximate size in three dimensions
- maintenance – how this is planned for in design and during the product's use
- production methods and materials
- cost – including design, production and material costs
- regulations – including health and safety
- scale of production – quantity required, use of mass or batch production.

You will learn that there may be more than one design solution that meets the needs of a client and you must learn how to evaluate the strengths and weaknesses of different design solutions.

Design specifications and solutions

To enable you to produce a design solution that meets the needs of the client, you must first analyse the design brief and related engineering drawings to identify the key design features. You must then be able to explain what is required, showing clear details and decisions you have made about the intended product. This is called a design specification and it will help you to produce your design solution.

You must be able to use your design specification to produce a design solution that meets the client's and sector's requirements. To produce a design solution, you must learn how to use all of the following techniques to develop your design ideas:

- research and analysis of information and data
- consideration of scientific principles, for example recognition and use of structures and how to support and reinforce them
- generation of ideas and solutions
- evaluation of ideas, solutions, testing and subsequent modifications
- 2D and 3D drawing and sketching techniques
- modelling techniques.

You must be able to select the most appropriate design solution from the range of initial design ideas. To do this, you need to devise and apply tests against the design criteria at critical points in the development. Your final design solution must include:

- justification for your final choice that refers to the key features in the client design brief and your design specification
- details of your final design idea
- an explanation of how you met the client's requirements and complied with sector standards.

Engineering drawings

You must learn to read and use engineering drawings as well as produce a selection of engineering drawings using both manual and computer techniques.

All your engineering drawings and diagrams must comply to sector specific-standards and conventions, eg BS8888:2000/BS3939-1. Engineering drawings produced using third-angle orthographic projection, for example, should have a title, name block, scale and borders.

You must be able to read electrical/electronic, pneumatic/hydraulic and mechanical engineering drawings and diagrams so that you can explain the purpose of the components and the features used. You must learn to recognise a selection of appropriate standard symbols.

Typical standard symbols you must be able to recognise include:

- electrical/electronic components – resistors, thermistors, LEDs, capacitors, bulbs, batteries, motors, buzzers, variable resistors, diodes
- mechanical features – holes, screw threads (internal and external)
- dimensions – including toleranced dimensions, radii, centres, springs
- pneumatic/hydraulic valves, cylinders, reservoirs, pipework, filters.

You must be able to produce engineering drawings that are sufficient to communicate your final design solution by selecting and using the following techniques appropriately:

- freehand sketches
- isometric projection
- oblique projection
- perspective drawing
- block diagrams
- flow diagrams
- schematic diagrams
- circuit diagrams
- first-angle orthographic projection
- third-angle orthographic projection
- assembly diagrams
- exploded diagrams.

You are not expected to become expert in any of these techniques but you must learn how to produce drawings, or appropriate parts of drawings and diagrams, by both manual and computer-generated methods. You must be able to use computer-aided design (CAD) and link this with computer-aided manufacture (CAM).

Choosing engineering drawing techniques

When you are choosing drawing techniques, you must take account of the purpose of the engineering drawing and the intended audience. Your drawing may be:

- a working/manufacturing drawing
- a servicing/repairing drawing
- an assembly drawing.

The types of audiences to consider are:

- service engineers
- manufacturing engineers
- technical customers.

Presenting a design solution

You must be able to explain your final design solution to other people. Your presentation must:

- give reasons for your final choice that refer to the key features in the design brief and your design specification
- show details of your final design idea
- give an explanation of how your final design solution meets the client design brief
- respond to feedback, checking against the design criteria and suitability for the user, and modify your proposed solution, if necessary.

ASSESSMENT EVIDENCE – UNIT 1: DESIGN AND GRAPHICAL COMMUNICATION

You need to produce a design specification and design solution for an engineered product including:

a an analysis of the brief with key features of the product or service
b details of the product criteria and production constraints
c a range of ideas and design solutions
d evidence of how you tested and selected the final solution
e evidence of how you selected and used engineering drawing techniques
f engineering drawings and technical details
g evidence of how the solution meets the criteria with suggested modifications to improve its fitness for purpose.

ASSESSOR'S MARKING GRID (Please see also the section *Assessment guidance* on page 21.)

	Mark band 1 **At this level work must show:**	**Mark range**	**Mark band 2** **At this level work must show:**	**Mark range**	**Mark band 3** **At this level work must show:**	**Mark range**	**Mark awarded**
(a) **AO1** **AO2** **6 marks**	• an analysis of the brief to identify basic client needs, with the identification of some key features of the engineering product	1–2	• an analysis of the brief to identify the main client needs, with a description of the main key features of the engineering product	3–4	• an analysis of the brief to explain the main client needs, with a justification of the main key features of the engineering product	5–6	
(b) **AO1** **AO2** **6 marks**	• a design specification that describes basic details of the product criteria and of the production constraints	1–2	• a design specification that describes some of the main details of the product and of the production constraints	3–4	• a design specification that describes the main details of the product and of the production constraints	5–6	
(c) **AO2** **6 marks**	• the generation of basic design ideas and the development of simple design solutions	1–2	• the generation of alternative design ideas and the development, in some detail, of design solutions	3–4	• the generation of imaginative design ideas and the development of detailed and appropriate design solutions	5–6	

ASSESSOR'S MARKING GRID (Please see also the section *Assessment guidance* on page 21.)

	Mark band 1 At this level work must show:	Mark range	Mark band 2 At this level work must show:	Mark range	Mark band 3 At this level work must show:	Mark range	Mark awarded
(d) **AO3** **6 marks**	• limited testing against the design criteria to select and outline the final design solution	1–2	• a range of testing against the design criteria to select and describe the final design solution	3–4	• objective testing against the design criteria to select and justify the final design solution	5–6	
(e) **AO1** **AO2** **6 marks**	• the selection and use of a limited range of engineering drawing techniques to communicate the final solution	1–2	• the selection and use of a range of engineering drawing techniques to communicate, in some detail, the final solution	3–4	• the selection and use of an effective range of engineering drawing techniques to communicate, in detail, the final solution	5–6	
(f) **AO1** **AO2** **AO3** **6 marks**	• engineering drawings that have limited compliance with sector-specific standards and conventions, and that use some common standard symbols	1–2	• engineering drawings that comply, in some detail, with sector-specific standards and conventions, describing the purpose of the components and features used	3–4	• appropriate engineering drawings that comply, in detail, with sector-specific standards and conventions, explaining the purpose of the components and features used	5–6	
(g) **AO3** **6 marks**	• limited description of how the final design solution meets the brief and specification, with an identification of some relevant modifications	1–2	• description, in some detail, of how the final design solution meets the brief and specification, describing relevant modifications	3–4	• an explanation, in some detail, of how the final design solution meets the brief and specification, explaining relevant modifications	5–6	
					Total Unit Mark	**42**	
					Student Unit Mark		

GUIDANCE FOR TEACHERS

Delivery strategies

This unit aims to help development of graphical techniques by using the design process. A range of graphical techniques should be taught along with techniques of producing a design specification and solution. Students are not expected to have occupational competencies at this level or to be working to commercially accepted standards. The unit introduces students to six aspects of the design process: analysing client design briefs, developing design specifications and solutions, applying scientific principles, producing and reading engineering drawings, selecting appropriate drawing techniques, and communicating design solutions. In preparing a design solution it is important that students understand that often calculations using scientific principles need to be considered or used to ensure that solutions meet any technical requirements.

It is also important to remember that a final design solution is not a manufacturing specification. The student's work should include information on materials, processes and costs and should clearly meet the client's requirements.

Using a wide range of different components will make the engineering drawings more applicable to the unit range requirements. For many sectors it will be appropriate to design an electro-mechanical engineered product that includes both electrical and mechanical components and drawings, remembering that pneumatic and hydraulic symbols need also to be included. It may be more convenient to look at these separately, then bring the three areas together in terms of a product. For some centres it may be more suitable to consider work on an engineering service, such as equipment for information technology or telecommunications.

Modification of an existing product, based on existing drawings, may make the assignment more manageable, realistic and interesting for a student. A suitable client brief could be developed for students to use.

It is recommended that assessment takes place in guided study hours as this would ensure the work is that of the student. It may be appropriate to put a time restriction on students as this is an important factor in industrial practice. It is important that all engineering drawings and diagrams comply to sector-specific standards and conventions, eg BS308, BS3939. Engineering drawings produced, therefore, using third-angle orthographic projection, for example, should have a title, name block, scale and borders.

Assessment guidance

This section should be read in conjunction with the general section *Applying the mark bands* on page 9.

Supporting the student

One of the factors affecting the student's marks for each evidence requirement (a) to (g) is the level of support and guidance required. Please refer to the section *Applying the mark bands* on page 9 for full details.

Awarding marks

Each evidence requirement is made up of two features

Up to two marks are available in band 1:

either one mark for each of the two features covered to the required standard

or if one feature has not reached the standard required for a mark, but the other feature goes beyond the standard required for band 1, two marks can be awarded.

If the student has fully met the requirements of mark band 1 and already has two marks, up to two further marks can be awarded in mark band 2:

either one mark for each of the two features developed to the required standard

or if one feature meets the requirements for mark band 1, and the other feature is developed beyond the mark band 2 requirement, two marks can be awarded.

Similarly, if the student has fully met the requirements of mark band 2 and already has four marks, up to two further marks can be awarded in mark band 3:

either one mark for each of the two features developed to the required standard

or if one feature meets the requirements for mark band 2, and the other feature is developed beyond the mark band 3 requirement, two marks can be awarded.

The evidence requirements

(a) an analysis of the brief with key features of the product or service (6 marks)

The student needs to analyse the key features of the design brief to understand the client's needs. These include the cost, quantity required, intended market, timescales and function. In order to meet these needs, the product must display particular key features, including styling aesthetics, size, quality standards and performance.

Mark band 1

- Simple identification of the most obvious client needs (eg 'it is for cyclists' – a general group).
- Simple identification of the most obvious key features of the product (eg 'it must be lightweight' – no qualification or quantification).

The student analyses the design brief to identify the most obvious client needs and the most obvious key features. These may be written as simple lists. In both cases it is possible that some important items may be overlooked. (1–2 marks)

Mark band 2

- Description of the main client needs (eg 'the product is aimed at professional mountain bikers who regularly enter competitive events' – a more precisely defined group).
- Description of the main key features of the product (eg 'it should not weigh more than 50 grammes' – some qualification/quantification).

The student analyses the design brief to describe the main client needs and the main key features of the product. Few, if any, of the most important items are overlooked, and most are described rather than merely listed. The needs and key features are considered individually rather than as a whole. (3–4 marks)

Mark band 3

- Explanation of the main client needs, eg the statement in mark band 2, plus an understanding of how this will relate to price, for example.
- Explanation of the main key features of the product, eg 'it should not weigh more than 50 grammes because the total weight of the bike must be kept as low as possible so it can be carried at difficult points on the course'.

The student analyses the design brief to explain the main client needs and the main key features of the product. For credit in this mark band the student should consider the needs as a whole rather than individually. (5–6 marks)

(b) details of the product criteria and production constraints (6 marks)

Details of the intended product are included in a design specification, which includes criteria related to the product's function, styling aesthetics, size, performance, intended markets and maintenance.

Details of the production constraints are included in a design specification, which includes criteria related to the scale of production, cost, production methods and materials, quality standards and regulations.

Mark band 1

- Description of some basic but relevant product criteria, eg that 'the speedometer needs to be lightweight and durable'.
- Description of some basic but relevant production constraints, eg that 'the speedometer has to be batch produced in batches of 50'.

Simple but accurate statements, starting to give some detail, which may give only incomplete coverage of the criterion. (1–2 marks)

Mark band 2

- The identification of the main relevant product details, with some criteria described in more detail than others, eg that the speedometer has to be lightweight, durable by being resistant to shock and impact.
- The identification of the main relevant production constraints, with some criteria described in more detail, eg that the speedometer has to be batch produced in batches of 50, at £1.50 per item and conforming to British Standards.

Clear and accurate statements, with sufficient detail, in both features, to meet the descriptions below, or more detailed coverage of one of the features. (3–4 marks)

Mark band 3

- A description of the main relevant product details, with some criteria explained in more detail than others, eg that the speedometer has to be lightweight, durable by being resistant to shock and impact, as it must be attached to a high-spec lightweight mountain bike.
- A description of the main relevant production constraints, with some criteria explained in more detail, eg that the speedometer has to be batch produced in batches of 50, catering for production on demand, at £1.50 per item and conforming to British Standards.

Clear and accurate statements, with sufficient detail in both features to meet the descriptions below, or more detailed coverage of one of the features. The student can give reasons for decisions made about the product and production constraints. (5–6 marks)

(c) a range of ideas and design solutions (6 marks)

Mark band 1

- Some basic design ideas – typically two or three variations of the same basic idea.
- The development of simple design solutions, with limited understanding of scientific principles, such as the recognition of structures and how to support and reinforce them.

The student generates basic design ideas and develops simple design solutions that lack detail or depth. Ideas and solutions are likely to be clarified through the use of simple techniques, such as the discussion of information and data, drawing and modelling. The student clarifies solutions with limited understanding of scientific principles. (1–2 marks)

Mark band 2

- Alternative design ideas – two or three may be enough if they are genuinely 'alternative' rather than close variations on a theme.
- The development, in some detail, of mainly appropriate design solutions, using some scientific principles, such as the use of structures and how to support and reinforce them.

The student generates alternative design ideas and develops, in some detail, mainly appropriate design solutions. These are clarified through the use of a range of design strategies and techniques, such as discussion, the analysis of information and data, drawing and modelling. The student clarifies solutions through an understanding of some scientific principles. (3–4 marks)

Mark band 3

- A range of design ideas that shows some imagination. Quality rather than quantity is the key, but three or four ideas might be expected. 'Imaginative' designs may be those which do not rely on established market-leading products, or that offer a new slant on an existing idea.
- The development of detailed and appropriate design solutions, understanding and using some scientific principles.

The student generates, in some detail and depth, a range of imaginative design ideas and develops detailed and appropriate design solutions. The student uses a wide range of design strategies and techniques to clarify ideas, with discriminating use of discussion, the analysis of information and data, drawing and modelling. The student clarifies solutions through a clear understanding of some scientific principles, such as the recognition and use of structures and how to support and reinforce them. (5–6 marks)

(d) evidence of how you tested and selected the final solution (6 marks)

Mark band 1

- Limited testing of ideas and solutions, perhaps against only some aspects of the design criteria.
- A brief outline of how the final design solution meets the design criteria.

The student applies limited comparative testing of ideas and solutions. In this mark band the student may be testing simply to see whether the idea or solution 'works', but for credit a link must be made, at least implicitly, to the design criteria. The student outlines briefly how the final design solution meets the design criteria. (1–2 marks)

Mark band 2

- A range of testing of ideas and solutions linked explicitly to most of the main design criteria in order to select the final solution.
- A description, in some detail, of how the final design solution meets the design criteria.

The student applies a range of comparative testing of ideas and solutions explicitly linked to the main design criteria to select the final solution. This includes comparative testing and some testing of mock-ups or models. The student describes in some detail how the final design solution meets the design criteria. (3–4 marks)

Mark band 3

- Objective testing of ideas that show how all the main design criteria are met in order to select the final solution.
- A justification, in some depth, of how the final design solution meets the design criteria.

The student devises and applies objective testing of ideas and solutions against the design criteria, to select the final solution. This includes comparative testing and the testing of mock-ups and models. The student explains and justifies in some depth how the final design solution meets the design criteria. (5–6 marks)

(e) evidence of how you selected and used engineering drawing techniques (6 marks)

Mark band 1

- The selection of a limited range of engineering drawing techniques that takes some account of the purpose of the drawing.
- The use of a limited range of engineering drawing techniques to communicate the final solution.

In both cases, the 'limited range' is likely to be one main technique with one or two alternatives which are essentially variations on a theme and add little to the overall presentation.

The student selects and uses, with some skill, a limited range of manual and computer-generated engineering drawing techniques (where appropriate) to communicate the final solution. The chosen techniques take some account of the purpose of the drawing, eg a working/ manufacturing drawing. (1–2 marks)

Mark band 2

- The selection of a range of engineering drawing techniques that take some account of the purpose of the drawing and the intended audience.
- The use of a range of engineering drawing techniques to communicate, in some detail, the final solution to the intended audience.

In both cases the 'range' of techniques may be no more than was required for mark band 1. The distinguishing feature is that they should be chosen so that they combine to give a clear idea of the solution.The student selects and uses, with some skill and accuracy, a range of manual and computer-generated engineering drawing techniques (where appropriate) to communicate, in some detail, the final solution. The chosen techniques take some account of the purpose of the drawing, eg a servicing/repairing drawing, and of the intended audience, eg a service engineer.

(3–4 marks)

Mark band 3

- The selection of a range of appropriate engineering drawing techniques that takes considered account of the purpose of the drawing and the intended audience.
- The use of a range of appropriate engineering drawing techniques to communicate, in detail, the final solution to the intended audience.

In both cases the techniques chosen should combine to ensure that there is a clear and detailed representation of the solution.

The student selects and uses, with skill and accuracy, an effective range of manual and computer-generated engineering drawing techniques (where appropriate) to communicate, in detail, the final solution. The chosen techniques take considered account of the purpose of the drawing, eg an assembly drawing, and of the intended audience, eg a technical customer.

(5–6 marks)

(f) engineering drawings and technical details (6 marks)

Mark band 1

- Basic engineering drawings that show limited compliance with sector-specific standards and conventions.
- Engineering drawings that use some relevant common standard symbols, eg for dimensions, electrical, electronic or mechanical features.

The student produces and uses a limited selection of basic engineering drawings, with some skill and attention to detail. Drawings show limited compliance with sector-specific standards and conventions and use some relevant common standard symbols. (1–2 marks)

Mark band 2

- Engineering drawings that comply, in some detail, with sector specific standards and conventions.
- A description, in some detail, of the purpose of components and features used, eg mechanical, electrical or electronic features, valves or dimensions.

The student produces and uses a selection of engineering drawings, with some skill, accuracy and attention to detail. Drawings comply, in some detail, with sector-specific standards and conventions and the student is able to describe, in some detail, the purpose of the components and features used. (3–4 marks)

Mark band 3

- Appropriate engineering drawings that comply, in detail, with sector-specific standards and conventions.
- An explanation, in some detail, of the purpose and use of the components and features used, eg mechanical, electrical, or electronic features, valves or dimensions.

The student produces and uses a selection of appropriate engineering drawings, with skill, accuracy and attention to detail. Drawings comply, in detail, with sector-specific standards and conventions and the student is able to explain, in some detail, the purpose of components and features used. (5–6 marks)

(g) evidence of how the solution meets the criteria with suggested modifications to improve its fitness for purpose (6 marks)

Mark Band 1

- Brief statements, making limited reference to the design brief and specification criteria, describing the solution. The focus is likely to be on the solution itself rather than on the brief or criteria.
- In response to feedback, some relevant modifications are identified, but there is no clear indication of how these would be achieved – the comments are restricted to statements such as 'it needs to do xxx better'.

A limited description of how the final design solution meets some key features in the design brief and design specification criteria. The student, in response to feedback, identifies some relevant modifications to the product to improve its fitness for purpose. (1–2 marks)

Mark band 2

- Description, in some detail, of how the final design solution explicitly meets the main key features in the design brief and design specification criteria.
- In response to feedback, relevant modifications to the product to improve its fitness for purpose are described. There should be an indication of how at least some of the modifications will be achieved.

Description, in some detail, of how the final design solution meets the main key features in the design brief and design specification criteria. The student, in response to feedback, describes relevant modifications to the product to improve its fitness for purpose. (3–4 marks)

Mark band 3

- An explanation, in some detail, of how the final design solution explicitly meets the main key features in the design brief and design specification criteria.
- An explanation, in response to feedback, of relevant modifications to the product to improve its fitness for purpose. There may be an attempt to show the extent to which the modifications will improve the product.

An explanation, in some detail, of how the final design solution meets the main key features in the design brief and design specification criteria. The student, in response to feedback, explains relevant modifications to the product to improve its fitness for purpose. (5–6 marks)

Resources

Some useful publications of National Standards for drawing include:

- PP 8888-1:2001 A Guide for Schools and Colleges to BS 8888:2000 Technical Product Documentation
- BS 3939-1 Graphical Symbols for Electrical Power, Telecommunications and Electronic Diagrams
- BS 2917 Fluid Power Systems
- BS 8888:2000 Technical Product Documentation

Also useful:

- BS 1553 Graphical Symbols for Piping Systems and Plant
- BS EN 20286-1 and BS EN 20286-2 ISO System of Limits and Fits

The CAD requirements of this unit are at an introductory level. It is not necessary for students to use very complex computer-aided design (CAD) packages at this level. Some of the smaller inexpensive packages available would be more than adequate, such as Autosketch and TurboCAD.

Unit 2: Engineered Products

ABOUT THIS UNIT

In this unit you will make an engineered product. The unit will develop your understanding of the process of designing a product and producing it.

In the unit you will learn to:

- use product specifications
- read and interpret engineering drawings and diagrams
- select suitable materials, parts and components for a product
- create a production plan
- use processes, tools and equipment, including computer aided manufacture (CAM), required to make an engineered product
- check that the quality of your work conforms to the standards required
- apply health and safety procedures.

This and other units will utilise prior learning in design and technology. The unit builds on *Unit 1: Design and Graphical Communication*, and will allow you to use what you learn about technology in *Unit 3: Application of Technology*. It will also help you to progress to some of the units in a Vocational A level in Engineering.

This unit provides some of the underpinning knowledge and understanding for the NVQ in Performing Engineering Operations.

You will also have the opportunity to develop your key skills when you are working towards this unit.

This unit will be internally assessed through a portfolio of evidence. Your result for this unit will be a mark from 0–100 which can be related to an equivalent grade.

WHAT YOU NEED TO LEARN

Using a product specification

To make an engineered product, you need to know the specific requirements for all the different parts of the product. This information is contained within the product specification and on the working drawings and/or diagrams. You need to be able to understand and use the information in the product specification to make decisions about the development of a product. You must learn how to use a product specification and be able to recognise the following essential information required for a product:

- size, shape, form
- materials, parts and components
- process methods, where these are specified
- quantity required, for example single unit, batch and volume production
- timescales.

Production planning

The production plan gives all the details required to make the product. You must be able to produce a production plan for your product. The plan will give information about:

- materials, parts and components to be used
- processes to be used
- tools, equipment and machinery to be used
- the sequence of production, including critical production and quality control points
- production scheduling, including realistic deadlines
- how quality will be checked and inspected
- health and safety factors.

You must be able to modify your plans as circumstances change.

Choosing materials, parts and components

You must learn how to select materials and components with suitable characteristics and properties to meet a product specification. If you need to use alternative materials, parts or components you must explain why.

Materials and their properties may be considered in the following groups:

- ferrous and non-ferrous metals and alloys
- polymers, such as thermosetting polymers and thermoplastic polymers
- ceramics
- composites which combine the properties of different materials, eg bi-metal strips, carbon composites and sintered metals.

You must learn to recognise and understand the function of mechanical, electrical/electronic and pneumatic/hydraulic parts and components and be able to select and use appropriate parts and components for the development of an engineered product, including:

- mechanical components, such as nuts, bolts, screws, springs, rivets, pins, clips, keys and drive mechanisms, including gear trains
- electrical/electronic components, such as resistors, capacitors, diodes, LEDs, bulbs, wire, cable, insulators, batteries, motors, buzzers, variable resistors, thermistors, transistors and integrated circuits
- pneumatic/hydraulic components, such as directional and flow control valves, cylinders, reservoirs and filters.

The materials and components available have properties, characteristics and features that may affect your choice. You must learn to appreciate these when selecting and using appropriate materials for your product. These properties, characteristics and features might include:

- ability to be shaped and formed, for example by hammering, casting, forging, forming, bending and coiling
- ability to be treated, for example by heat or chemicals
- ability to be given a surface finish, for example by painting or chrome plating
- ease of handling, for example by being small, light, no sharp edges

- cost, for example the relative cost compared with other alternative materials and components
- availability, form and supply, for example by being available in standard sizes and standard values.

Using processes

For your chosen product you must be able to use the following processes and to understand their importance for functional and aesthetic reasons:

- material removal, such as turning, drilling, etching, milling and grinding
- shaping and manipulation, such as hammering, forming and bending
- joining and assembly, such as crimping, soldering, adhesion, wiring, threaded fasteners, welding and brazing
- heat and chemical treatment, such as annealing, tempering, hardening, etching, plating
- surface finishing, such as polishing and coating.

Quality control techniques

You must be able to inspect, test, measure and compare engineered products to their product specification to ensure that they comply with the standards required. Important features in a specification include the:

- dimensions
- tolerances
- fit
- finish
- performance
- quality.

Tools and equipment

You must learn to select and use appropriate tools and equipment, including computer-aided manufacture (CAM), needed for producing an engineered product. Your selection should take account of availability, cost, ease of handling, properties of materials and components. You must learn to care for tools and equipment and to maintain them where appropriate.

Health and safety

You must be aware of health and safety issues relating to the use of materials, components, tools and equipment required for your engineering activities. These usually include:

- taking reasonable care of yourself and others in an engineering environment
- wearing appropriate clothing and using safety equipment as appropriate
- carrying out risk assessments
- following health and safety procedures and instructions
- keeping a safe, clean and tidy workplace
- ensuring that tools, equipment and machinery are properly maintained and fit for use.

ASSESSMENT EVIDENCE – UNIT 2: ENGINEERED PRODUCTS

You need to make an engineered product including evidence of:

a how you used a product specification and interpreted engineering drawings
b information about details of resources and processing requirements
c information about production details and constraints
d how you selected and used materials to safely make your product
e how you selected and used parts and components to safely make your product
f how you selected and used processes, tools and equipment to safely make your product
g how you tested your product and how it complied to the standards required.

ASSESSOR'S MARKING GRID (Please see also the section *Assessment guidance* on page 34.)

	Mark band 1 At this level work must show:	Mark range	Mark band 2 At this level work must show:	Mark range	Mark band 3 At this level work must show:	Mark range	Mark awarded
(a) **AO1** **AO2** **6 marks**	• use of some information in a product specification and interpretation of basic details in engineering drawings and/or diagrams	1–2	• use of the main information in a product specification and interpretation of the main details in engineering drawings and/or diagrams	3–4	• confident use of the main information in a product specification and competent interpretation of the main details of engineering drawings and/or diagrams	5–6	
(b) **AO2** **AO3** **6 marks**	• a production plan that identifies basic details of resources and processing requirements	1–2	• a production plan that describes some details of the resources and processing requirements	3–4	• a production plan that explains the main details of the resources and processing requirements	5–6	
(c) **AO1** **AO2** **AO3** **6 marks**	• a production plan that identifies basic details about production requirements and constraints	1–2	• a production plan that describes, in some detail, production requirements and constraints	3–4	• a production plan that explains the production requirements and constraints	5–6	

ASSESSOR'S MARKING GRID (Please see also the section *Assessment guidance* on page 34.)

	Mark band 1 At this level work must show:	Mark range	Mark band 2 At this level work must show:	Mark range	Mark band 3 At this level work must show:	Mark range	Mark awarded
(d) **AO1** **AO2** **6 marks**	• a selection, with guidance, of some appropriate materials, using them safely with some skill to make a product	1–2	• a selection, with limited guidance, of appropriate materials, using them safely with skill to make a product	3–4	• an independent selection of appropriate materials, using them safely with skill and accuracy to make a product	5–6	
(e) **AO1** **AO2** **6 marks**	• a selection, with guidance, of some appropriate parts and components, using them safely with some skill to make a product	1–2	• a selection, with limited guidance, of appropriate parts and components, using them safely with skill to make a product	3–4	• an independent selection of appropriate parts and components, using them safely with skill and accuracy to make a product	5–6	
(f) **AO1** **AO2** **6 marks**	• a selection, with guidance, of some appropriate processes, tools and equipment, using them safely with some skill to make a product	1–2	• a selection, with limited guidance, of appropriate processes, tools and equipment, using them safely with skill to make a product	3–4	• an independent selection of appropriate processes, tools and equipment, using them safely with skill and accuracy to make a product	5–6	
(g) **AO3** **6 marks**	• basic testing against the product specification and limited compliance to the standards required	1–2	• a range of testing against the product specification and compliance to the main standards required	3–4	• objective testing against the product specification and consistent compliance to the main standards required	5–6	
					Total Unit Mark	**42**	
					Student Unit Mark		

GUIDANCE FOR TEACHERS

Delivery strategies

This unit aims to help develop an understanding of the process of designing a product and producing it. Techniques to produce a production plan should be taught along with techniques used to select appropriate materials and components and processes to produce products. Students are not expected to have occupational competencies at this level or to be working to commercially accepted standards. The unit introduces students to seven aspects of designing and producing a product: using product specifications, reading and interpreting engineering drawings and diagrams, selecting suitable materials, parts and components for a product, creating a production plan, using processes, tools and equipment, including computer aided manufacture (CAM), required to make an engineered product, checking that the quality of your work conforms to the standards required, and applying health and safety procedures.

Centres should think carefully about the product specification to be given to students. It should be designed to suit the materials and resources available to that centre. However, it should also endeavour to reflect the diverse realms of engineered products, for example by including mechanical and electrical components where feasible to do so. Using a wide range of different components will make the engineered product more applicable to the unit range requirements.

Before students use a process, adequate information and training may need to be provided. For many students this unit will be an introduction to some of the manual operations, and occupational levels of skill are not required. In addition to physically making an engineered product the unit seeks to develop understanding of the reasons for selecting the materials, components and processes. At this level students should be able to produce a product with a number of different components. In preparing a production plan it is important that students understand that often calculations using scientific principles need to be considered or used to ensure that materials selected meet any technical and property requirements in the product specification. Mathematical calculations will be evident when students are making decisions on size, shape and form of products and set up parameters for processes such as speeds and feeds.

Some centres may find it useful to split students into groups and for the groups to utilise resources in a carousel-type system. Instruction/process cards may prove valuable to the smooth running of this type of system.

Health and safety information should be provided and manuals and standards are a useful resource to have available.

Assessment guidance

Supporting the student

One of the factors affecting the student's marks for each evidence requirement (a) to (g) is the level of support and guidance required. Please refer to the section *Applying the mark bands* on page 9 for full details.

Awarding marks

Each evidence requirement is made up of two features.

Up to two marks are available in band 1:

either one mark for each of the two features covered to the required standard

or if one feature has not reached the standard required for a mark, but the other feature goes beyond the standard required for band 1, two marks can be awarded.

If the student has fully met the requirements of mark band 1 and already has two marks, up to two further marks can be awarded in mark band 2:

either one mark for each of the two features developed to the required standard

or if one feature meets the requirements for mark band 1, and the other feature is developed beyond the mark band 2 requirement, two marks can be awarded.

Similarly, if the student has fully met the requirements of mark band 2 and already has four marks, up to two further marks can be awarded in mark band 3:

either one mark for each of the two features developed to the required standard

or if one feature meets the requirements for mark band 2, and the other feature is developed beyond the mark band 3 requirement, two marks can be awarded.

The evidence requirements

(a) how you used a product specification and interpreted engineering drawings (6 marks)

Essential information required when making decisions about a product is included in working drawings and/or diagrams and in a product specification. These give the specific requirements for all the different parts of the product. The specification includes criteria related to the product's size, shape, form; materials, parts and components; process methods (where specified); quantity required; timescales. Engineering drawings and/or diagrams present information about electrical, electronic and mechanical products and comply to sector-specific standards and conventions.

Mark band 1

- With support and guidance use some of the information in a product specification when making decisions about a product.
- The interpretation of basic details in engineering drawings and/or diagrams when making decisions about a product.

The student makes use of sufficient specific requirements in the product specification to make basic decisions about how the product should be manufactured. The student understands and interprets sufficient technical details in engineering drawings and/or diagrams to make basic decisions about how the product should be manufactured. (1–2 marks)

Mark band 2

- With limited guidance use the main information in a product specification when making decisions about a product.
- The interpretation of the main details in engineering drawings and/or diagrams when making decisions about a product.

The student makes use of sufficient specific requirements in the product specification to make informed decisions about how the product should be manufactured. The student understands and interprets sufficient technical details in engineering drawings and/or diagrams to make informed decisions about how the product should be manufactured. (3–4 marks)

Mark band 3

- Independent use of the main information in a product specification when making decisions about a product.
- Interpretation of the main details in engineering drawings and/or diagrams to make decisions about a product.

The student makes use of sufficient specific requirements in the product specification to make confident decisions about how the product should be manufactured. The student interprets sufficient technical details in engineering drawings and/or diagrams to make competent decisions about how the product should be manufactured. (5–6 marks)

(b) information about details of resources and processing requirements (6 marks)

The production plan gives all the details required to make the product, giving information about materials, parts and components to be used; processes to be used; and tools, equipment and machinery to be used.

Mark band 1

- A production plan that identifies basic details of resources to be used.
- A production plan that identifies basic details of processing requirements.

(In both cases most resources and processing requirements are listed, but some may be overlooked. The student may be able to follow it, but there is insufficient detail or structure to allow a third party to use it.)

The student produces a production plan that identifies sufficient information about the materials, parts and components required to achieve the manufacture of a product.

The student produces a production plan that identifies sufficient information about the processes, tools, equipment and machinery required to achieve the manufacture of a product. (1–2 marks)

Mark band 2

- A production plan that describes some details of the resources to be used.
- A production plan that describes, in some detail, the processing requirements.

(In both cases all relevant resources and processing requirements are considered, with enough detail for an experienced third party to be able to follow it.)

The student produces a production plan that describes, in some detail, the materials, parts and components required to achieve the manufacture of a product.

The student produces a production plan that describes, in some detail, the processes, tools, equipment and machinery required to achieve the manufacture of a product. (3–4 marks)

Mark band 3

- A production plan that explains the main details of the resources to be used.
- A production plan that explains the processing requirements.

(In both cases all relevant resources and processing requirements are developed in detail and the production plan can be easily followed.)

The student produces a production plan that explains the materials, parts and components required to achieve the manufacture of a product.

The student produces a production plan that explains the processes, tools, equipment and machinery required to achieve the manufacture of a product. (5–6 marks)

(c) information about production details and constraints (6 marks)

The production plan gives all the details required to make the product, giving information about the sequence of production, including critical production and quality control points; production scheduling, including realistic deadlines; how quality will be checked and inspected; health and safety factors.

Mark band 1

- A production plan that identifies basic details about production requirements
- A production plan that identifies basic details about production constraints.

(In both cases most production requirements and constraints are listed, but some may be overlooked. The student may be able to follow it, but there is insufficient detail or structure to allow a third party to use it.)

The student produces a production plan that identifies sufficient information about the sequence of production, scheduling or health and safety factors to achieve the manufacture of a product. There may be incomplete coverage of the criterion, eg scheduling or the sequence of production may not be considered.

The production plan identifies sufficient production constraints related to critical production and quality control points, realistic deadlines or how quality will be checked and inspected, to achieve the manufacture of a product. There may be incomplete coverage of the criterion, eg quality or deadlines may not be considered. (1–2 marks)

Mark band 2

- A production plan that describes, in some detail, production requirements.
- A production plan that describes, in some detail, production constraints.

(In both cases all relevant production requirements and constraints are considered, with enough detail for an experienced third party to be able to follow it.)

The student produces a production plan that describes, in some detail, production requirements about the sequence of production, scheduling and health and safety factors to achieve the manufacture of a product.

The plan also describes, in some detail, production constraints related to critical production and quality control points, realistic deadlines and how quality will be checked and inspected to achieve the manufacture of a product. (3–4 marks)

Mark band 3

- A production plan that explains the production details.
- A production plan that explains the production constraints.

(In both cases all relevant production requirements and constraints are developed in detail and the production plan can be easily followed.)

The student produces a production plan that explains production requirements about the sequence of production, scheduling and health and safety factors to achieve the manufacture of a product.

The plan also explains, in some detail, production constraints related to critical production and quality control points, realistic deadlines and how quality will be checked and inspected to achieve the manufacture of a product. (5–6 marks)

(d) how you selected and used materials to safely make your product (6 marks)

Students need to learn how to select materials with suitable characteristics and properties to meet a product specification. If they use alternative materials they must explain why.

Mark band 1

- A selection, with some support and guidance, of some appropriate materials.
- Use materials safely with some skill to make a product.

The student selects some materials that are mainly appropriate to meet a product specification, and uses them safely, with some skill, to make a product. (1–2 marks)

Mark band 2

- A selection, with limited guidance, of appropriate materials.
- Use materials safely with skill to make a product.

The student makes a considered selection of materials that are appropriate to meet a product specification, and uses them safely, with skill, to make a product. (3–4 marks)

Mark band 3

- An independent selection of appropriate materials.
- Use materials safely with skill and accuracy to make a product.

The student makes a confident selection of materials that are appropriate to meet a product specification, and uses them safely, with skill and accuracy, to make a product. (5–6 marks)

e) how you selected and used parts and components to safely make your product (6 marks)

Students need to recognise and understand the function of mechanical, electrical/electronic and pneumatic/hydraulic parts and components in order to be able to select and use them appropriately for the development of an engineered product.

Mark band 1

- A selection, with some support and guidance, of some appropriate parts and components.
- Use parts and components safely with some skill to make a product.

The student selects some parts and components that are mainly appropriate to meet a product specification, and uses them safely, with some skill, to make a product. (1–2 marks)

Mark band 2

- A selection, with limited guidance, of appropriate parts and components.
- Use parts and components safely with skill to make a product.

The student makes a considered and thought through selection of parts and components that are appropriate to meet a product specification, and uses them safely, with skill, to make a product. (3–4 marks)

Mark band 3

- An independent selection of appropriate parts and components.
- Use parts and components safely, with skill and accuracy, to make a product.

The student makes a confident selection of parts and components that are appropriate to meet a product specification, and uses them safely, with skill and accuracy, to make a product. (5–6 marks)

(f) how you selected and used processes, tools and equipment to safely make your product (6 marks)

Students need to be able to select and use different processes, tools and equipment, including the use of computer-aided manufacture (CAM) where appropriate and available, and to understand the importance of processes for functional and aesthetic reasons. Processes may include material removal, shaping and manipulation, joining and assembly, heat and chemical treatment and surface finishing.

Mark band 1

- A selection, with some support and guidance, of some appropriate processes, tools and equipment.
- Use processes, tools and equipment with some skill to make a product.

The student selects some processes, tools and equipment that are mainly appropriate to meet a product specification, and uses them safely, with some skill, to make a product. (1–2 marks)

Mark band 2

- A selection, with limited guidance, of appropriate processes, tools and equipment.
- Use processes, tools and equipment safely with skill to make a product.

The student makes a considered and thought-through selection of processes, tools and equipment that are appropriate to meet a product specification, and uses them safely, with skill, to make a product. (3–4 marks)

Mark band 3

- An independent selection of appropriate processes, tools and equipment.
- Use processes, tools and equipment safely with skill and accuracy to make a product.

The student makes a confident selection of processes, tools and equipment that are appropriate to meet a product specification, and uses them safely, with skill and accuracy, to make a product. (5–6 marks)

(g) how you tested your product and how it complied to the standards required (6 marks)

Students must be able to inspect, test, measure and compare engineered products to their product specification to ensure that they comply with the standards required. Important features in a product specification include dimensions, tolerances, fit, finish, performance and quality. Students must use planned quality checks and inspection at critical control points in the product manufacture and be able to modify the production as required to improve quality.

Mark band 1

- Limited testing, perhaps against only some aspects of the product specification.
- Limited compliance to the standards required.

The student applies and records basic testing against the product specification, using quality checks at some critical control points in the product manufacture. Testing results in the manufacture of a product that has a limited compliance with standards required. (1–2 marks)

Mark band 2

- A range of testing that is explicitly linked to most aspects of the product specification.
- Compliance to the main standards required.

The student applies and records a range of testing against the product specification, using quality checks with some precision at the main critical control points in the product manufacture. Testing results in the manufacture of a product that complies to the main standards required. (3–4 marks)

Mark band 3

- Objective testing against the product specification that shows how all requirements of the product specification have been met.
- Consistent compliance to the main standards required.

The student applies and records a range of objective testing against the product specification, using quality checks with precision at the main critical control points in the product manufacture. Testing results in modifications to the production and production plan to enable the manufacture of products that consistently comply to the main standards required.

(5–6 marks)

Resources

Some useful publications of National Standards for product specification include:

- PP 8888-1:2001 A Guide for Schools and Colleges to BS 8888:2000 Technical Product Documentation
- BS 3939-1 Graphical Symbols for Electrical Power, Telecommunications and Electronic Diagrams
- BS 2917 Fluid Power Systems
- BS 8888:2000 Technical Product Documentation

Also useful:

- BS 1553-1 Graphical Symbols for Piping Systems and Plant
- BS EN 20286-1 and BS EN 20286-2 ISO System of Limits and Fits
- Health and Safety Manuals and Catalogues

The CAM requirements of this unit are at an introductory level. It is not necessary for students to use very complex computer-aided manufacture packages at this level. It may be appropriate for centres such as schools to forge links with local further educational establishments which are likely to have a full range of CAM equipment.

The centre will need a range of product specifications that gives students an opportunity to develop appropriate production plans.

A comprehensive range of materials, parts and components is required for product manufacture. A range of processes should also be available to cover those processes that the production plan will show from the product specification. This highlights the need for careful product specifications to be developed around the centre's resources.

Unit 3: Application of Technology

ABOUT THIS UNIT

Technology affects every stage in the design and manufacture of products. In this unit you will investigate the impact of modern technology on the design and manufacture of a range of products in different engineering and manufacturing sectors. You will learn how new technology has helped to develop design and manufacturing processes and to improve the quality of products and the service offered to customers. You will also learn about the benefits and implications modern technology has for the workforce, the wider community, the global environment and sustainability.

You will investigate the impact of:

- information and communications technology
- new components and a range of modern materials, including smart materials
- control technology.

This and other units will utilise prior learning in design and technology. This unit links with *Unit 1: Design and Graphical Communication* and *Unit 2: Engineered Products* where you will have the opportunity to use new technology and materials. This unit may also help you to progress to Vocational A levels in Engineering or Manufacturing and forms part of a GCSE in Manufacturing (Double Award).

This unit provides some of the underpinning knowledge and understanding for the NVQ in Performing Manufacturing Operations and Performing Engineering Operations.

You will also have the opportunity to develop your key skills when working towards this unit.

This unit will be assessed through an examination set and marked by Edexcel.

There will be one 1½ hour examination paper. Pre-release material will be issued in advance of the examination, and questions will relate to this material.

Your result for this unit will be a mark from 0-100 which can be related to an equivalent grade.

WHAT YOU NEED TO LEARN

Manufacturing and engineering sectors

You will investigate the impact of technology on the design and manufacture of different products across a range of the engineering and manufacturing sectors listed below:

Engineering

- engineering fabrication
- mechanical/automotive
- electrical and electronic/computer/process control/telecommunications.

Manufacturing

- food and drink/biological and chemical
- printing and publishing/paper and board
- textiles and clothing.

When investigating products, you must be able to identify in which sector the product was made.

New technology

You will learn about and look at examples of how modern technology is involved in the design and manufacture of a range of products across the different sectors. The modern technologies you will learn about are as follows.

The use of information and communications technology, including:

- sourcing and handling information and data, such as databases, spreadsheets and internet sites
- CAD (computer-aided design) techniques
- CAM (computer-aided manufacture)
- communications technology
- control technology.

The use of modern and smart materials and components, including:

- polymers, including plastics, adhesives and coatings
- metals and composites, including shape memory alloys
- biological, chemical and food products, modified ingredients and methods of preparation and production
- computer technology, including microprocessors and memory devices
- micro-electronic components and parts, including integrated circuits and display devices
- textile technology, including liquid crystal coated fabrics and thermochromic dyes.

The use of systems and control technology to organise, monitor and control production, including:

- process/quality control and automation, including programmable logic controllers (PLCs) and embedded computers, such as those used in both industrial and domestic appliances
- robotics, including continuous operation, improved reproducibility, increased speed, work in hazardous environments
- ICT as applied to integrated manufacturing/engineering systems, computer-integrated engineering (CIE), computer-integrated manufacturing (CIM) and including CAD/CAM links.

You must understand the impact of these modern technologies on:

- range, types and availability of products
- design and development of products
- materials, components and ingredients used

- safety and efficiency of modern methods of production, in terms of materials, energy consumption and time
- improved characteristics of products, such as size, weight/density, ease of use, disposability and reclaimability
- markets for the products.

You must also understand the advantages and disadvantages that the use of modern technology has brought to society. These might include:

- changes in the type and size of the workforce
- changes in the working environment
- impact on the global environment and sustainability.

Stages in engineering and manufacturing a product

Making a product involves a number of important stages and activities. These can be generally grouped as:

- design
- marketing
- production planning
- material supply and control
- processing – production
- assembly and finishing
- packaging and dispatch.

When you look at a product, you must be able to identify the main stages and activities in making the product.

You also need to understand the impact of modern technology on the stages of manufacturing.

Investigating products

You will learn how to investigate products from a variety of sectors that use modern technology by:

- researching information from manufacturers and suppliers
- handling and examining individual products
- carrying out simple assessment of properties, such as structure, heaviness, colour and feel of surfaces, scratch and wear resistance, areas likely to be damaged
- evaluating the need for the technology, materials and components used.

When investigating the impact of technology on the design and manufacture of a range of products in different sectors, you should consider the:

- role the modern technology plays in the design and manufacture of the product
- technology or process it replaced
- benefits of using the technology
- implications of using the technology for the product and the manufacturer.

You must be able to use the information you have gathered, together with drawings, diagrams and sketches, to explain how a product works in terms of its:

- purpose
- structure and form
- materials and components
- technology used.

GUIDANCE FOR TEACHERS

Preparation for external assessment

This unit is externally assessed. There are, consequently, a number of strategies that teachers will need to consider when developing schemes of work and action plans.

The teaching strategies for externally assessed units are likely to be very similar to those strategies for units that are assessed through portfolio evidence. Students will still need to be able to apply the skills, knowledge and understanding identified in the section *What you need to learn*. However, there are additional aspects to consider.

Teachers must ensure students are prepared for the external assessment. This will include familiarising students with the format and structure of the assessment. They should be clear about the rules and regulations of external assessments and they should also be reminded of the duration and aims of the assessment. In other words they should be well rehearsed in the format and structure of external assessments.

Students should understand the terminology of assessment, for example describe, explain, evaluate. Teaching time should be allocated to support students with this. The external assessment aims to assess the student's vocational knowledge skills and understanding.

Teachers should be aware of marking schemes and their implications and students should practise effective time management for the external assessment.

Students need to be able to apply the knowledge, skills and understanding of the unit to the demands of the questions set. The ability to transfer knowledge, skills and understanding to different situations is an invaluable preparation for employment, training and further education. External assessment is one example where this transference is critical, for example coping with the controlled conditions of an external assessment, the imagined scenarios and responding to questions.

Unit delivery

This unit is concerned with the way technology affects products and companies, particularly in the stages of design and manufacture. It provides a good focus for the interesting developments that have changed the ways items are produced. The positive aspects of technology should be stressed. It is appropriate to consider improvements in quality through using technology and the benefits and implications modern technology has for the workforce, the wider community, the global environment and sustainability.

Technology has affected all stages of engineering, from customer enquiries to final dispatch and eventual tracking of products. Many companies have websites on the internet; these are a good starting point for obtaining information. Guidance should be given when product choices are being made. It is often useful if the product both uses technology and was made using technology.

The investigation of impact should cover the following fields:

- information and communication technology
- new components and a range of modern materials, including smart materials
- control technology.

It is helpful if students have seen a modern production process. Students should appreciate that changing technologies affect many aspects of engineering, including design, production planning and operations. For example, automation can be used for quality monitoring.

When examining a product it is useful if it can be taken apart and examined. This helps introduce a practical activity into the unit and provides information about materials and components. This will not only maintain student interest but will allow them to see clearly how products are structured and how they work. An outcome of this work could take the form of a sectioned display that is annotated by students.

It is important that students investigate a number of different engineered products either as a group activity or as a formal lesson as they will be asked questions about products from a sector of their choice. This will help them to develop learning about purpose, form and structure, which they may find difficult.

The products should be chosen carefully so that they can be supported by centres and satisfy the interest of the students. The link with industry is particularly important to ensure realistic case studies. As such, the delivery of this unit would benefit from a series of industrial visits.

Good simulations of automation and other new technologies can be achieved by using the equipment available from educational suppliers.

External assessment

This unit will be assessed through an external assessment and as such the teacher should ensure that each student is prepared for such an assessment. The student must be entered for an assessment in **one** of the **six** following sectors:

- printing and publishing, paper and board
- food and drink, biological and chemical
- textiles and clothing
- engineering fabrication
- electrical and electronics, process control, computers, telecommunications
- mechanical, automative.

Students are asked to answer a range of questions, which relate to the sector chosen.

Section A questions will relate generally to information about the chosen sector (eg mechanical/automotive).

Section B will illustrate a product from the chosen sector and questions will relate to that product. This product will be pre-released in September for the following June's examination and will act as a focus for research in preparation for the examination.

Sample assessment material, together with mark schemes, is available to accompany this specification and, increasingly, past assessment material will also be available.

Resources

Because of the nature of this unit, textbooks will be of limited use to the student, and much reliance will be placed upon materials prepared by the teacher, or materials supplied through engineering organisations' own literature. The internet will be of particular interest to students wishing to gain a broad range of information on products and technology.

A comprehensive range of products, parts and components is required for product investigation.

Appendices

Appendix A – Glossary of terms

These are the working definitions of key terms used in the GCSE in Engineering (Double Award).

Engineered product: the result of a planned electrical/electronic, mechanical or, most often, electro-mechanical engineering activity to produce products or components to specification. Key to the term engineered product is the understanding that the finished product will meet the specification. It should be functional, fit for its intended purpose and serve the needs of the client.

Engineering information: technical details, often quoted in a specification, relating to factors such as materials, finish, tolerances, processes or equipment involved in manufacturing an engineered product or service. These details may be communicated in oral, graphical or written form.

Engineering service: the application of engineering principles to install, maintain or repair engineered products to a state of effective and efficient functionality, usually in accordance with a specification.

Specification: a detailed statement of technical information required to produce an engineered product or perform an engineering service. This information will reflect both the requirements of the client and the constraints of production or of installation/maintenance. A specification may be communicated in written or graphical form and may form an important element of a contract. It may refer to factors such as the purpose, timing, materials, processes, quality and cost of an engineering service, or the function, materials, processes, quality, tolerances, finish, quantity, measurements and cost of an engineered product.

Customer: it should be noted that the customer is not necessarily external to the organisation, nor the end user of the product. They may come from another department within the organisation or may be another manufacturer.

Design brief: instructions from the customer, outlining requirements for function, performance, aesthetics, cost, quality, etc. The design brief represents the first stage of the product's design and development, and forms the basis of the future development or design proposals, solutions and present specifications.

Record: an account (written or recorded in other form which can be scrutinised) of the activity which is being assessed. The form and content of the record will vary according to the nature of the element. For example, the record could be in tabular form, a series of prose statements, a check-list and so on.

Report: a finished piece of work which brings together the ideas and information that the student has researched and investigated for the range and performance criteria specified. In producing her/his report, the student will need to: consider carefully what material to include; sequence the material in a way that is appropriate to the purpose and the audience; use examples to illustrate general points; and express the report with due care and attention. The form in which the report is presented will vary depending on the nature of the element. For example, it could be written, oral or in tabular form.

Appendix B – Grade descriptions

The following grade descriptions indicate the level of attainment characteristic of the given grade for GCSEs in Engineering. They give a general indication of the required learning outcomes at each specified grade. The descriptions should be interpreted in relation to the content outlined in the specification; they are not designed to define that content. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of the assessment may be balanced by better performances in others.

Grade F

Candidates are able to recall and apply basic knowledge, skills and understanding to engineering problems and tasks. Candidates will make use of a limited range of sources of information to analyse engineering problems and will clarify their ideas through discussion, drawing and modelling. With some support and guidance, candidates will plan and carry out investigations and will work with a range of tools, materials, equipment, components and processes with some precision in a safe and appropriate manner. Candidates will check their work as it develops and modify their approach in the light of progress. They will gather, record and analyse information from a limited range of evidence to test and evaluate their solutions to manufacturing problems. They will present conclusions based on a limited evaluation of the evidence.

Grade C

Candidates are able to recall and apply knowledge, skills and understanding to a range of engineering problems and tasks. Candidates will make use of a wide range of appropriate sources of information to analyse engineering problems and develop ideas. They will use a range of strategies to develop, clarify and communicate ideas, using appropriate media. With limited guidance, candidates will plan and carry out investigations, producing plans that make effective use of time and resources, and will work with a range of tools, materials, equipment, components and processes. They will organise their work so that they can carry out processes accurately and consistently, and use tools, equipment, materials and components with precision in a safe and appropriate manner. They will adapt their methods of manufacture to changing circumstances, providing a sound explanation for any changes from the plan. Candidates will gather, record and analyse information from a range of sources, selecting appropriate techniques to test and evaluate solutions. They will present reasoned conclusions, based on their evaluation of the evidence.

Grade A

Candidates will recall and apply knowledge, skills and understanding to a range of complex engineering problems and tasks. Candidates will be discriminating in their selection and use of a wide range of information sources to analyse engineering problems and develop ideas. They will identify conflicting demands on the design, manufacture and use of products. They will use a wide range of strategies to develop, clarify and communicate appropriate ideas and solutions using appropriate media. Candidates will independently plan and carry out investigations, making effective use of time and resources. They will demonstrate a sound understanding of materials, processes and components, and will work with a range of tools, equipment, materials and components to a high degree of precision in a safe and appropriate manner. They will organise their work so that they can carry out processes accurately and consistently and will review and adapt their methods of manufacture to changing circumstances, providing a well-reasoned explanation for any changes to the plan. They will gather, record and analyse information from a wide range of appropriate sources and will identify and apply a broad range of criteria for evaluating and testing their solutions. They will present carefully reasoned and appropriate conclusions, based on a systematic evaluation of the evidence.

Appendix C – Key skills mapping – level 1

Key:		
	✓	The unit contains clear opportunities for generating key skills portfolio evidence.
		The unit contains opportunities for developing the key skill, and possibly for generating portfolio evidence if teaching and learning is focused on that aim.
	✗	There are no obvious opportunities for the development or assessment of the key skill in the unit.

Key skill	**GCSE unit**	**Examples of opportunities for developing the key skill or for generating key skills portfolio evidence** **NB these are illustrative only**	
N1.1 Interpret straightforward information from two different sources. At least one source should be a table, chart, diagram or line graph.	Unit 1	✔	Interpreting basic numerical information on production methods, the properties of materials, scales of production, costs, etc as part of developing design solutions. Interpreting engineering drawings.
	Unit 2	✔	Interpreting basic technical information in a product specification, information on materials properties, quality control data, drawings, etc.
	Unit 3		Interpreting straightforward technical information on the properties of materials, on the structure and form of engineered products, etc.
N1.2a Carry out straightforward calculations to do with amounts and sizes.	Unit 1	✔	Calculating resources for manufacture: amounts of raw materials, costs, etc, calculating quantities, calculating the size of the product in three dimensions, measuring materials, calculating tolerances, etc.
	Unit 2	✔	Calculating resources requirements, cost, dimensions, quantities etc.
	Unit 3	✔	Investigating the structure and composition of an engineered product: dimensions, quantities manufactured, etc.
N1.2b Carry out straightforward calculations to do with scales and proportion.	Unit 1	✔	Working with scale models, making decisions about materials, using different projections in engineering drawings, etc.
	Unit 2	✔	Working with dimensions, eg in relation to the properties of materials, the size of components, etc.
	Unit 3	✔	Working with dimensions and producing scale drawings to explain how a product works.

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
N1.2c Carry out straightforward calculations to do with handling statistics.	Unit 1	✔	Working with quality control information, considering markets for the product or service, etc.
	Unit 2	✔	Working with quality control data.
	Unit 3	✔	Quantifying the different products made by the engineering and manufacturing sectors, and the impact of new technologies in terms of eg market share, range of products available, energy consumption, etc.
N1.3 Interpret the results of your calculations and present your findings. You must use one chart and one diagram.	Unit 1	✔	Presenting the results of calculations of cost, quantity, product size, tolerances, etc in the final design solution, using appropriate graphical methods.
	Unit 2		Presenting numerical information in the production plan, on eg costs, quantities, tolerances, quality control, based on own calculations and using appropriate graphical methods.
	Unit 3		Presenting the results of investigations of an engineered product, showing its dimensions, how new technology has influenced the design/sales, etc, using appropriate graphical methods.
C1.1 Take part in a **one-to-one** discussion and a **group** discussion about different, straightforward subjects.	Unit 1	✔	Discussing the design brief with the client to clarify their requirements, or with other members of the design team to formulate a design specification, generate ideas, etc.
	Unit 2		Discussing the product specification with other members of the production team to derive information for inclusion in the production plan. Discussions during production eg of quality control findings.
	Unit 3		Identifying and discussing the impact of new technology, with the class or others, eg an engineer with long experience of manufacturing technology. Considering advantages and disadvantages for eg the workforce and the environment, etc.
C1.2 Read and obtain information from **two** different types of documents about straightforward subjects, including at least **one** image.	Unit 1		Simple design briefs and design specifications, summaries of relevant regulations, data sheets, manuals, textbooks, etc.
	Unit 2	✔	Product specifications, data sheets, manuals and guides for parts and components, extracts and summaries from health and safety regulations, quality manuals, textbooks, etc.
	Unit 3		Product information: manuals, guides, etc, promotional materials for companies using new technology, suppliers, catalogues, textbooks, trade magazines, etc.

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
C1.3 Write **two** different types of documents about straightforward subjects. Include at least **one** image in one of the documents.	Unit 1	✔	A design specification and a design solution based on the design brief. The design solution should describe the brief and how it was met, with drawings and models, etc as appropriate. Design ideas in their development, eg sketches, prototypes, etc, also supported by text.
	Unit 2		A production plan based on the product specification, with text. Descriptions of materials data, quality control data, the operation of parts and components, reasons for choice of materials, tools and components, etc.
	Unit 3		Reports on particular examples of new technology, with drawings. Product reviews or reports about products featuring new technology, identifying the sector in which they were manufactured, the main stages in their manufacture, the role of the new technology and a description of their operation, purpose, etc.
IT1.1 Find, explore and develop information for **two** different purposes.	Unit 1		Using given sources from the internet, CD ROMs, databases and other media as possible sources of technical data, eg on materials. These sources might also inform research into a new product or service by providing details of: markets, existing products/services, sources of materials, as well as ideas for design and aesthetics and images which might be used in developing work.
	Unit 2		Using given sources from the internet, CD ROMs, databases and other media to obtain information on the properties and characteristics of materials, on parts and components, tools and equipment, production methods and processes, etc.
	Unit 3		Using given sources from the internet, CD ROMs, databases and other media as sources of product information and for information on the operation and impact of new technologies.
IT 1.2 Present information for **two** different purposes. Your work must include at least **one** example of text, **one** example of images and **one** example of numbers.	Unit 1		Presenting final design solutions using WP, imported images, information on cost, materials, production, timescales, etc. Using IT to present design ideas and specifications, production information, etc to the client during the development of the final design.
	Unit 2		Presenting production plans using WP, the results of testing and measurement, drawings, graphical information on quality and quantity, etc.
	Unit 3		Reporting on new technology using WP, imported text and images, etc. Drafting and finalising product reports, using CAD, recording, manipulating and presenting numerical data, etc.

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
LP1.1 Confirm understanding of your short-term targets, and plan how these will be met, with the person setting them.	Unit 1		If the group's work is planned to allow an appropriate person to set individual targets, eg to produce an engineering drawing, and also to identify action points eg to practise different types of drawings, study a textbook, etc, deadlines, arrangements for reviewing progress, and who to ask for help.
	Unit 2		If the group's work is planned to allow an appropriate person to set individual targets, eg to produce a first sample of the product. And also to identify action points, eg to practise using the machinery, deadlines, arrangements for reviewing progress, and who to ask for help.
	Unit 3	✗	
LP1.2 Follow your plan, using support given by others to help meet targets. Improve your performance by: a studying a straightforward subject b learning through a straightforward practical activity.	Unit 1		If the student follows the plan agreed in LP1.1, seeking support where necessary, and uses different approaches to learning, eg reading textbooks and making notes, looking at professional engineering drawings, etc. Also acting on suggestions for improvements.
	Unit 2		If the student follows the plan agreed in LP1.1, seeking support where necessary, and uses different approaches to learning, eg comparing their product to a commercially produced one, consulting manuals, etc. Also acting on suggestions for improvements.
	Unit 3	✗	
LP1.3 Review your progress and achievements in meeting targets, with an appropriate person.	Unit 1		Reviewing what has been learned and how the student went about it, on a one-to-one basis, eg in tutorials, with encouragement to identify good work and bad, with suggestions for improvements.
	Unit 2		Reviewing what has been learned and how the student went about it, on a one-to-one basis, eg in tutorials, with encouragement to identify good work and bad, with suggestions for improvements.
	Unit 3	✗	

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
PS1.1 Confirm your understanding of the given problem with an appropriate person and identify **two** options for solving it.	Unit 1	✔	The design brief is the 'problem'. With support from an appropriate person or people, identifying the client's requirements of the product or service, eg its key features. Working with others to establish options for meeting the brief, including researching materials, production methods, generating ideas and solutions, etc. Identifying which options are likely to work best. Also applies to decisions during the development of designs, eg about choosing a material.
	Unit 2	✔	Analysing the product specification and identifying essential product information. Identifying materials, parts and components, processes, etc which might fulfil the specification and choosing those which seem the most suitable.
	Unit 3	✗	
PS1.2 Plan and try out at least **one** option for solving the problem, using advice and support given by others.	Unit 1	✔	Planning the design process, eg areas for research, timescales, etc, showing how the product might be made or the service provided, testing different solutions and making changes to the solution or design specification as necessary.
	Unit 2	✔	Planning the testing of materials and parts and components as part of developing the production plan, and carrying out those tests. Making changes and seeking advice as necessary while testing. Also, implementing the production plan itself, and making any changes which become necessary.
	Unit 3	✗	
PS1.3 Check if the problem has been solved by following given methods and describe the results, including ways to improve your approach to problem solving.	Unit 1	✔	Comparing the product or service with the design brief and design specification, and saying how well they were met. In the presentation of the design solution, describing the planning and production process, what went well and what didn't, and how problems were tackled. Also making suggestions for avoiding those problems.
	Unit 2		Comparing a sample product to the product specification. Applying any tests of size, function, quality, etc given in the specification and describing results. Describing what went well in production and what didn't, and how problems were tackled. Also making suggestions for avoiding those problems in future.
	Unit 3	✗	

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
WO1.1 Confirm what needs to be done to achieve given objectives, including your responsibilities and working arrangements.	Unit 1		If the design brief is tackled by a team, identifying the group's objectives and what needs to be done, including confirming both group and individual responsibilities. Reference might be made to timescales, resources, opportunities for feedback, etc. Could fulfil the group-working requirement for this key skill.
	Unit 2		Team working to make a product. Identifying individual responsibilities and group aims, as well as methods for scheduling production, making sure everyone is clear on individual responsibilities, eg for testing samples for quality control, ensuring availability of materials, etc, and timing activities.
	Unit 3	✗	
WO1.2 Work with others towards achieving given objectives, carrying out tasks to meet your responsibilities.	Unit 1		Allocating responsibilities to individuals which they must then pursue to achieve the group's objectives, eg costing materials, researching the scale of production, identifying relevant regulations, testing materials, etc. Showing cooperative and safe working, and seeking advice as appropriate. If working in pairs or liaising with client, could satisfy the one-to-one working requirement for this key skill.
	Unit 2		Individuals will be given their own responsibilities and instructed in the working methods they are expected to use. Carrying out individual production tasks, eg quality control, safely and effectively, asking for help and supporting other members of the production team. If working in pairs or liaising with client, could satisfy the one-to-one working requirement for this key skill.
	Unit 3	✗	
WO1.3 Identify progress and suggest ways of improving work with others to help achieve given objectives.	Unit 1		If group working is planned to allow discussion of progress, where good ways of tackling aspects of the design brief are identified, as well as problems and how they were dealt with, with a view to suggesting better ways of working together.
	Unit 2		If group working is planned to allow discussion of progress, where good ways of working are identified, eg ways of using particular processes, as well as problems and how they were dealt with, with a view to suggesting better ways of working together.
	Unit 3	✗	

Appendix D – Key skills mapping – level 2

Key:		
	✓	The unit contains clear opportunities for generating key skills portfolio evidence.
		The unit contains opportunities for developing the key skill, and possibly for generating portfolio evidence if teaching and learning is focused on that aim.
	✗	There are no obvious opportunities for the development or assessment of the key skill in the unit.

Key skill	**GCSE unit**	**Examples of opportunities for developing the key skill or for generating key skills portfolio evidence** **NB these are illustrative only**	
N2.1 Interpret information from two different sources, including material containing a graph.	Unit 1	✔	Interpreting numerical information on production methods, the properties of materials, scales of production, costs, etc as part of developing design solutions. Interpreting engineering drawings.
	Unit 2	✔	Interpreting technical information in a product specification, information on materials properties, quality control data, drawings, etc.
	Unit 3		Interpreting technical information on the properties of materials, on the structure and form of engineered products, etc.
N2.2a Carry out calculations to do with amounts and sizes.	Unit 1	✔	Calculating resources for manufacture: amounts of raw materials, costs, etc, calculating quantities, calculating the size of the product in three dimensions, measuring materials, calculating tolerances, etc.
	Unit 2	✔	Calculating resources requirements, cost, dimensions, quantities, etc, making any modifications necessary during production.
	Unit 3	✔	Investigating the structure and composition of an engineered product: dimensions, quantities manufactured, etc.
N2.2b Carry out calculations to do with scales and proportions.	Unit 1	✔	Working with scale models, making decisions about materials, using different projections in engineering drawings, etc.
	Unit 2		Working with dimensions, eg in relation to the properties of materials, the size of components, etc.
	Unit 3		Working with dimensions and producing scale drawings to explain how a product works.
N2.2c Carry out calculations to do with handling statistics.	Unit 1	✔	Working with quality control information, considering markets for the product or service, etc.
	Unit 2	✔	Working with quality control data.
	Unit 3	✔	Quantifying the different products made by the engineering and manufacturing sectors, and the impact of new technologies in terms of eg market share, range of products available, energy consumption, etc.

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
N2.2d Carry out calculations to do with using formulae.	Unit 1	✔	Considering and applying scientific principles underpinning the functioning of the product or service.
	Unit 2		Where the scientific principles of eg force and power are relevant to production.
	Unit 3		Explaining the operation of an engineered product in terms of its underlying scientific principles.
N2.3 Interpret the results of your calculations and present your findings. You must use at least **one** graph, **one** chart and **one** diagram.	Unit 1	✔	Presenting the results of calculations of cost, quantity, product size, tolerances, etc in the final design solution, using a range of appropriate graphical methods.
	Unit 2		Presenting numerical information in the production plan, on eg costs, quantities, tolerances, quality control, based on own calculations and using appropriate graphical methods.
	Unit 3		Presenting the results of investigations of an engineered product, showing its properties, dimensions, how new technology has influenced the design/sales, etc, using appropriate graphical methods.
C2.1a Contribute to a discussion about a straightforward subject.	Unit 1	✔	Discussing the design brief with the client to clarify their requirements, or with other members of the design team to formulate a design specification, generate ideas, etc.
	Unit 2		Discussing the product specification with other members of the production team to derive information for inclusion in the production plan. Discussions during production, eg of quality control findings.
	Unit 3		Identifying and discussing the impact of new technology, with the class or others, eg an engineer with long experience of manufacturing technology. Considering advantages and disadvantages for eg the workforce and the environment, etc.
C2.1b Give a short talk about a straightforward subject, using an image.	Unit 1	✔	Presenting a range of design solutions and ideas to the client for their feedback, explaining how the solutions were developed and why. Presenting the final design solution to the client, making use of drawings, models, etc as necessary.
	Unit 2		Conveying information to the production team, on eg the performance of materials or components, the quality of the finished product, any modifications felt to be necessary, etc, using appropriate visual aids.
	Unit 3		Presenting results of the investigation of an engineered product, using drawings and sketches, or of an investigation of a particular form of new technology such as polymers.

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
C2.2 Read and summarise information from **two** extended documents about a straightforward subject. One of the documents should include at least **one** image.	Unit 1		Design briefs and design specifications, relevant regulations, data sheets, manuals, textbooks etc. There must be evidence that information from such sources has been summarised in the student's written work.
	Unit 2	✔	Product specifications, data sheets, manuals and guides for parts and components, health and safety regulations, quality manuals, textbooks, etc. There must be evidence that information from such sources has been summarised in the student's written work.
	Unit 3		Product information: manuals, guides, etc, promotional materials for companies using new technology, suppliers, catalogues, textbooks, trade magazines, etc. There must be evidence that information from such sources has been summarised in the student's written work.
C2.3 Write **two** different types of documents about straightforward subjects. **One** piece of writing should be an extended document and include at least **one** image.	Unit 1	✔	A design specification and a design solution based on the design brief. The design solution should include an explanation of the brief and how it was met, with drawings and models, etc as appropriate. Design ideas in their development, eg sketches, prototypes, etc also supported by text.
	Unit 2		A production plan based on the product specification, with explanatory text. Analysis of materials data, quality control data, the operation of parts and components, reasons for choice of materials, tools and components, etc.
	Unit 3		Reports on particular examples of new technology, with drawings. Product reviews or reports about products featuring new technology, identifying the sector in which they were manufactured, the main stages in their manufacture, the role of the new technology and an explanation of their operation, purpose, etc.
IT2.1 Search for and select information for **two** different purposes.	Unit 1		Using the internet, CD ROMs, databases, etc as possible sources of technical data, eg on materials. They might also inform research into a new product or service, providing details of markets, existing products/services, sources of materials, ideas for design and aesthetics, and images which might be used in presentations, etc.
	Unit 2		Using the internet, CD ROMs, databases, etc to obtain information on the properties and characteristics of materials, parts and components, tools and equipment, production methods and processes, etc.
	Unit 3		Using the internet, CD ROMs, databases, etc as sources of product information and for information on the operation and impact of new technologies.

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
IT2.2 Explore and develop information, and derive new information, for **two** different purposes.	Unit 1		Using CAD, developing design ideas through manipulating and finalising text and images, carrying out calculations, simulations, etc.
	Unit 2		Using CAM, recording test data eg on materials or quality, and manipulating it to derive conclusions and inform production planning, carrying out calculations, etc.
	Unit 3		Carrying out calculations to use when describing and explaining products, drafting and finalising text to use in reports on new technology, importing images, CAD drawings, etc.
IT2.3 Present combined information for **two** different purposes. Your work must include at least **one** example of text, **one** example of images and **one** example of numbers.	Unit 1		Presenting final design solutions using WP, CAD drawings, imported images, graphical information on cost, materials, production, timescales, etc. Presenting design ideas and specifications, production information, etc to the client during the development of the final design.
	Unit 2		Presenting production plans, using WP, the results of testing and measurement, drawings, graphical information on quality and quantity, etc.
	Unit 3		Reporting on new technology, using WP, imported text and images, etc. Drafting and finalising product reports, using CAD, recording, manipulating and presenting numerical data, etc.
LP2.1 Help set short-term targets with an appropriate person and plan how these will be met.	Unit 1		Supporting the development of a design solution with structured planning on a one-to-one basis with the student. Setting targets, eg to produce a high-quality engineering drawing or to identify relevant scientific principles, and deadlines and action points for achieving these, eg to practise different types of drawings, study a textbook, etc.
	Unit 2		Supporting the development of engineering skills such as the use of different processes and the calibration of machinery with structured planning on a one-to-one basis with the student. Setting targets, eg to produce a sample of the product, with deadlines and action points for achieving these, eg to practise using the machinery, etc.
	Unit 3	✗	
LP2.2 Take responsibility for some decisions about your learning, using your plan and support from others to help meet targets. Improve your performance by: a studying a straightforward subject b learning through a straightforward practical activity.	Unit 1		If the student takes responsibility for successfully executing the plan agreed in LP2.1, and chooses different approaches to learning, eg reading textbooks and making notes, looking at professional engineering drawings, etc. Taking advice where appropriate.
	Unit 2		If the student takes responsibility for successfully executing the plan agreed in LP2.1, and chooses different approaches to learning, eg comparing their product to a commercially produced one, consulting manuals, etc. Taking advice where appropriate.
	Unit 3	✗	

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
LP2.3 Review progress with an appropriate person and provide evidence of your achievements, including how you have used learning from one task to meet the demands of a new task.	Unit 1		Reviewing what has been learned and how they went about it, on a one-to-one basis with the student, eg in tutorials.
	Unit 2		Reviewing what has been learned and how they went about it, on a one-to-one basis with the student, eg in tutorials.
	Unit 3	✗	
PS2.1 Identify a problem and come up with **two** options for solving it.	Unit 1	✔	The design brief is the 'problem'. Identifying its key features, and the client's requirements of the product or service, researching information and data about materials, production, maintenance, etc, generating ideas and solutions, choosing ones which might work, and identifying constraints, taking advice where necessary. Also applies to decisions about eg choice of finish during design process.
	Unit 2	✔	Analysing the product specification and identifying essential product information. Identifying the range of materials, parts and components, processes, etc which might fulfil the specification and choosing those which seem the most suitable.
	Unit 3	✗	
PS2.2 Plan and try out at least **one** option for solving the problem, obtaining support and making changes to your plan when needed.	Unit 1	✔	Developing design solutions based on research, showing how the product might be made or the service provided, testing solutions and making changes to the solution or design specification as necessary on the basis of testing and feedback.
	Unit 2	✔	Planning the testing of materials and parts and components as part of developing the production plan, and carrying out those tests. Making changes and seeking advice as necessary while testing. Also, implementing the production plan itself, and making any changes which become necessary.
	Unit 3	✗	

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
PS2.3 Check if the problem has been solved by applying given methods, describe results and explain your approach to problem solving.	Unit 1	✔	Comparing the product or service with the design brief and design specification, and drawing conclusions as to how well they were met. In the presentation of the design solution, explaining decisions at each stage of the planning and production process, and why they were necessary, evaluating the strengths and weaknesses of decisions, and any reflections on tackling such briefs again.
	Unit 2		Comparing a sample product to the product specification. Applying any tests of size, function, quality, etc given in the specification, and drawing conclusions as to how well it was met on the basis of those measurements and other feedback. Explaining decisions taken about materials, components and processes at each stage and why they were necessary, evaluating strengths and weaknesses in meeting the specification, with reflections on how production, or its planning, might be improved.
	Unit 3	✗	
WO2.1 Plan straightforward work with others, identifying objectives and clarifying responsibilities, and confirm working arrangements.	Unit 1		Tackling the design brief as a team, allocating group and individual objectives, agreeing and planning how work is to be carried out, with reference to timescales, resources, opportunities for feedback, etc. Could fulfil the group-working requirement for this key skill.
	Unit 2		Team working to develop and execute the production plan, which should be supported by the clear allocation of production responsibilities, eg for quality control, ensuring availability of materials, testing components, etc. The plan should indicate timescales, resources, quality control points, etc.
	Unit 3	✗	
WO2.2 Work cooperatively with others towards achieving identified objectives, organising tasks to meet your responsibilities.	Unit 1		Allocating responsibilities to individuals which they must then pursue to achieve the group's objectives, eg costing materials, researching the scale of production, identifying relevant regulations, testing materials, etc. Showing cooperative and safe working, and seek advice as appropriate. If working in pairs, or liaising with client, could satisfy one-to-one working requirement for this key skill.
	Unit 2		Allocating responsibilities to individuals which they must then pursue to achieve the group's objectives. Showing co-operative and safe working, and seek advice as appropriate. If work in pairs could satisfy one-to-one working requirement for this key skill.
	Unit 3	✗	

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
WO2.3 Exchange information on progress and agree ways of improving work with others to help achieve objectives.	Unit 1		Planning the group's work to allow for progress checking, feedback and brainstorming, eg on ideas for solving a technical problem in the design.
	Unit 2		Planning the group's work to allow for progress checking, feedback and brainstorming, eg on the choice of parts, ways of using particular processes, etc.
	Unit 3	✗	

Appendix E – Wider curriculum – spiritual, moral, ethical, social and cultural (SMESC) signposting

The purpose of the following tables is to signpost possible opportunities for assessing SMESC-related issues, as well as signposting opportunities for the inclusion of Citizenship (Cz), Environmental (En) and European initiatives (EI) assessment possibilities. These opportunities derive from the unit specifications for the specific subject areas and as such they may be included more than once (if such an opportunity arises in the units more than once). Subsequently, the opportunity to assess a given criterion can occur more than once. The rationale behind this is that a student may require more than one opportunity to achieve the criterion, or the teacher may be elect to pursue a later opportunity should it fit more easily into the assessment design.

It should be noted that the signposting serves only to highlight possible assessment opportunities. It is suggestive and therein a marker of an indicative assessment opportunity. It is not a prescriptive order, more a marker of prospective assessment occasions for a given criterion. It signifies potentiality for given SMESC, Cz, EI and En criteria to be assessed; it is not mandatory for assessment at every opportunity signposted. The discretion of the teacher in how and when to include the signposted opportunity in an assessment vehicle will be essential. As such, the signposting tables are an initial attempt to indicate where such opportunities may be found. It is envisaged that subject specialists and teachers will transform the signposting into 'real' opportunities for assessment. Further, that they will furnish in detail the potential assessment opportunities with context-driven scenarios that are conscious of the students' own backgrounds and circumstances in an attempt to realise the assessment opportunity.

Wider curriculum signposting

Key:

Sp	spiritual	**M**	moral
E	ethical	**So**	social
C	cultural	**Cz**	citizenship
EI	European initiatives	**En**	environmental

	Sp	M	E	So	C	EI	En
Unit 1							
So, C and Sp (tenuous) issues will have a bearing on design briefs of clients' intended markets/customer base).	*			*	*		
Design specifications and the methods and materials have EI and En concerns.						*	*
Communicating the design solution: So, C and Sp, in that clients represent varying sectors of society and preferences for styling aesthetics.	*			*	*		
Awareness of regulations including health and safety introduces EI and E and M.		*	*			*	
Research and analysis introduces E and M obligation when accessing and using source data and in meeting the design brief without compromising the integrity of the project.		*	*				
Engineering drawings and standards and conventions (ie BS numbers): EI.						*	
Communicating the final design solution: So, C (tenuous).				*	*		
Unit 2							
Schedule for manufacture: Sp, So and C, ie taking into account religious holidays and festivities affecting days available for work.	*			*	*		
Quality control and health, safety and hygiene will introduce EI/legislations and E and M considerations in terms of what is 'right', 'best' and/or fit for purpose and in the use of certain products and processes and professional practice. This may also introduce En.		*	*			*	*
The use of certain processes may be due to new developments/trends, hence a So and possibly En aspect.				*			*

Unit 3							
Implications of technology introduce EI, En as well as E and M (ie increased technology such as robotics may lead to job losses). This will have a So impact which may differ across C and Sp groups.	*	*	*	*	*	*	*
En issues will be covered when considering the global environment and sustainability.							*
The use of certain materials may involve EI and En concerns. Certain materials or processes may be by particular C or Sp groups.	*				*	*	*

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