Specification

Edexcel GCSE in Manufacturing (Double Award) (2351)

For first award in 2004

Issue 2 January 2004

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This specification is Issue 2 and is valid for examinations from 2004. Key changes to requirements are sidelined. Centres will be informed in the event of any necessary future changes to this specification. The latest issue can be found on the Edexcel website, www.edexcel.org.uk

Acknowledgements

This specification has been produced by Edexcel on the basis of consultation with teachers, examiners, consultants and other interested parties. Edexcel recognises and values all those who contributed their time and expertise to the development of GCSE specifications.

Authorised by Peter Goff

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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 Manufacturing (Double Award)

The Edexcel GCSE in Manufacturing (Double Award) has been designed to provide a broad educational basis for further training, further education or for moving into employment within the manufacturing industry. The QCA Qualification Accreditation Number for this title is 100/2064/0.

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: Designing Products for Manufacture Product requirements and constraints, production details and constraints, material details and constraints, developing design idea, scientific principles, presenting design solutions and modifying design solutions.	**Internal assessment** Produce a product design specification and design solution for a manufactured product from a given customer brief.
Unit 2: Manufactured Products Use a production plan, develop a schedule for manufacture, use and apply quality control techniques, record and respond to quality data, use tools, equipment including CAM safety, team working.	**Internal assessment** Produce a portfolio and a quantity of one product manufactured as part of a team and from a given product specification and production plan. The product must be made from at least two components of different materials.

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, 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 available 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 if 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 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 in Manufacturing (Double Award) has been designed to provide a broad educational basis for further training, further education or for moving into employment within the manufacturing 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 Manufacturing, 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 Manufacturing are to:

- enable students to develop a broad knowledge and understanding of the manufacturing sector
- allow students to prepare for further study on a vocational course in manufacturing or in a manufacturing-related subject, or prepare for employment or further training in the manufacturing sector
- widen participation in vocationally-related learning pre-16
- allow students to experience vocationally-related learning to see if 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.

Recommended prior learning

Students embarking on a GCSE in Manufacturing 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 Manufacturing (Double Award) offers students a variety of routes for progression. These are as follows:

- direct entry into employment within the manufacturing industry
- further learning opportunities within employment (for example Modern Apprenticeships in manufacturing-related areas)
- access to occupational standards at the same or next level (eg NVQs in Performing Manufacturing 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, Intermediate GNVQ in Manufacturing 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 (Food 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 the units **Designing Products for Manufacture** and **Manufactured Products**.

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

- GCSE Design and Technology (Food Technology) to food and drink/biological and chemical
- GCSE Design and Technology (Graphic Products) to printing and publishing/paper and board
- GCSE Design and Technology (Textiles Technology) to textiles and clothing
- GCSE Design and Technology (Resistant Materials Technology) to engineering fabrication

NVQs

- Engineering Production level 2
- Performing Manufacturing Operations level 2
- Engineering Manufacture level 2
- Food and Drink Manufacturing level 2
- Manufacturing Textiles level 2

GCSE (Double Award)

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

GCSE in Manufacturing units	GCSE in Engineering units
Unit 1: Designing Products for Manufacture	Unit 1: Design and Graphical Communication
Unit 2: Manufactured Products	Unit 2: Engineered 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 Manufacturing and Engineering
- GCSE in Engineering (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 0005.

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: Designing Products for Manufacture
- Unit 2: Manufactured 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: Designing Products for Manufacture	5351	**33.3%**	**Internal assessment** Produce a product design specification and design solution for a manufactured product from a given customer brief.
Unit 2: Manufactured Products	5352	**33.3%**	**Internal assessment** Produce a portfolio and a quantity of one product manufactured as part of a team and from a given product specification and production plan. The product must be made from at least two components of different materials.
Unit 3: Application of Technology		**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 available to centres in September for the following June's examination.
	5318/01		• Printing and Publishing, Paper and Board
	5318/02		• Food and Drink, Biological and Chemical
	5318/03		• Textiles and Clothing
	5318/04		• Engineering Fabrication
	5318/05		• Electrical and Electronics, Process Control, Computers, Telecommunications
	5318/06		• Mechanical, Automotive

Assessment objectives

There are three assessment objectives for GCSEs in Manufacturing. 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, ingredients, components and processes, in which they analyse vocational issues and problems; 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%	30%	45–55%	35–39%
AO2	35%	35%	15–25%	28–32%
AO3	33%	35%	20–30%	29–33%

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, automotive.

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 1 and 2. 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 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 only be awarded where the student's work does not meet any of the required criteria.

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

Individual unit results, prior to certification of the qualification, have a shelf-life limited only by the shelf-life of the specifications.

Students with particular requirements

Regulations and guidance relating to students with special requirements are published annually by the Joint Council for General Qualifications and are circulated to examinations officers. Further copies of guidance documentation may be obtained from the following address or by telephoning 0870 240 9800.

Edexcel will assess whether or not special consideration or concession can 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 B and *C* 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

Telephone: 01623 467467
Fax: 01623 450481
Email: publications@linneydirect.com

Unit 1: Designing Products for Manufacture

ABOUT THIS UNIT

In this unit you will gain an understanding of how the manufacturing industry brings a product to the market place, by working from a client's design brief. You will develop a design specification for a product, develop design and manufacturing proposals and draw up a final design and manufacturing solution. You will learn how to present your design solutions to a client and how to respond to feedback by modifying your design and manufacturing proposal accordingly.

You will learn about:

- product requirements and constraints
- production details and constraints
- material details and constraints
- developing design ideas
- scientific principles
- presenting design solutions
- modifying design solutions.

This and other units will utilise prior learning in design and technology. There are links between this unit and the production processes covered in *Unit 2: Manufactured Products*, as the development of design solutions must show an understanding of how the product would be manufactured. Your design ideas may also use some of the knowledge from *Unit 3: Application of Technology*. This unit may also help you to progress to a Vocational A level in Manufacturing.

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

You will also have the opportunity to develop your key skills when 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

The design brief tells you the client's requirements. Before you start to produce design proposals, you must understand your client's needs.

The client's brief will usually specify a product's:

- function — where and what the product will be used for
- 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

- quantity — how many are required
- styling/aesthetic appearance — the product's appearance and appeal
- quality standards — client and/or sector standards
- cost — factory gate, retail cost
- timescales.

Product design specifications

Before you can develop a design proposal, you need to pick out key features from the client design brief and research detailed information on each one. It is worth remembering that most design briefs are about adapting existing products rather than inventing new ones.

Designers use product design specifications to develop a proposal for how the product should be manufactured, how much it might cost and what it will be like. It allows them to judge if their ideas are likely to deliver a successful product. You will learn how to develop a product design specification which will include:

- product design details
- material details and constraints
- production details, constraints and quality standards.

Material details and constraints

You will draw upon your knowledge, experience and understanding of materials, components, and ingredients in order to decide which are most appropriate for your design and manufacturing proposals. When comparing materials, components, and ingredients you will need to consider the following:

- their availability, form and supply
- their properties, characteristics and performance
- their cost
- health, safety and hygiene requirements
- handling and storage.

Production details and constraints

One of the important factors that you will need to consider is the most cost effective and efficient way to manufacture the product. Factors to consider might include:

- labour — are there enough staff? Do they have the right skills or training?
- materials and components — what are the properties and features of materials and components that make them suitable for certain processes? Can they be bought in?
- available technology — what is the most appropriate technology for a particular process and material?
- health, safety and hygiene — when and where is it important in the production process?
- quality standards required by the customer and/or the sector — is a special material quality required?

Researching how leading manufacturing companies run their production lines as cost effectively as possible will help you to do this for your own products.

Quality standards

You must understand the importance of sector-specific standards and other aspects of quality that the client may refer to in the design brief. Quality standards included in the product design specification might relate to:

- level of output during production
- level of performance for the product
- the materials, components, ingredients to be used in production
- tolerance in relation to characteristics such as size, weight, composition, density and viscosity
- product finish, packaging and presentation
- health, safety and hygiene standards.

Developing design ideas

You must know how to use the product design specification to develop initial ideas for how the product could be manufactured and how it might meet the client design brief. Your ideas should be developed around the key features, production and material constraints, and quality standards in the product design specification.

You must know how to use the following techniques to help you 'work up' initial design ideas:

- researching and analysing existing products, materials and manufacturing processes and market need
- discussing your ideas with others
- freehand sketching of ideas
- modelling and testing ideas
- developing and testing samples and prototypes.

You must be able to use ICT applications in addition to manual techniques to model and test design ideas and solutions.

Each design idea must contain information about the following:

- production — the most suitable process, tools, equipment and machinery
- materials — their size, properties, characteristics and suitability for manufacturing processes
- cost — of materials, resources and production processes and estimated cost of each item
- market — type and size
- quality standards — for finish, tolerances, performance and quality of material.

You must be able to explain any restrictions on the use of materials and methods you have included in your design ideas. For example, you might say that if the client wants the product to be a certain size, new equipment would need to be bought and that would add to the cost.

From your initial design ideas, you will need to choose the one you think best meets the client design brief. This process should be based upon all available criteria as you will be expected to justify your choice of design solution.

Presenting your design solution

You must learn how to present your chosen design solution to the client effectively. The presentation is your chance to explain and 'sell' your proposal to the client, and it is their chance to comment on your solution. To be effective, you must show how the work you have done to develop the design solution meets the client design brief.

The presentation must explain:

- the key features of the solution, including information about production and material constraints
- how you met the client design brief, including how your design will conform to quality standards
- what research you have carried out.

To present your design solution you will need to choose and use suitable presentation techniques. These may include:

- fully annotated freehand sketches and drawings
- photographs and ICT-generated images
- samples and swatches
- technical drawings and diagrams
- written material
- spoken explanations
- mock-ups, models and prototypes.

You should use appropriate ICT applications to develop and make your presentation.

Modifying design solutions

You must know how to respond to feedback from your client about your design solution. For example, you might need to change your design solution, or you might need to explain it in more detail. Your final, modified design proposal will need to reflect both the client's needs and the research you have done on the best way to manufacture the product.

ASSESSMENT EVIDENCE — UNIT 1: DESIGNING PRODUCTS FOR MANUFACTURE

You need to produce a product design specification and design solution for a manufactured product from a given brief including:

(a) an analysis of the client design brief and information about key features

(b) details of the product design and material constraints

(c) details of production requirements and quality standards

(d) a range of design ideas and evidence of testing them

(e) evidence of how you tested and justified your final solution

(f) evidence of how you selected and used presentation techniques

(g) evidence of how you responded to external feedback and modified your design proposal.

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 and most of the key features of the product	1–2	• an analysis of the brief to describe the main client needs and the main key features of the product	3–4	• an analysis of the brief to explain the main client needs and the main key features of the product	5–6	
(b) **AO1** **AO2** **6 marks**	• a design specification that identifies basic details of the product design, the materials chosen and some constraints	1–2	• a design specification that describes some of the details of the product design, the materials chosen and the constraints	3–4	• a design specification that explains the main details of the product design, justifies the materials chosen and evaluates the constraints	5–6	
(c) **AO2** **AO1** **AO2** **6 marks**	• a design specification that identifies basic details of production requirements and quality standards	1–2	• a design specification that describes some of the details of production requirements and quality standards	3–4	• a design specification that explains the main details of production requirements and quality standards	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) **AO2** **AO3** **6 marks**	• the generation of basic design ideas and limited testing of ideas	1–2	• the generation of alternative design ideas and a range of testing of ideas	3–4	• the generation of imaginative design ideas and objective testing of ideas	5–6	
(e) **AO3** **6 marks**	• limited testing against the design criteria and an outline of the final design solution	1–2	• a range of testing against the design criteria and a description of the final design solution	3–4	• objective testing against the design criteria and a justification of the final design solution	5–6	
(f) **AO1** **AO2** **6 marks**	• the selection and use of a limited range of techniques to present the final solution	1–2	• the selection and use of a range of techniques to present, in some detail, the final solution	3–4	• the selection and use of an appropriate range of techniques to present, in detail, the final solution	5–6	
(g) **AO2** **AO3** **6 marks**	• limited response to external feedback and the identification of relevant modifications to the design proposal	1–2	• evaluation of external feedback and a description of relevant modifications to the design proposal	3–4	• objective evaluation of external feedback and an explanation of relevant modifications to the design proposal	5–6	
					Total Unit Mark	**42**	
					Student Unit Mark		

GUIDANCE FOR TEACHERS

Delivery strategies

The work for this unit may be undertaken in any of the sectors of manufacturing and most students will be able to use a structure similar to that developed during their study of design and technology at Key Stage 3 of the National Curriculum.

This unit allows students to gain an understanding of the designing process. Students are encouraged to analyse a customer's brief, produce a product design specification, consider production constraints and quality standards, develop a number of design proposals, and finally present these proposals to the customer.

This unit could be delivered alongside or after *Unit: 2: Manufactured Products*. This will give students experience of using a specification for production planning and of being involved in production processes. Students would then find it easier to judge their proposals realistically against production constraints.

To make the design development suitable for this level, students should normally be given a range of materials or components they can utilise in their work. This will allow you to plan for prototyping and experimentation if required. The modelling and testing of ideas is to be encouraged in this unit.

When considering the design brief students should recognise that it is vital to get the briefing correct. The brief should not be open ended and students should be provided with a set of parameters in which to work. They should be encouraged to discuss the brief with the 'client' to understand their requirements, before proceeding to develop proposals. In this case, the client ideally would be involved in industry but may have to be a tutor. If a revised design brief is agreed, normal industrial practice is to require written agreement to the modifications.

Students will be expected to make use of product design specifications in the formal presentation of their chosen design solution to the client and it would be useful for students to be introduced to presentation skills in order to plan their presentations. The presentation of chosen design solutions should simulate the industrial environment and the 'client' should provide realistic feedback about how closely the solution meets the original needs.

This unit builds on knowledge and skills obtained in design technology and allows students to put into practice what has been learnt in *Unit 2: Manufactured Products* and *Unit 3: Application of Technology* during their research activities.

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.

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 client brief and information about key features (6 marks)

The student needs to analyse the key features of the design brief to understand the client needs. The client's needs 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 teenagers' — a general group).
- Simple identification of most 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 teenagers, particularly girls in the 12–14 age range' — a more precisely-defined group).
- Description of the main key features of the product (eg 'it should not weigh more than 3 kg' — 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 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 10 kg because it must be light enough to be picked up and carried'.

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 design and material constraints (6 marks)

Research is needed into the product's styling/aesthetic appearance and into materials, components or ingredients to decide which materials are most appropriate for the product. The student should consider materials availability; properties, characteristics and performance; materials cost; health and safety or hygiene requirements; handling and storage. This should enable the student to develop a design specification that includes information about the product design and about material's details and constraints.

Mark band 1

- Some basic details of the product design, perhaps given as a list — 'it needs a handle, a fastener, and should be brightly coloured with glitter finish.'
- Basic details of some materials and a few of the constraints listed above (eg 'plastic for the handle because it is cheap and can be coloured').

The student undertakes some limited research and develops a design specification that identifies some basic but relevant details of the product design and that makes some basic but relevant comments on materials used and some of the constraints. (1–2 marks)

Mark band 2

- Description of the main details of the product design (eg the list suggested for Mark band 1 with some qualification — 'a fastener that can be done up with one hand').
- Details of the main materials used and significant constraints (eg the type of plastic for the handle, plus mention of the most significant constraints).

The student undertakes research and draws on a range of sources to develop a design specification that describes the main details of the product design and that describes the main materials used and some of the most significant constraints. (3–4 marks)

Mark band 3

- Explanation of the main details of the product design (eg the description suggested in mark band 2 together with a reason why it needs to be like that).
- Justification of the main materials chosen and an evaluation of their constraints (eg explains why one material is more suitable than another, and recognises that some constraints are more significant than others).

The student undertakes detailed research and draws on a wide range of sources to develop a design specification that explains the main details of the product design, giving reasons for decisions taken, justifies the choice of materials and evaluates the constraints. (5–6 marks)

(c) details of the production requirements and quality standards (6 marks)

Research is needed into production details and constraints and into aspects of quality referred to in the design brief, including sector specific standards. This should enable the student to decide which is the most cost effective and efficient way to manufacture the product. The student develops a design specification that includes information about production details and constraints and quality standards.

Mark band 1

- Some basic details of production requirements.
- Some basic details of quality standards.

The student undertakes some limited research and develops a design specification that identifies some basic but relevant details of production requirements and some basic but relevant details of quality standards, possibly presented as a list or table of unqualified/unquantified points. (1–2 marks)

Mark band 2

- Description of the main details of production requirements.
- Description of the main details of quality standards.

The student undertakes research and draws on a range of sources to develop a design specification that describes the main details of production requirements and the main details of quality standards. Few, if any, are overlooked and most are described rather than listed. (3–4 marks)

Mark band 3

- Explanation of the main details of production requirements.
- Explanation of the main details of quality standards.

The student undertakes detailed research and draws on a wide range of sources to develop a design specification that explains the main details of production requirements and the main details of quality standards, in both cases giving reasons for decisions taken. (5–6 marks)

(d) a range of design ideas and evidence of testing them (6 marks)

The student uses the product design specification to develop initial ideas for how the product could be manufactured and how it might meet the client design brief. Ideas are 'worked up' using the analysis of existing products, discussion and a range of techniques, including the use of ICT where appropriate and available. Ideas are tested against the client design brief through the use of modelling and prototyping. Each design idea includes information about production, materials, components or ingredients, cost, the market and quality standards.

Mark band 1

- Some basic design ideas — typically two or three variations of the same basic idea.
- Limited testing of ideas, perhaps against only some aspects of the design criteria.

The student generates some basic design ideas, and is likely to have attempted the use of some techniques such as product analysis, discussion of information and data, drawing and modelling. The student applies limited comparative testing of ideas. In this mark band the student may be testing simply to see if the idea 'works', but for credit a link must be made, at least implicitly, to the design criteria. (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.
- A range of testing of ideas that are explicitly linked to most of the main design criteria.

The student generates, in some detail, alternative design ideas, and uses a range of design strategies and techniques, such as product analysis, discussion, the analysis of information and data, drawing and modelling. The student applies a range of comparative testing of ideas explicitly linked to the main design criteria. (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
- Objective testing of ideas that show how all the main design criteria are met.

The student generates, in some detail and depth, a range of imaginative ideas, through the discriminating use of a wide range of design strategies and techniques, such as product analysis, discussion, the analysis of information and data, drawing and modelling. The student applies objective comparative testing of ideas against the design criteria. (5–6 marks)

(e) evidence of how you tested and justified your final solution (6 marks)

The student develops a design solution and explains its key features, including production and materials constraints. The student tests the solution, using comparative testing and the testing of mocks-ups and models, against the design criteria and justifies how it meets the client design brief and conforms to quality standards.

Mark band 1

- Limited testing against the design criteria.
- An indication of how the final design solution meets some of the requirements.

The student carries out limited testing of the solution against the client design brief and specification criteria. This should include comparative testing and some testing of mocks-ups and models. The student offers some brief statements that give a partial indication of how the final design solution meets requirements. (1–2 marks)

Mark band 2

- A range of testing against the design criteria.
- A clear description of how the final design solution meets all the main requirements.

The student carries out a range of tests on the solution against the client design brief and specification criteria. This includes comparative testing and some testing of mocks-ups or models. The student describes how the final design solution meets all the main requirements. (3–4 marks)

Mark band 3

- Objective testing against the design criteria to give some measurable outcomes.
- A justification of the final design solution, which may evaluate strengths and weaknesses of the solution, or offer comparative comments with alternative design ideas which were rejected.

The student devises and carries out a range of objective tests of the solution against the client design brief and specification criteria. This includes comparative testing and the testing of mocks-ups and models. The student explains and justifies how the final design solution meets requirements. (5–6 marks)

(f) evidence of how you selected and used presentation techniques (6 marks)

The student selects and uses suitable communication techniques to present the final solution, such as annotated sketches, photographs, ICT-generated images, samples and swatches, technical drawings/diagrams, written material, spoken explanations, mock-ups, models and prototypes.

Mark band 1

- The selection of a limited range of communication techniques — there should be some indication of why the student chose the techniques used, eg 'I chose to use photographs because the model was really large'.
- The use of a limited range of communication techniques to present the final solution — the nature of the solution should be clear from the overall presentation, although individual key points might not be made clearly.

The student selects and uses, with some skill, a limited range of manual and computer generated techniques (where appropriate) to communicate the final solution — two or three are likely to be enough for a limited range. (1–2 marks)

Mark band 2

- The selection of a range of communication techniques — there should be some explanation of why the techniques were chosen, eg the statement in mark band 1 above could be developed to explain that the model was too large to move or see from all angles, or that the photographs allowed people to see inaccessible parts of the model, while it was in its construction stage.
- The use of a range of communication techniques to present, in some detail, the final solution. As well as the overall solution being made clear, some individual key points become clear.

The student selects and uses, with some skill and accuracy, a range of manual and computer generated techniques to communicate, in some detail, the final solution. The range is likely to consist of at least three or four techniques. Quality is more important than quantity, however, and credit should not be given for the repeated use of similar techniques. (3–4 marks)

Mark band 3

- The selection of an appropriate range of communication techniques, each of which is justified.
- The use of an appropriate range of communication techniques to present, in detail, the final solution. The combined techniques make clear both the overall solution, and all the key points that make it successful.

The student selects and uses, with skill and accuracy, an appropriate range of manual and computer generated techniques to communicate, in detail, the final solution. There may still be only three or four techniques, but the student justifies why these are the most appropriate for the purpose. (5–6 marks)

(g) evidence of how you responded to external feedback and modified your design proposal (6 marks)

The student uses discussion and evaluative techniques to respond to feedback about how the final design proposal meets the client design brief and conforms to quality standards. The student explains any relevant modifications required to the design or manufacture of the product to ensure that it meets the client's needs.

Mark band 1

- Limited response to external feedback — the student responds to only some of the feedback, ignoring and/or not understanding the remainder.
- The identification of some relevant modifications to the design proposal — likely to be two or three modifications which may not be fully worked through eg 'It would not weigh so much if I used something lighter for the case.'

The student takes some account of feedback about the suitability of the final design proposal and identifies some simple modifications required to the design or manufacture of the product, although does not necessarily work them through fully. (1–2 marks)

Mark band 2

- An evaluation of external feedback — most of the feedback, is addressed including the most important points.
- A description of relevant modifications to the design proposal — eg the statement in mark band 1 above could suggest a suitable alternative material, rather than 'something lighter'.

The student evaluates feedback about the suitability of the final design proposal and describes, in some detail, the most important modifications required to the design or manufacture of the product. (3–4 marks)

Mark band 3

- Objective evaluation of external feedback — all significant points should be addressed, either with modifications or justification for not modifying.
- An explanation of relevant modifications to the design proposal — this could develop the statement in mark band 2 by quantifying the effect of using the lighter material, and/or by explaining the effect on the cost of the product.

The student objectively evaluates feedback about the suitability of the final design proposal and explains any modifications required to the design or manufacture of the product. (5–6 marks)

Unit 2: Manufactured Products

ABOUT THIS UNIT

In this unit you will work as part of a team to manufacture a quantity of products. You will learn:

- how to use a production plan
- how to develop a schedule for manufacture
- how to use and apply quality control techniques
- how to record and respond to quality data
- how to use tools, equipment, including Computer Aided Manufacture (CAM), and machinery safely
- about tools, equipment, materials and processes
- what makes an effective team.

This and other units will utilise prior learning in design and technology. This unit links with *Unit 3: Application of Technology* and *Unit 1: Designing Products for Manufacture* as you will be able to put what you have learnt about design and new technology into practice when manufacturing your own products. This unit may also help you to progress to the Vocational A level in Manufacturing.

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

You will also have the opportunity to develop your key skills when 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

Production plans and schedule for manufacture

Production plans provide information about the type and quantity of product to be manufactured, such as single unit, batch and volume production. You will learn how to use a given production plan to develop a realistic schedule for manufacture. A schedule for manufacture should include the following information:

- all preparation, processing and assembly stages
- the sequence and timing of stages
- critical production and quality control points
- production and quality control procedures
- allocation of roles and responsibilities.

You will also learn how to modify the production plan and schedule for manufacture as circumstances change.

Teamwork

You must understand what makes an effective team. You will learn how an effective team can be built through:

- allocating and agreeing roles and responsibilities, based on the strengths and weaknesses of team members
- setting and agreeing individual and team targets
- ensuring good communication between team members
- ensuring that team members are motivated
- creating an appropriate working environment.

Preparing materials, components, ingredients, tools, equipment and machinery

You must understand the function of each component and must know how to prepare materials, ingredients and components according to the production plan and schedule for manufacture. You will need to recognise that some parts, components, and ingredients are purchased already manufactured and ready for inclusion in the product. You will need to learn about the processing methods for given materials and their working properties to achieve optimum use of materials.

You must be aware of other forms of materials component and ingredient preparation such as trimming, cleaning or degreasing, preparing blanks and initial processing such as annealing or freezing.

You must be able to select, prepare and use tools, equipment and machinery needed for the manufacture of a product. This includes cleaning and setting up, for example checking cutting edges, tensioning sewing machines.

You must be able to carry out health, safety and hygiene checks on tools, equipment and machinery, for example checking guards are in position.

Processing materials and components

You must learn how to use appropriate tools, equipment, including Computer Aided Manufacture (CAM), and machinery safely and use manufacturers' instructions to produce a given product. To do this you must be able to:

- control and adjust appropriate equipment and machinery correctly to process materials, components/ingredients to specification, and quality standards
- maintain levels of materials and resources
- understand the principles that determine the correct use of tools, equipment and machinery.

Combining, assembling and finishing materials and components/ingredients

You must be able to combine, assemble and finish materials, components and ingredients to a production plan and schedule for manufacture in order to meet client requirements and conform to quality standards.

Applying quality and production control techniques during manufacture

You must understand about quality indicators given in the production plan and be able to apply these during manufacture. You must be able to:

- inspect, test and compare (as required) samples of the product material, component/ingredient at the critical control points specified in your schedule for manufacture
- record data in appropriate formats, using manual techniques or ICT applications

- identify variances from the quality standards and suggest possible causes and changes needed to prevent them from happening again
- monitor the progress of production, and identify, record and remedy any variance from the schedule for manufacture.

Health, safety and hygiene

When manufacturing a product, you must always be aware of health, safety and hygiene issues relating to the use of materials, components, ingredients, tools and equipment. You must be able to:

- carry out a risk assessment
- care for yourself and others in a manufacturing environment
- follow safety procedures and instructions
- keep a safe place of work
- check that safety equipment, health, safety and hygiene procedures and systems are operational
- use safety equipment and health, safety and hygiene procedures and systems correctly during combining, assembly and finishing

Safety systems include guards or stop buttons, as well as procedures to ensure hygiene standards are met.

Safety equipment includes emergency equipment, first-aid equipment and personal safety, including clothing.

ASSESSMENT EVIDENCE — UNIT 2: MANUFACTURED PRODUCTS

You need to produce a quantity of one product, from a given product specification and production plan. The product must be made from at least two components or different materials. You must also compile a portfolio to show how you:

(a) worked as part of an effective team

(b) used a production plan and developed a schedule for manufacture

(c) used quality control techniques and identified problems

(d) prepared and used materials and components safely

(e) prepared and used tools, equipment (including appropriate use of ICT) and machinery safely

(f) manufactured your product safely to meet requirements and conform to standards

(g) modified the production plan and schedule for manufacture.

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** **AO3** **6 marks**	• that the student contributed to the work of an effective team, and the student's success in meeting some targets	1–2	• that the student helped build an effective team, and the student's success in meeting key targets	3–4	• that the student played a leading role in building an effective team, and the student's success in meeting all achievable targets	5–6	
(b) **AO1** **AO2** **6 marks**	• use of some details in a production plan and the development of an outline schedule for manufacture	1–2	• use of the main information in a production plan and the development of a realistic schedule for manufacture	3–4	• confident use of the main information in a production plan and the development of a detailed and effective schedule for manufacture	5–6	
(c) **AO2** **AO3** **6 marks**	• limited use of quality control techniques to monitor production and identify problems	1–2	• use of a range of quality control techniques to monitor production and describe the causes of problems	3–4	• use of objective quality control techniques to monitor production and explain how to prevent problems happening again	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) **AO2** **AO1** **AO2** **6 marks**	• preparation, with guidance, of materials and components, according to some relevant production criteria, using materials safely with some skill to make a product	1–2	• preparation, with limited guidance, of materials and components, according to the main production criteria, using materials safely with skill to make a product	3–4	• independent preparation of materials and components, according to all relevant production criteria, achieving optimum and safe use of materials when making a product	5–6	
(e) **AO1** **AO2** **6 marks**	• preparation, with guidance, of tools, equipment and machinery with some skill, using them safely with some accuracy to make a product	1–2	• preparation, with limited guidance, of tools, equipment and machinery with skill, using them safely with accuracy and some skill to make a product	3–4	• independent and precise preparation of tools, equipment and machinery, using them safely with accuracy and skill to make a product	5–6	
(f) **AO2** **AO3** **6 marks**	• safe manufacture of the product, to meet some client requirements and to conform to some quality standards required	1–2	• safe manufacture of the product, to meet the main client requirements and to conform to the main quality standards required	3–4	• safe manufacture of the product, to effectively meet the main client requirements and to consistently conform to the main quality standards required	5–6	
(g) **AO2** **AO3** **6 marks**	• modifications, some of which are relevant and lead to the improvement of some aspects of the production plan and schedule for manufacture in response to quality data	1–2	• modifications, most of which are relevant and lead to the improvement of several aspects of the production plan and schedule for manufacture in response to quality data	3–4	• modifications, all of which are relevant and lead to the improvement of significant aspects of the production plan and schedule for manufacture in response to quality data	5–6	
					Total Unit Mark	**42**	
					Student Unit Mark		

GUIDANCE FOR TEACHERS

Delivery strategies

The unit introduces students to the need for effective planning and scheduling as part of the manufacturing process. They will be expected to work in a team and to develop their knowledge of effective team building whilst producing a quantity of products to a required standard. It is essential that students develop their knowledge, understanding and skills in a manufacturing context throughout their studies.

It would be useful for students to be introduced to the concept of teamwork and how effective teams can be built before considering the manufacture of the products. This could be through a discussion of the principal features of an effective team and developing this discussion to identify the main principles of team working. This knowledge can then be applied later to the development and operation of the production team(s).

A certain amount of team work is required, both to cover the 'What you need to learn' content and to meet the assessment requirements. Students need not carry all work out in a team, however, and two strategies are acceptable in producing the work for assessment:

- students form teams which work together throughout the planning and manufacture of the product for assessment on a team basis
- students form teams which work together on simulations and practice runs, but then carry out the planning and manufacture of the product for assessment on an individual basis. The teamwork feature of the simulation or practice run will contribute to the assessment.

For further information on assessing work carried out in teams, see the *Assessment guidance* section on the next page.

It would be helpful if students were to be introduced to the main scales of production. This could be through the discussion of the characteristics of typical manufacturing production operations that may be familiar to the student and may include visits to local examples of single unit, batch and volume production manufacturers.

When looking at production planning and scheduling for manufacture, teachers would be advised to give input on the key production stages and to promote discussion relating to these stages applied to products with which the students are familiar. Students could then be introduced to graphical methods of recording activities such as flow charts, Gantt charts, organisation charts etc.

Students will need to make a suitable product, and in order that this product provides a suitable vehicle for learning and assessment the teacher will need to consider:

The product

The product needs to be carefully considered and should have the following features:

- provide a stimulating experience for students
- be made of at least two components made from different materials
- be non-sophisticated
- be suitable for manufacture in quantity by a team (several production teams may be working at once)
- be relatively easy to manufacture using a of range tools, equipment and machinery

The production plan

The production plan given to students should be appropriate for the facilities and working areas available to them. It should be detailed, clear and as unambiguous as possible. Where possible it needs to be related to industrial practice.

When looking at the production plan and the development of a production schedule, teachers would be advised to give illustrations of how a production plan may be interpreted in order to develop a production schedule and the subsequent modification of the production plan before the students are presented with the final assessment package. Planning involves a number of technical terms and it is essential that throughout the teaching of this aspect of the unit, students are familiar with the terminology to be able to understand and use it appropriately.

When the students consider the manufacture of the chosen products, it is important that the teacher explains fully the given production plan, and instruction on the correct use of tools and equipment should be provided. This instruction should be underpinned by general scientific principles and students should be given clear health and safety instructions on the use of equipment and machinery. Manuals and codes of practice should be available for reference.

When considering quality and production control techniques, teachers are advised to provide input on general inspection, test and comparison procedures, and techniques for recording data. Students could then be asked to identify suitable procedures and to implement these activities in order to meet the required standards of the chosen products. These tests should include the quantity and quality of the finished products.

This unit builds on knowledge obtained in design technology and allows students to put into practice what has been learnt in *Unit 1: Designing Products for Manufacture* and *Unit 3: Application of Technology* during the manufacture of their own products.

Assessment guidance

This section should be read in conjunction with the general section *Applying the mark bands* on page 9. Please refer to the section *Applying the mark bands* on page 9 for full details.

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.

Assessing teamwork

The first evidence requirement is explicitly aimed at teamwork, while the remainder of the evidence may also have been gathered while the student was working as part of a team, and so it is important that the student clearly identifies their own contribution to any team activities. The focus of the work handed in for assessment should be the student's own contribution, with comment on what was done by the team as a whole or by others in the team to put the student's contribution in context. A portfolio that takes a third-person perspective and reports just on the work done by the team should be restricted to marks in band 1.

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) worked as part of an effective team (6 marks)

The student needs to provide evidence of the part they played in building and working as part of an effective team. This can be achieved by reporting on team-building activities, eg the allocation and agreeing of roles and responsibilities, the setting and agreeing of individual and team targets and the use of good communication skills, which create an appropriate working environment and provide team motivation. The student needs to provide evidence of how successfully individual and team targets were met. Much of the evidence is likely to emerge as the student works through the whole assignment, and much is likely to be recorded via witness statements rather than provided in writing by the student.

Mark band 1

- Some indication from the student of their role in the team, plus his/her own account or witness statements of their contribution.
- Success in meeting some individual and/or team targets (eg a statement of targets, with evidence of success coming from achieving some in the stages of manufacture *b* — *g* below).

The student is essentially a passive participant in team building activities but works as part of an effective team. The student provides evidence of how successfully some individual and/or team targets were met. (1–2 marks)

Mark band 2

- A description by the student of their role in the team, with their own description or witness statements to confirm how they helped ensure the team worked effectively.
- Success in meeting key individual and/or team targets (eg a statement of targets, with evidence of success coming from achieving some in the stages of manufacture *b* — *g* below).

The student plays an active part in team building activities and works to make sure the team is effective. The student provides evidence of how successfully key individual and/or team targets were met. (3–4 marks)

Mark band 3

- A description of team roles with some evaluation by the student of his/her own role, together with their own description and witness statements to confirm how s/he played a leading role in ensuring the team worked effectively.

- Success in meeting all achievable individual and/or team targets (eg a statement of targets, with evidence of success coming from achieving some in the stages of manufacture *b–g* below).

The student plays a leading role in team-building activities and in ensuring that the team works effectively. The student provides evidence of how successfully effective individual and/or team targets were met. (5–6 marks)

(b) used a production plan and developed a schedule for manufacture (6 marks)

Detailed information about the type and quantity of product to be manufactured, such as single unit, batch and volume production is included in the production plan. Students use this information to develop a schedule for manufacture, which should record information about the preparation, processing and assembly stages of manufacture; the sequence and timing of stages; critical production and quality control points; production and quality control procedures; the allocation of roles and responsibilities (if this is carried out as part of a team). Students should organise their work so that the following information can also be recorded:

- any later modifications to the production plan and schedule for manufacture
- information about what makes an effective team
- setting individual targets, and agreeing team targets, if relevant.

Mark band 1

- The student needs some support and guidance to use sufficient information in the production plan.
- The development of an outline schedule for manufacture (eg most key stages in the schedule 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 uses sufficient information in the production plan to make basic decisions about how the chosen products should be manufactured, and develops sufficient relevant information in the schedule for manufacture to achieve the manufacture of products. (1–2 marks)

Mark band 2

- With limited support and guidance, the student uses the main information in a production plan.
- The development of a realistic schedule for manufacture (eg the schedule considers all relevant criteria, with enough detail for an experienced third party to be able to follow it).

The student makes use of the main information in the production plan to make informed decisions about how the chosen products should be manufactured.

The student develops a realistic schedule for manufacture. (3–4 marks)

Mark band 3

- The student works independently to use the main information in a production plan.
- The development of a detailed and effective schedule for manufacture (eg all relevant criteria are developed in detail and the schedule not only works, but consideration has been given to how to make it work most effectively. It can be easily followed).

The student makes confident use of the main information in the production plan to make effective decisions about how the chosen products should be manufactured. The student develops detailed and realistic information in the schedule for manufacture. (5–6 marks)

(c) used quality control techniques and identified problems (6 marks)

Students need to understand the importance of quality indicators given in the production plan. They need to apply quality control techniques, using quality indicators when inspecting, testing and comparing (as required) samples of the product material, component/ingredients at the critical control points specified in the schedule for manufacture. Students need to monitor and record the progress of production.

Mark band 1

- Limited use of quality control techniques to monitor production.
- The identification of most problems, perhaps given as a list. The problems must be clearly enough recorded that a third party could act on the information to deal with them.

The student applies limited quality control techniques to monitor the progress of production, using quality indicators at some critical control points in the product manufacture. The student identifies and records most problems, ie variances from the quality standards in the schedule for manufacture. (1–2 marks)

Mark band 2

- Use of a range of quality control techniques to monitor production.
- A description of the causes of most problems. The descriptions must contain enough information for a third party to be able to deal with the problems.

The student uses a range of quality control techniques to monitor the progress of production, using quality indicators, with some precision, at the main critical control points in the product manufacture. The student describes the causes of most problems, ie why variances from the quality standards in the schedule for manufacture occur. (3–4 marks)

Mark band 3

- Use of objective quality control techniques to monitor production.
- An explanation of how to prevent most problems happening again.

The student applies objective quality control techniques to monitor the progress of production, using quality indicators, with precision, at the main critical control points in the product manufacture.

The student explains how to prevent most problems happening again, ie how to prevent variances from the quality standards in the schedule for manufacture in order to achieve the appropriate level of quality. (5–6 marks)

(d) prepared and used materials and components safely (6 marks)

The student needs to know how to prepare and use materials, ingredients and components safely to meet the requirements of the production plan and schedule for manufacture. This requires an understanding of the working properties of materials in order to achieve their optimum use. The student also requires an understanding of the function of components; the purchasing of materials and resources; the processing materials such as trimming, cleaning or de-greasing, preparing blanks, annealing or freezing.

Mark band 1

- The student needs some support and guidance to prepare materials and components, meeting some production criteria.
- Use of materials safely with some skill to make products.

The student prepares materials and components appropriate to the production plan and schedule for manufacture. Materials and components are used safely, with some skill, to make the chosen products. (1–2 marks)

Mark band 2

- The student requires limited guidance to prepare materials and components, according to the main production criteria.
- Use of materials safely with skill to make products.

The student prepares materials and components according to the main details in the production plan and schedule for manufacture. Materials and components are used safely, with skill, to make the chosen products. (3–4 marks)

Mark band 3

- The student works independently to prepare materials and components, according to the main production criteria.
- Optimum and safe use of materials when making products.

The student demonstrates confident preparation of materials and components according to the main details in the production plan and schedule for manufacture. Materials and components are used safely, with skill and understanding, to achieve optimum use when making the chosen products. (5–6 marks)

(e) prepared and used tools, equipment (including appropriate use of ICT) and machinery safely (6 marks)

The student needs to know how to select, prepare and use appropriate tools, equipment and machinery safely, including the use of Computer Aided Manufacture (CAM) where appropriate and available, to meet the requirements of the production plan and schedule for manufacture. This includes correct cleaning and setting up; and carrying out health, safety and hygiene checks, eg carrying out a risk assessment and following safety procedures and instructions.

Mark band 1

- The student shows some skill but needs some support and guidance to prepare tools, equipment and machinery.
- The student works with some accuracy but needs some support and guidance to use tools, equipment and machinery safely to make products.

The student prepares appropriate tools, equipment and machinery with sufficient skill to enable the manufacture of products. Tools, equipment and machinery are used safely, with some accuracy, to make the chosen products. (1–2 marks)

Mark band 2

- The student shows skill, and needs limited guidance in the preparation of tools, equipment and machinery.
- The student works accurately and with some skill to use tools, equipment and machinery safely to make products.

The student prepares appropriate tools, equipment and machinery with skill to enable the manufacture of products. Tools, equipment and machinery are used safely, with accuracy and some skill, to make the chosen products. (3–4 marks)

Mark band 3

- Independent and precise preparation of tools, equipment and machinery.
- Use tools, equipment and machinery independently and safely with accuracy and skill to make products.

The student prepares appropriate tools, equipment and machinery with precision to enable the manufacture of products. Tools, equipment and machinery are used safely, with accuracy and skill, to make the chosen products. (5–6 marks)

(f) manufactured your products safely to meet production requirements and conform to standards (6 marks)

The student needs to combine, assemble and finish materials, components/ingredients safely, to meet requirements specified in the production plan and schedule for manufacture, eg relating to the quantity of products required or the prescribed manufacturing methods. The student manufactures products that conform to the appropriate quality standards, eg the correct dimensions, tolerances, fit, performance, sensory characteristics.

Mark band 1

- Safe manufacture of the products, to meet some of the production requirements such as those listed above.
- Conformance to some quality standards required.

The student achieves the safe manufacture of the chosen products, which meet some specified production requirements. The products conform to some quality standards required. (1–2 marks)

Mark band 2

- Safe manufacture of the products, to meet the main production requirements.
- Conformance to the main quality standards required.

The student achieves the safe manufacture of the chosen products, which meet the main specified production requirements. The products conform to the main quality standards required. (3–4 marks)

Mark band 3

- Safe manufacture of the products, to effectively meet the main production requirements.
- Consistent conformance to the main quality standards required.

The student achieves the safe manufacture of the chosen products, which effectively meet the main specified production requirements. The products demonstrate consistent conformance to the main quality standards required. (5–6 marks)

(g) modified the production plan and schedule for manufacture (6 marks)

The reason for recording modifications to the production plan and schedule for manufacture is to achieve the manufacture of identical high quality products. The student formats the production plan to record any modifications required, eg in response to quality requirements. Modification to the schedule for manufacture relates to how well the products meet quality requirements, in response to quality data collected through the application of quality control techniques; and to what changes may be required to further improve the quality of the products.

Mark band 1

- An identification of some relevant modifications to the production plan in response to quality data.
- An identification of some relevant modifications to the schedule for manufacture in response to quality data.

In both cases the modifications needed could be stated as a list or table, but there is little indication of how they would be carried out.

The student identifies some relevant modifications necessary to the production plan in response to quality data. The student identifies some relevant modifications necessary to the schedule for manufacture in response to quality data. Modifications identified relate to how well the products meet quality requirements and what changes may be required to further improve the quality of the products. (1–2 marks)

Mark band 2

- A description of relevant modifications to the production plan in response to quality data.
- A description of relevant modifications to the schedule for manufacture in response to quality data.

In both cases there should not only be a clear description of the modifications needed, but also some suggestions for achieving the modifications.

The student describes relevant modifications necessary to the production plan in response to quality data. The student describes relevant modifications necessary to the schedule for manufacture in response to quality data. Modifications relate to how well the products meet quality requirements and what changes may be required to further improve the quality of the products. (3–4 marks)

Mark band 3

- An explanation of relevant modifications to the production plan in response to quality data.
- An explanation of relevant modifications to the schedule for manufacture in response to quality data.

In both cases the reasons for the modifications should be made.

The student explains relevant modifications necessary to the production plan in response to quality data. The student explains relevant modifications necessary to the schedule for manufacture in response to quality data. Modifications relate to how well the products meet quality requirements and what changes may be required to further improve the quality of the products. (5–6 marks)

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: Designing Products for Manufacture* and *Unit 2: Manufactured 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 Manufacturing or Engineering. This unit also forms part of a GCSE in Engineering (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 manufacturing and engineering sectors listed below:

Manufacturing

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

Engineering

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

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:

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 thermocromic 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 need to 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 also need to 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

Teaching strategies

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. Students 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 test 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. A good focus is 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 manufacturing, 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 manufacturing, 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. When doing so this will not only maintain student interest but 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 manufactured 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:

- food and drink/biological and chemical
- printing and publishing/paper and board
- textiles and clothing
- engineering fabrication
- mechanical/automotive
- electrical and electronic/computer/process control/telecommunications.

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 food and drink/biological and chemical).

Section B will illustrate a product from the chosen sector (eg food and drink/biological and chemical) and questions will relate to that product (eg a fruit pie). This product will be pre-released in September for the following June's examination and will act as a focus on 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 manufacturing 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 are required for product investigation.

Appendices

Appendix A — Glossary of terms

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

Components: manufactured parts, often produced by secondary suppliers.

Customer: it should be noted that the customer is not necessarily external to the organisation, nor the end-user of the product; s/he 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 product specifications.

Design proposal: potential design solutions, for use in producing a product specification, will be considered by the designer, in consultation with the client. The proposal which best matches the client's requirements, and is most feasible for production will be selected as the design solution.

Materials: chemical/biological, constructions (woods, metals, polymers, ceramics), electrical/electronics, fibres/fabric, paper and board.

Processes: sequence of production methods.

Product: chemical/biological, durable/engineered, electrical/electronic, food/drink, textile, paper and board.

Product specification: the final stage in the design and development process, the product specification is taken from the design solution. The product specification is intended for use by the production team and will contain technical information required for production measurements, tolerances, finish, quality, cost, quantity, processes.

Quality assurance: a formal system in which all the activities and functions concerned with achieving and maintaining quality output are set out in written form as procedures and work instructions. Quality assurance involves the consideration of all aspects of the production process (eg staff, equipment, standards, materials, layout) in producing products of a consistently high quality.

Quality control: the application of techniques and systems to the production process to ensure that all materials used, and all products manufactured, meet the product specification. Techniques include inspection, testing and input and output control.

Scales of production: continuous, repetitive batch, batch (small, large, repetitive), jobbings (eg production prototype).

Appendix B — Grade descriptions

The following grade descriptions indicate the level of attainment characteristic of the given grade for GCSEs in Manufacturing. 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 manufacturing problems and tasks. Candidates will make use of a limited range of sources of information to analyse manufacturing problems and will clarify their ideas through discussion, drawing, modelling and preparing samples. With some support and guidance, candidates will plan and carry out investigations and will work with a range of tools, materials, equipment, ingredients, 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 manufacturing problems and tasks. Candidates will make use of a wide range of appropriate sources of information to analyse manufacturing 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, ingredients, components and processes. They will organise their work so that they can carry out processes accurately and consistently, and use tools, equipment, materials, ingredients 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 manufacturing problems and tasks. Candidates will be discriminating in their selection and use of a wide range of information sources to analyse manufacturing 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, ingredients 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 and constraints eg quantities, the properties of materials, scales of production, costs etc as part of developing design solutions.
	Unit 2	✓	Interpreting technical information from a production plan eg numbers of components, quantities of ingredients, materials' properties, simple quality and production control data, drawings etc.
	Unit 3	*	Interpreting technical information on the properties of materials, on the dimensions of manufactured products etc.
N1.2 a Carry out straightforward calculations to do with amounts and sizes.	Unit 1	✓	Calculating resources for manufacture: amounts of raw materials or ingredients, labour, costs etc, measuring quantities and materials, calculating product dimensions, tolerances etc.
	Unit 2	✓	Calculating and maintaining levels of resources, identifying correct calibration of machinery etc.
	Unit 3	✓	Investigating the dimensions and composition of a manufactured product, also details of how many are manufactured etc.
N1.2 b Carry out straightforward calculations to do with scales and proportion.	Unit 1	✓	Working with ingredients, scale models, etc, working out scales of production and cost implications of changing scale.
	Unit 2	✓	Working with dimensions (eg in relation to the size of components, quantities of ingredients etc).
	Unit 3	*	Working with dimensions and producing scale drawings to explain how a product works.
N1.2 c Carry out straightforward calculations to do with handling statistics.	Unit 1	✓	Working with quality control information, considering markets for the product, producing simple statistics from feedback during the development of design ideas etc.
	Unit 2	✓	Working with quality control data and information on variations during production.
	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	
N1.3 Interpret the results of your calculations and present your findings. You must use **one** chart and **one** diagram.	Unit 1	✓	Calculating cost, quantity, product size, tolerances, etc in the final design solution, using basic graphical methods.
	Unit 2	✓	Calculating numerical information for use in the production schedule. Using results to develop the production plan, eg calculating resources required at different points, and presenting this information diagrammatically in the production plan.
	Unit 3	*	Presenting the results of investigations of a manufactured product, eg using simple diagrams to show results of measurements etc.
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 the design team as a whole to formulate a design specification, generate ideas etc.
	Unit 2	*	Discussing the production plan with other members of the production team to develop the production schedule, on an individual or group basis. Reviewing the plan and the schedule during production eg discussing quality control findings.
	Unit 3	*	Identifying and discussing the impact of new technology, with the class or with individuals, eg the user of a product, a manufacturer etc. Talking about the advantages and disadvantages of new technology, for example, the workforce, 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, brochures, data sheets, extracts from market research reports, instructions booklets for machinery, textbooks etc.
	Unit 2	✓	Production plans and schedules, product specifications, data sheets, manuals and guides for machinery, tools and equipment, information on manufacturing processes, health and safety regulations, quality manuals, textbooks, etc.
	Unit 3	*	Product information: manuals, guides etc, promotional materials for companies using new technology, 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	✓	Producing a product design specification and a design solution based on the design brief. The design solution should include information on production constraints etc, an explanation of how the brief was met, with drawings and models etc as appropriate. Also design ideas in their development supported by text eg sketches, prototypes, a modified design proposal, a simple risk assessment.
	Unit 2	*	Producing a schedule for manufacture, based on a given production plan, with text eg brief explanations of use and suitability of processing and preparation methods for given materials, and of the use of tools, equipment etc. Also records of quality and production control data, reports on health and safety and hygiene issues and identifying points where checks should be made.
	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.
IT1.1 Find, explore and develop information for **two** different purposes.	Unit 1	*	Given sources from the internet, CD-Roms, databases and other non-IT sources may provide technical data eg on materials constraints and production methods. These may also be used to explore markets and existing product lines, and to obtain information on production methods and sources of materials etc. Also, to develop ideas eg for styling and aesthetics and provide images which might be used in presentations etc.
	Unit 2	*	Given sources on the internet, CD-Roms, databases etc can be used in finding information eg on the preparation and processing of materials and ingredients, the use of tools and equipment, on heath, safety and hygiene, quality systems etc. Production information might also be recorded and developed using IT.
	Unit 3	*	Given sources on the internet, CD-Roms or databases might be used to obtain product information and information on the operation and impact of new technologies. IT may also be used to record the results of investigations.

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
IT1.2 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 the final design solution using WP, drawings, imported images, graphical information on cost, materials, production, timescales etc. Presenting the product design specification, design ideas, production information etc to the client during the development of the final design.
	Unit 2	*	Presenting the production schedule using WP, also the results of measurements and tests, drawings, graphical information on quality, quantity etc.
	Unit 3	*	Reporting on new technology using WP, imported text and images, etc. Drafting and finalising a product report, recording, manipulating and presenting numerical data etc.
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 learn about a production technique, to test a material, to choose the most appropriate ingredients etc. And also to identify: action points eg to collect a range of sample ingredients etc, deadlines, arrangements for reviewing progress, and who to ask for help.
	Unit 2	*	If the development of manufacturing skills such as the use of different processes and the calibration of machinery is supported by structured target-setting with the student by an appropriate person. Targets might include learning about particular processes, etc. Also identifying: action points eg to practise using the machinery etc, 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: Studying a straightforward subject 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 looking at examples of advertising and making notes, finding and trying recipes 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, reading instruction manuals etc. Also acting on 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	
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, and suggest improvements.
	Unit 2	✻	Reviewing what has been learned and how they went about it, on a one-to-one basis eg in tutorials, with encouragement to identify good work and bad, and suggest improvements.
	Unit 3	✗	
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 what the client wants to achieve, and picking out key features such as materials and constraints. Working with others to establish options for meeting the brief, including researching materials and 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	✓	With support from an appropriate person or people, identifying ways to schedule manufacture from the production plan, eg identifying several appropriate processing techniques, calibrations for machinery, sequencing etc and choosing options which are most likely to be successful, given basic constraints.
	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 how the design specification and design solutions will be tackled, carrying out necessary research, showing how the product might be made and identifying basic constraints, trying out appropriate solutions, seeking advice as necessary.
	Unit 2	✓	Planning the testing of materials and processes, and ideas for sequencing of manufacture, as part of developing the production schedule, and testing those ideas, logging results. Making changes and seeking advice as necessary. Also, implementing the production plan and schedule, 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	
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 product design specification, and saying how well they were met. In the presentation of the design solution, describing 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 specified in the production plan, 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.
	Unit 3	✗	
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 and 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. Scheduling production will mean checking group aims and being clear on individual responsibilities eg for testing samples for quality control, ensuring availability of materials, timing activities etc. Also being clear on working methods.
	Unit 3	✗	
WO1.2 Work with others towards achieving given objectives, carrying out tasks to meet your responsibilities.	Unit 1	✻	Individuals will be given their own responsibilities and working methods, and must show that they can carry tasks out safely and effectively to meet the design brief eg costing materials, researching the scale of production, identifying relevant regulations, testing materials etc, asking for help and supporting other members of the design team. 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 liasing with client, could satisfy the 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	
WO1.3 Identify progress and suggest ways of improving work with others to help achieve given objectives.	Unit 1	*	If group working is planned in such a way as to allow discussion of progress, where good ways of tackling aspects of the design brief are identified, and problems and how they were dealt with identified, with a view to suggesting better ways of working together.
	Unit 2	*	If group working is planned in such a way as to allow discussion of progress, identifying good ways of tackling production, 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 details and constraints, the properties of materials, scales of production, costs etc as part of developing design solutions.
	Unit 2	✓	Interpreting technical information from a production plan, relating to components, ingredients, materials, properties, quality and production control data, drawings etc.
	Unit 3	*	Interpreting technical information on the properties of materials, on the structure and form of manufactured products etc.
N2.2 a Carry out calculations to do with amounts and sizes	Unit 1	✓	Calculating resources for manufacture: amounts of raw materials or ingredients, labour, costs etc, measuring quantities and materials, calculating product dimensions, tolerances etc.
	Unit 2	✓	Calculating and maintaining levels of resources, identifying correct calibration of machinery etc, making any modifications necessary during production.
	Unit 3	✓	Investigating the structure and composition of a manufactured product: dimensions, quantities manufactured etc.
N2.2 b Carry out calculations to do with scales and proportions	Unit 1	✓	Working with ingredients, scale models, etc, working out scales of production and cost implications of changing scale.
	Unit 2	✓	Working with dimensions eg in relation to the size of components, quantities of ingredients etc.
	Unit 3	*	Working with dimensions and producing scale drawings to explain how a product works.
N2.2 c Carry out calculations to do with handling statistics;	Unit 1	✓	Working with quality control information, considering markets for the product, quantifying feedback during the development of design ideas etc.
	Unit 2	✓	Working with quality control data and information on variance in production.
	Unit 3	✓	Quantifying the different products made by the engineering and manufacturing sectors, and the impact of new technologies in terms of, for example, 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	
N2.2 d Carry out calculations to do with using formulae.	Unit 1	✻	Considering any relevant scientific principles underpinning the functioning of the product.
	Unit 2	✻	Considering the scientific principles underpinning the use of tools, equipment and machinery in production.
	Unit 3	✻	Explaining the operation of a manufactured 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 and drawings.
	Unit 2	✓	Presenting numerical information in the production schedule, and in modifying the production plan, on, for example, sequencing and timing, quantities, tolerances, critical control points, etc based on own calculations and using appropriate graphical methods.
	Unit 3	✻	Presenting the results of investigations of a manufactured product, showing its properties, dimensions, how new technology has influenced the design etc.
C2.1 a 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 production plan with other members of the production team to develop the production schedule. Reviewing plan and schedule during production eg discussing quality control findings.
	Unit 3	✻	Identifying and discussing the impact of new technology, with the class or others eg someone with long experience of working in manufacturing. Considering advantages and disadvantages for, for example, the workforce and the environment etc.
C2.1 b Give a short talk about a straightforward subject, using an image.	Unit 1	✓	Presenting a range of design solutions and ideas to the client to get their feedback, as part of the development process, explaining key features, production and materials' constraints, and quality standards. Presenting the final design solution to the client, making use of drawings, models etc as necessary.
	Unit 2	✻	Presenting information to the production team on, for example, health and safety, levels of materials, the quality of the finished product, any modifications to the schedule or plan felt to be necessary etc. Using appropriate visual aids.
	Unit 3	✻	Presenting results of the investigation of a manufactured 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, market research reports, manuals, textbooks etc. There must be evidence that information from such sources has been summarised in the student's written work.
	Unit 2	✓	Production plans and schedules, product specifications, data sheets, manuals and guides for machinery, tools and equipment, information on manufacturing processes, 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	✓	Producing a product design specification and a design solution based on the design brief. The design solution will include information on production constraints etc, an explanation of how the brief was met, with drawings and models etc, as appropriate. Design ideas in their development eg sketches, prototypes and the analysis of materials will also be supported by text. Producing a modified design proposal. Producing a risk assessment.
	Unit 2	✻	Producing a schedule for manufacture, based on a given production plan, with explanatory text. Also, explanations of use and suitability of processing and preparation methods for given materials, and of the use of tools, equipment etc. Recording quality and production control data and analysing findings. Reporting on health and safety and hygiene issues and identifying points where checks should be made.
	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.

Key skill	GCSE unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
IT2.1 Search for and select information for **two** different purposes.	Unit 1	✻	The internet, CD-Roms, databases etc are possible sources of technical data eg on materials constraints and production methods. Providing details of markets and existing product lines, information on production methods and sources of materials, ideas for styling and aesthetics, images which might be used in presentations etc.
	Unit 2	✻	The internet, CD-Roms, databases etc can provide information on the preparation and processing of materials and ingredients, on CAM, and the use of tools and equipment, on health, safety and hygiene, quality systems etc.
	Unit 3	✻	The internet, CD-Roms, databases etc are good sources of product information and for information on the operation and impact of new technologies.
IT2.2 Explore and develop information, and derive new information, for **two** different purposes.	Unit 1	✻	Developing design ideas through manipulating and finalising text and images, using spreadsheets, carrying out calculations, simulations, modelling etc. Developing information for use in presenting the final design solution.
	Unit 2	✓	Using CAM, recording control data eg on materials or quality, and manipulating it to derive conclusions and inform production schedules, carrying out calculations, etc.
	Unit 3	✻	Carrying out calculations to use in describing and explaining products, drafting and finalising text to use in reports on new technology, importing images, using 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 the final design solution using WP, drawings, imported images, graphical information on cost, materials, production, timescales etc. Presenting the product design specification, design ideas, production information etc to the client during the development of the final design.
	Unit 2	✻	Presenting the production schedule, using WP, the results of measurements and tests, drawings, graphical information on quality, quantity etc.
	Unit 3	✻	Reporting on new technology, using WP, imported text and images, etc. Drafting and finalising product report, 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	
LP2.1 Help set short-term targets with an appropriate person and plan how these will be met.	Unit 1	✻	If the development of a design solution is supported by structured planning on a one-to-one basis with the student. Setting targets eg to choose the most appropriate ingredients, with deadlines and action points for achieving these eg to collect a range of sample ingredients etc.
	Unit 2	✻	If the development of manufacturing skills such as the use of different processes, the calibration of machinery is supported by 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 practice 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: Studying a straightforward subject 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 market research results and making notes, finding and trying recipes 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	✗	
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: product design details, material details and constraints, researching information and data about materials, production etc, generating ideas and solutions, choosing ones which might work, and identifying constraints, taking advice where necessary. Also applies to decisions during the development of designs eg about choosing a material.
	Unit 2	✓	Analysing the production plan and identifying information for use in the schedule for manufacture, identifying several appropriate processing techniques, calibrations for machinery, sequencing etc, and choosing options which are most likely to be successful.
	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	
PS2.2 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 a design specification and design solutions based on research, showing how the product might be made and the constraints, 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 processes, and ideas for sequencing of manufacture, as part of developing the production schedule, and testing those ideas, logging results. Making changes and seeking advice as necessary while testing. Also, implementing the production plan and schedule, and making any changes which become necessary.
	Unit 3	✗	
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 product design specification, and drawing conclusions as to how well they were met. In the presentation of the design solution, explaining decisions at each planning and production stage, 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 specified in the production plan, 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 planning or scheduling might be improved.
	Unit 3	✗	
WO2.1 Plan straightforward work with others, identifying objectives and clarifying responsibilities, and confirm working arrangements.	Unit 1	✻	If the design brief is tackled by a team, it will be important that both group and individual objectives, are allocated, and a plan for carrying out the work is agreed, with reference to timescales, resources, opportunities for feedback etc. Could fulfil the group-working requirement for this key skill.
	Unit 2	✓	Team working. The production schedule should be supported by the clear allocation of production responsibilities for individuals and the group eg for testing samples for quality control, ensuring availability of materials etc. The schedule should show sequencing of tasks at all stages, quality control points etc.
	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	
WO2.2 Work co-operatively 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 co-operative and safe working, and seeking 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 production 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	✗	
WO2.3 Exchange information on progress and agree ways of improving work with others to help achieve objectives.	Unit 1	✻	If the group's work is planned to allow for progress checking, feedback and brainstorming eg on ideas for solving a technical problem in the design.
	Unit 2	✻	If the group's work is planned to allow for progress checking, feedback and brainstorming eg on ways of using particular processes, modifying the schedule 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 assessment possibilities in Citizenship (Cz), Environmental (En) and European Initiatives (EI). These opportunities derive from the unit specifications for the specific subjects areas, 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 in to '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**	environment

	Sp	M	E	So	C	EI	En
Unit 1							
How the manufacturing industry brings a product to the market place: So and C issues will impact on design briefs of clients and how these are interpreted.				*	*		
Design briefs will have to conform to EI and standards and possibly En concerns.						*	*
E and M will play a part in the interpretation of the design brief — professional M and E obligation to fulfil the brief (ie cheapest possible versus best option).		*	*				
Material details and constraints: EI and associated regulations and, again En issues.						*	*
Discussing ideas with others: So, C and Sp to be responsive and aware of cultural and spiritual diversities, and how this may impact on communication and expectations.	*			*	*		
Unit 2							
Schedule for manufacture: Sp, So and C, ie taking in to 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. This may also bring En considerations.		*	*			*	*
Effective teams and the allocation of roles and working with different groups of people: So, C and Sp. E and M may also be included here in terms of respecting differing So, C and SP orientations.	*	*	*	*	*		

	Sp	M	E	So	C	EI	En
Unit 3							
Implications of technology introduce EI 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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