Oxford Cambridge and RSA Examinations

RECOGNISING ACHIEVEMENT

OCR GCSE IN DESIGN AND TECHNOLOGY (INDUSTRIAL TECHNOLOGY) 1959

Key Features

- Covers National Curriculum order for KS4 Design and Technology.
- Coursework clearly linked to teaching content requirement.
- A range of capability tasks clearly linked to teaching content requirement.
- Immediate support from specialist subject officer.
- Assessment based on practical capability and the knowledge and understanding that underpins this capability.
- Content clearly reflecting modern industrial production and practice.
- Moderation by visit.

Support and In-Service Training for Teachers

- A full programme of In-Service training meetings arranged by the Training and Customer Support Division (telephone 01223 552950).
- Specimen question papers and mark schemes, available from the Publications Department (telephone 0870 870 6622 fax 0870 870 6621).
- Past question papers and mark schemes, available from the Publications Department (telephone 0870 870 6622 fax 0870 870 6621).
- Written advice on coursework proposals.
- A report on the examination, compiled by senior examining personnel after each examination session.
- Individual feedback to each Centre on the moderation of internally assessed work.

CONTENTS

Throughout the specification the following icons are used to signpost teaching and learning opportunities in:

 Citizenship

 ICT

 Key Skills

CO	-	Communication
N	-	Application of Number
IT	-	Information Technology
WO	-	Working with Others
LP	-	Improving own Learning and Performance
PS	-	Problem Solving

OCR GCSE IN DESIGN AND TECHNOLOGY (INDUSTRIAL TECHNOLOGY) (1959)

SECTION A: SPECIFICATION SUMMARY

Outline

The revised GCSE specification retains the characteristics of the Design and Technology (Industrial Production) specification previously offered by OCR.

The revised specification provides a coherent, satisfying and worthwhile course of study for candidates, whether they wish to pursue the study of Design and Technology in the future or whether it will be their last experience of studying the subject.

The specification meets the National Curriculum Order for England (DfEE/QCA 1999) for Design and Technology and the GCSE Subject Criteria (QCA 2000). It provides opportunities for candidates to develop an awareness of the nature and significant importance of Design and Technology in a rapidly changing society. It enables candidates to develop their application of knowledge, skills, and understanding of Industrial Technology within an overall design and make based approach. The specification offers a system of assessment of GCSE based on clear targets and a coherent set of criteria for rewarding positive achievement across grades G to A*. The assessment of candidates includes both practical capability in Design and Technology applied to designing and making a device to manufacture products, and the knowledge and understanding which underpins this capability.

The specification is fundamentally designed to assess a candidate's capability at the end of KS4. It does, however, recognise that appropriate experiences at KS3 are essential if a candidate is to realise his/her full potential. This specification also provides candidates with a path into AS/A level Design and Technology and GNVQ Manufacturing and Engineering.

TIERS

<table>
<tr><th>Grades</th><th>Foundation Tier
G to C</th><th>Higher Tier
D to A*</th></tr>
<tr><td>A*</td><td rowspan="3"></td><td rowspan="3">Candidates take
Components 2, 4
and 5</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="5">Candidates take
Components 1, 3
and 5</td><td rowspan="5"></td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
<tr><td>G</td></tr>
</table>

COMPONENTS

Component	Name	Duration	Weighting
1	Paper 1 (Foundation)	1 hour	20%
2	Paper 2 (Higher)	1 hour 15 mins	20%
3	Paper 3 (Foundation)	1 hour	20%
4	Paper 4 (Higher)	1 hour 15 mins	20%
5	Internal Assessment (Coursework)	40 hours	60%

QUESTION PAPERS

Papers 1, 2, 3 and 4 will test a candidate's knowledge and understanding of Industrial Technology through questions on designing and making. There will be no choice of questions.

Papers will include product analysis questions based on information contained in the question paper.

INTERNAL ASESSMENT (COURSEWORK)

Internal Assessment (coursework) will consist of a project where candidates will be expected to design and make a device to manufacture products in quantity.

The project can be linked to a candidates own interests, industrial practice or the community.

Projects may involve an enterprise activity, where candidates identify an opportunity, design to meet a need, manufacture products and evaluate the whole design and make process.

Candidates must use appropriate ICT to help with their work. This can include computer-aided design and manufacture (CAD/CAM) software, control programs, data analysis and ICT based sources for research.

Candidates must consider how technology affects society and their own lives.

ENTRY OPTIONS

All candidates should be entered for 1959 with one of the following option codes:

Option Code	Option	Components
F	Foundation Tier	1, 3, 5
H	Higher Tier	2, 4, 5

SECTION B: GENERAL INFORMATION

1 Introduction

1.1 RATIONALE

The specification aims to prepare candidates to participate in tomorrow's rapidly changing technologies.

The specification calls for candidates to become autonomous and creative problem solvers, as individuals and members of a team. They must look for needs, wants and opportunities and respond to them by developing a range of ideas and making products and systems. This specification combines practical skills with an understanding of aesthetics, social and environmental issues, function and industrial practices. Candidates reflect on and evaluate relevant present and past design and technology, its uses and effects.

The specification seeks to help candidates to become discriminating and informed users and innovators of products. It encourages candidates to think and intervene creatively to improve the quality of life for society.

The specification provides a framework which can be accessed by all candidates with the potential of gaining a GCSE grade G to A*.

OCR has taken great care in the preparation of this specification and assessment material to avoid bias of any kind.

1.2 CERTIFICATION TITLE

This specification will be shown on a certificate as:

OCR GCSE in Design and Technology (Industrial Technology).

1.3 LEVEL OF QUALIFICATION

GCSE Full Course

This qualification is approved by the regulatory authorities (QCA and ACCAC) as part of the National Qualifications Framework for England and Wales.

Candidates who gain grades G to D will have achieved an award at Foundation Level.

Candidates who gain grades C to A* will have achieved an award at Intermediate Level.

1.4 RECOMMENDED PRIOR LEARNING

Candidates who are taking courses leading to this qualification at Key Stage 4 should normally have followed the corresponding Key Stage 3 programme of study within the National Curriculum.

Candidates entering this course should have achieved a general educational level equivalent to National Curriculum Level 3, or a distinction at Entry Level within the National Qualifications Framework.

1.5 PROGRESSION

GCSE qualifications are general qualifications which enable candidates to progress either directly to employment, or to proceed to further qualifications.

Many candidates who enter employment with one or more GCSEs would undertake training or further part-time study with the support of their employer.

Progression to further study from GCSE will depend upon the number and nature of the grades achieved. Broadly, candidates who are awarded mainly grades G to D at GCSE could either strengthen their base through further study of qualifications at Foundation Level within the National Qualifications Framework or could proceed to Intermediate level. Candidates who are awarded mainly grades C to A* at GCSE would be well prepared for study at Advanced Level within the National Qualifications Framework.

Specifically students who achieve a grade C or above would be well prepared to study AS/A level Design and Technology and GNVQ Manufacturing and Engineering.

1.6 OVERLAP WITH OTHER QUALIFICATIONS

Specifically, Two GCSEs at grade G to D or two GCSEs at grade C to A* are equivalent to Part One GNVQ at Foundation and Intermediate Level respectively.

Four GCSEs at grade G to D or four GCSEs at grade C to A* are equivalent to full award GNVQ at Foundation and Intermediate Level respectively.

The format of this specification is shared with other specifications in the Design and Technology suite. The very nature of designing and making means that processes are similar, however, the content that is examined in the papers and internal assessment of the specification is unique.

Of a more general nature this specification provides opportunities to promote knowledge and understanding of a wide range of skills, many of which are shared with other subject areas.

Those identified in the National Curriculum Order for England (DfEE/QCA 1999) for Design and Technology are :

thinking skills, identifying relevant sources of information, and developing criteria for designs to guide their thinking;

financial capability, through taking account of the relative cost of materials and components, in relation to their working characteristics and properties when deciding if, when and how to use them;

enterprise and entrepreneurial skills, through identifying an opportunity to design something to meet a specific need, finding out about the work of professional designers and the manufacturing industry and then making and marketing the prototype product, and evaluating the whole process;

work-related learning, through bringing a realistic industrial or commercial perspective to the development of a product in school based design studios or areas, visiting a workplace for hands-on experience related to designing and making, and providing the opportunity for visitors from business to act as product advisers or clients;

education for sustainable development, through developing knowledge and understanding of the principles of sustainable design and production systems, developing skills in creative problem solving and evaluation, and exploring values and ethics in relation to the application of design and technology.

1.7 RESTRICTIONS ON CANDIDATE ENTRIES

Candidates who enter for this GCSE specification may not also enter for an OCR GCSE specification with the certification title Design and Technology (Resistant Materials) in the same examination series.

Candidates who enter for this GCSE may however also enter for any GNVQ specification with the certification title GNVQ Manufacturing, GNVQ Engineering, GNVQ CBE. in the same examination series. They may also enter for any NVQ qualification.

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

Centres should be aware that candidates who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

The classification code for this specification is 9070.

1.8 CODE OF PRACTICE REQUIREMENTS

These specifications will comply in every respect with the revised Code of Practice requirements for courses starting in September 2001.

1.9 STATUS IN WALES AND NORTHERN IRELAND

This specification has been approved by ACCAC for use by Centres in Wales

Candidates in Wales and Northern Ireland should not be disadvantaged by terms, legislation or aspects of government that are different from those in England. Where such situations might occur, including in the external assessment, the terms used have been selected as neutral, so that candidates may apply whatever is appropriate to their own situation.

OCR provides specifications, assessments and supporting documentation only in English.

Further information on the provision of assessment materials in Welsh and Irish may be obtained from the Information Bureau at OCR (telephone 01223 553998).

2 Specification Aims

The specification requires candidates to demonstrate fully their design and technology capability by combining skills with knowledge and understanding, in order to design and make quality products.

The specification allows candidates to acquire and apply knowledge, skills and understanding through:

(i) analysing and evaluating products and processes;

(ii) engaging in focussed tasks to develop and demonstrate techniques;

(iii) engaging in strategies for developing ideas, planning and producing products;

(iv) considering how past and present design and technology, relevant to a designing and making context, affects society;

(v) recognising the moral, cultural and environmental issues inherent in design and technology.

The aims of this specification are:

- to encourage candidates to combine their designing and making skills with knowledge and understanding, in order to design and make quality devices to manufacture products;
- to promote design and technology capability in candidates through activities which involve a range of contexts, materials, processes and to lead to practical outcomes;
- to give opportunities to develop practical abilities and the confidence to design, make and modify products for identified purposes, selecting and using resources effectively;
- to promote the use of graphic techniques and ICT including computer-aided design (CAD), to generate, develop, model and communicate design proposals;
- to promote the use of computer-aided manufacture (CAM) in single item production and in batch or volume production;
- to encourage the development of candidates' critical and aesthetic abilities, enabling them to evaluate design and technology activity, including their own, in the context of an identified need;
- to encourage the development of candidates' understanding of the needs and values of a range of users; including spiritual, moral, social, and cultural considerations;
- to promote the keys skills of communication, application of number, IT, working with others, improving learning and performance and problem solving;
- to encourage the development of candidates' thinking skills, financial capability, enterprise and entrepreneurial skills;
- to encourage the development of candidates' understanding of work-related learning and the principles of sustainable design and production systems;
- to encourage candidates to consider how present and past design and technology, relevant to a designing and making process, affects society;
- to encourage candidates to consider the uses and affects of new technologies and modern materials on design and manufacture;
- to provide for activities which give candidates opportunities to work both individually and as a member of a team.

Most of these aims are reflected in the assessment objectives, others, due to their very nature, cannot be readily assessed.

3 Assessment Objectives

The assessment objectives are designed to reflect the programme of study for Design and Technology.

Within this specification candidates will need to demonstrate their ability to:

- develop, plan and communicate ideas;
- work with tools, equipment, materials and components to produce quality products;
- evaluate processes and products;
- understand materials and components;
- understand systems and control.

The GCSE Subject Criteria (QCA 2000) sets out three specification Assessment Objectives for the scheme of assessment :

AO1	Capability through acquiring and applying knowledge, skills and understanding of materials components, processes, techniques and industrial practice;
AO2	Capability through acquiring and applying knowledge, skills and understanding when designing and making quality products;
AO3	Capability through acquiring and applying knowledge, skills and understanding when evaluating processes and products; and examining the wider effects of design and technology on society.

Assessment Components 1-4 Terminal Examination papers

These will test candidates' specialist knowledge, skills and understanding of Industrial Technology through questions on the subject content (Section 5) outlined in the specification.

Assessment Component 5 Internal Assessment (coursework)

Internal Assessment (coursework) will test the knowledge, skills and understanding necessary to design and make a device capable of manufacturing products in quantity. The evidence required to be submitted for this task must include a 3 dimensional device with a concise portfolio and/or appropriate ICT evidence.

Internal Assessment will be evaluated against the following six internal assessment objectives: (see guidance 7.3.2.)

1 identify a need or opportunity that leads to a design brief;

2 conduct research into the design brief which results in a specification;

3 generate possible ideas for a solution;

4 develop the device for manufacturing products;

5 plan and realise the device;

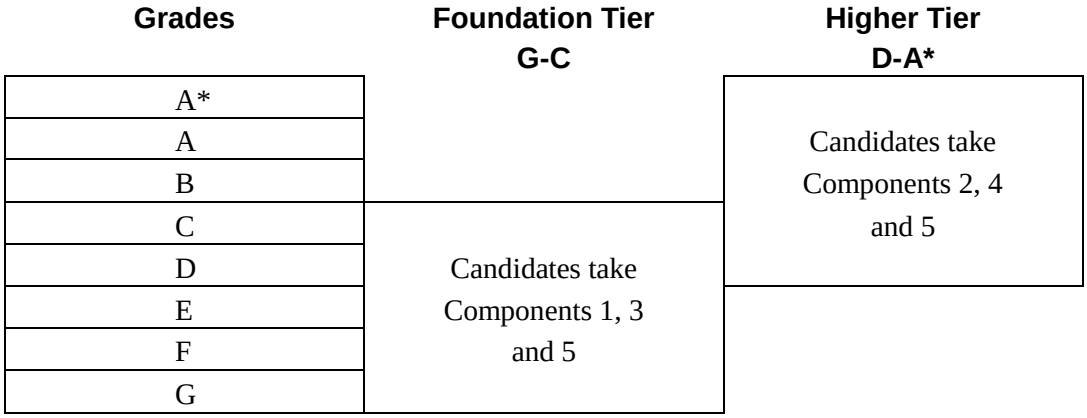
6 evaluate and test the device.

4 Scheme of Assessment

4.1 TIERS

The scheme of assessment consists of two tiers: Foundation Tier and Higher Tier. Foundation Tier assesses grades G to C and Higher Tier assesses grades D to A*. Candidates must be entered for either the Foundation Tier or the Higher Tier.

Under no circumstances will a candidate entered for the Foundation Tier be awarded a grade higher than grade C. Candidates on the Higher Tier who fail to achieve the minimum mark for the award of a grade D will normally be ungraded. There is however provision for those who narrowly fail to achieve this mark to be awarded a grade E.



4.2 COMPONENTS

Component	Name	Duration	Weighting
1	Paper 1	1 hour	20%
2	Paper 2	1 hour 15 mins	20%
3	Paper 3	1 hour	20%
4	Paper4	1 hour 15 mins	20%
5	Internal Assessment (Coursework)	40 hours	60%

4.3 QUESTION PAPERS

Each question paper will contain five questions reflecting the grades targeted. Responses from candidates will be required in the form of one word, sentences and sketches with supporting notes.

Papers will include product analysis questions based on information contained in the question paper.

A formulae sheet (OCR tables 2) is provided by OCR for candidate use in examination.

4.4 WEIGHTING OF ASSESSMENT OBJECTIVES (AO1, 2, 3)

The relationship between the components and the specification assessment objectives of the scheme of assessment is shown in the following grid.

Foundation Tier

Component	AO1	AO2	AO3	Total
1	4%	12%	4%	20%
3	4%	12%	4%	20%
5	12%	36%	12%	60%
Overall	20%	60%	20%	100%

Higher Tier

Component	AO1	AO2	AO3	Total
2	4%	12%	4%	20%
4	4%	12%	4%	20%
5	12%	36%	12%	60%
Overall	20%	60%	20%	100%

4.5 ENTRY OPTIONS

All candidate should be entered for 1959 with one of the following option codes:

Option Code	Title	Components
F	Foundation Tier	1, 3, 5
H	Higher Tier	2, 4, 5

4.6 INTERNAL ASSESSMENT (COURSEWORK)

The Internal Assessment will consist of **one** project where candidates will be expected to respond to one of the industrial technology capability tasks given in Section 6. This project requires a design and make activity related to industrial/commercial practices, and the appropriate application of systems and control.

Candidates must use appropriate ICT to help with their work, including computer-aided design and manufacture (CAD/CAM) software, control programs, data analysis and ICT based sources for research.

Through their project candidates must consider how relevant technology affects society and their own lives.

The evidence required to be submitted for this project must include a 3 dimensional device with a concise portfolio and/or appropriate ICT evidence. The whole activity must not exceed 40 hours of work.

If candidates work in groups, each candidate must take responsibility for a uniquely definable aspect of the overall project and undertake unique research, product design, manufacture and evaluation of that project aspect. Each candidate must provide unique evidence for assessment against the six internal assessment objectives with additional evidence in internal assessment objective 6 (evaluation and testing) to indicate the performance of the candidate's design within the context of the performance of the overall project.

Full details of the internal assessment objectives for internally assessed work can be found in Section 7.

4.7 ASSESSMENT OF PRESENTATION AND ICT

Overall presentation skills are assessed in the internally assessed component only. Please refer to guidance in Section 7.

The assessment of this course requires candidates to use ICT through preparing, presenting, and reviewing information as they work on their design ideas, developing models that communicate these ideas, and making using computer-aided manufacture (CAM).

4.8 DIFFERENTIATION

Differentiation will be achieved by tiered papers in the terminal examination and by task and outcome in the Internal Assessment. The internal assessment tasks undertaken by each candidate should reflect their capabilities. Exemplar tasks will be available. (See Section 6).

4.9 AWARDING OF GRADES

The written papers will have a total weighting of 40% and internal assessment a weighting of 60%.

A candidate's mark for each of the components taken will be combined in the appropriate weighting to give the candidate's total mark for the specification. The candidate's grade will be determined by this total mark.

Candidates achieving less than the minimum mark for grade G will be ungraded.

Candidates on the Higher Tier who fail to achieve the minimum mark for the award of a grade D will normally be ungraded. There is however provision for those who narrowly fail to achieve this mark to be awarded a grade E.

4.10 GRADE DESCRIPTIONS

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by the candidates awarded particular grades. The descriptions must be interpreted in relation to the content specified in Section 5; 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 overall assessment objectives. Shortcomings in some aspects of the assessment may be balanced by better performance in others.

Grade F

When applying their knowledge, skills and understanding to design and make products, candidates:

- draw on and use various sources of information;
- clarify their ideas through discussion, drawing and modelling;
- use their understanding of the characteristics of familiar products when developing and communicating their own ideas;
- work from their own plans, modifying them where appropriate;
- work with a range of tools, materials, equipment, components and processes with some precision;
- check their work as it develops and modify
- their approach in the light of progress;
- test and evaluate their products, showing that they understand the situations in which their designs will have to function and are aware of resources as a constraint;
- evaluate their use of basic information sources.

Grade C

When applying their knowledge, skills and understanding to design and make products, candidates:

- use a wide range of appropriate sources of information to develop ideas;
- use a range of strategies to develop ideas, responding to information they have identified;
- investigate form, function and production processes and communicate ideas, using appropriate media;
- recognise the needs of users and develop realistic designs;
- produce plans that make use of time and resources to carry out the main stages of making products;
- work with a range of tools, materials, equipment, components and processes, taking account of their characteristics;
- organise their work so that they can carry out processes accurately and consistently, and use tools, equipment, materials and components with precision;
- adapt their methods of manufacture to changing circumstances, providing a sound explanation for any change from the initial specification;
- select appropriate techniques to test and evaluate how their products would perform when used and modify their products in the light of ongoing evaluation to improve their performance;
- evaluate their use of information sources.

Grade A

When applying their knowledge, skills and understanding to design and make products, candidates:

- seek out and use information to help their detailed design thinking, and recognise the needs of a variety of client groups;
- are discriminating in their selection and use of information sources to support their work;
- they use a wide range of strategies to develop appropriate ideas, responding to information they have identified;
- investigate form, function and production processes and communicate ideas using a variety of appropriate media;
- recognise the different needs of a range of users when developing fully realistic designs;
- when planning, they make sound decisions on materials and techniques based on their understanding of the physical properties and working characteristics of materials;
- work from formal plans that make the best use of time and resources;
- work with a range of tools, equipment, materials and components to a high degree of precision;
- make products that are reliable and robust and that fully meet the quality requirements given in the design proposal;
- identify conflicting demands on their design, explain how their ideas address these demands and use this analysis to produce proposals;
- identify a broad range of criteria for evaluating and testing their products, clearly relating their findings to the purpose for which the products were designed and the appropriate use of resources;
- fully evaluate their use of information sources.

SECTION C: SPECIFICATION CONTENT

5 Introduction

During the key stage, candidates should be taught the knowledge, skills and understanding through: (N.C. order reference paragraph number)

- product analysis (6a);
- focused practical tasks that develop a range of techniques, skills, processes and knowledge (6b);
- design and make assignments, which include activities related to industrial practices and the application of systems and control. (6c).

This section is set out in column format to help teachers relate the requirements of the specification content with experiences that would be applicable.

Design and Technology, by its very nature, is continually developing. Teachers should be aware of new developments when preparing candidates for this examination.

The subject content in this section will be tested in the terminal examination. In addition candidates must address this content in their project work.

5.1 DESIGNING AND MAKING

5.1.1 Developing and Writing a Design Brief (1a)

 C1.2, C2.2, WO1.1, WO1.2, WO2.1, LP2.1, PS2.1

Candidates should be able to: (N.C. order reference paragraph number)		**Range of activities:**
(a)	provide a detailed description of the design need using various means of communication;	text, drawings, photographs, graphs, media clippings.
(b)	work from product design requirements, taking into account the needs of the customer/clients;	life styles, popular activities, media publicity, consideration of information, professional advice and market research to identify the situation and design brief.
(c)	identify the range of users and the market for which the product is intended; (1b)	enquiry of potential users, influences of trends, potential market possibilities.
(d)	develop a design brief for a manufacturing device.	a clear statement of design intention linked to either the candidates own interests, home, industrial practice or the community.

5.1.2 Drawing up a Specification

 IT1.1, WO1.1, WO1.2, WO2.1, LP1.1, PS1.1

Candidates should be able to:		Range of activities:
(a)	examine the intended purpose of the product;	consideration of existing products past and present.
(b)	identify and collect data relevant to the manufacturing device, its products and its users; (1b)	i.e. dimensions, ergonomics and anthropometric data, British and European standards e.g. ISO, BS, EN, DIN, CE mark.
(c)	consider issues that affect planning;	appropriate environmental and monetary costs.
(d)	identify and evaluate how existing devices fulfil the needs of their intended users;	market and product analysis, market surveys, in relationship to moral, social, economic, environmental and cultural factors.
(e)	demonstrate an ability to express the results of research and analysis in the form of a suitable detailed specification;	a written specification.
(f)	consider the capability required to manufacture products in batch quantity. (1c)	consideration of the system that would control production.

5.1.3 Generating Design Proposals

 IT1.2, IT2.1, WO1.1, WO1.2, WO2.1, LP2.2, PS1.2, PS2.1, PS2.2

Candidates should be able to:	Range of activities:
(a) generate and record a range of design proposals suitable for manufacturing in quantity; (1c)	ideas recorded in a combination of text and graphic techniques.
(b) identify within those proposals the resources needed for the solution to be realised; (1e)	materials, constructions and processes.
(c) evaluate their ideas against the specification and modify where necessary;	annotated comments about ideas.
(d) consider whether ideas meet the original need; (3a)	compare generated ideas with the design specification criteria.
(e) understand the relevance of function and aesthetics;	ergonomic, sensory and functional consideration of design ideas.
(f) use mock-up models to check on the feasibility of the idea;	simple modelling; use 2D/3D software.
(g) identify, with reasons for selection/rejection, the chosen design proposal(s) for development;	evidence to support choice and reasons for rejection.
(h) use graphic techniques and ICT, including computer-aided design (CAD), to generate, develop, model and communicate design proposals. (1g)	graphic techniques and computer aided design (CAD) used to generate, develop, model and communicate design proposals.

5.1.4 Product Development

 IT2.2, WO1.1, WO1.2, WO2.1, LP1.2, PS2.2

Candidates should be able to:		Range of activities:
(a)	conduct testing or trialling to make decisions on materials, production processes and selection of pre-manufactured standard components;	appropriate testing to determine: optimum sizes of product, materials, degree of accuracy, production method and appearance.
(b)	match materials and components with tools, equipment and processes when deciding how to manufacture the device; (1e)	determine all details needed to manufacture the manufacturing device and products in quantity taking notice of the relative costs of materials and components.
(c)	simulate production by developing a system to control the manufacture of products; (2e)	batch production methods applied to the manufacture of the final product, appropriate use of jigs and/or templates.
(d)	be flexible and adaptable in responding to changing circumstances and new opportunities; (1f)	adjusting and modifying parts of the design if required.
(e)	use graphic techniques and ICT, including computer-aided design (CAD), to generate, develop, model and communicate design proposals. (1g)	graphic techniques and computer aided design (CAD) used to generate, develop, model and communicate design proposals.

5.1.5 Product Planning

 WO2.2, LP1.1, LP2.1, PS2.2

Candidates should be able to:	Range of activities:
(a) produce and use a detailed plan of work including: • standard pre-manufactured items; • materials; • equipment; • tools and processes; • consideration of health and safety issues; against a realistic time schedule. (1d) (3b)	a proposed work plan which sets realistic deadlines and identifies critical points.
(b) prepare materials economically allowing for waste and fine finish and use standard pre-manufactured components appropriately.	efficient material preparation.

5.1.6 Tools and Equipment

Candidates should be able to use a range of tools, equipment and processes effectively and safely, including: (2a)	Range of activities:
(a) proper procedures for the preparation of materials; (4a)	use of datum edges/points/surfaces.
(b) correct use of marking-out, measuring and testing tools;	rule, engineers square, calipers, dividers, scriber, vee blocks, surface plate and gauge, combination square, vernier calipers, micrometers, centre punches and templates.
(c) correct use of tools, equipment and components for shaping, forming, cutting, joining, fitting, assembling and finishing;	matching tools and equipment to the materials and processes, maintenance of tools/equipment to include sharpening.
(d) safe working practices.	personal protection and the safety of others.
Use of drawing instruments	
Candidates should be able to use drawing instruments to achieve a good standard of graphical representation.	access to a minimum range of drawing instruments: drawing board (at least A3 in size) with either T-square or parallel motion, 30°/60° and 45 ° set square, protractor, compasses, 300mm rule, pencils, pens and erasers.
Use of drafting aids	
Candidates should be able to use drafting aids to develop good drafting techniques.	access to a minimum range of drafting aids: circle templates, ellipse templates, flexi curves or french curves.
Use of colouring media	
Candidates should be able to use colouring media to enhance drawings.	access to a minimum range of colouring media: coloured pencils and marker pens.
Use of tools and equipment for model making	
Candidates should be able to use tools and equipment to make 2 and 3 dimensional models.	access to scissors, craft knives, safety rules and cutting boards to cut paper, card, foamboard and styrofoam.

5.1.7 Processes

C1.2, N1.2

Candidates should be able to:	Range of activities
(4b)	
(a) work by wasting;	an understanding of hand wasting: sawing, cold chiselling, filing, drilling and an understanding of machine wasting (to include portable tools): abrading, metal turning, milling, drilling and polishing.
(b) work by deforming;	an understanding of forging, bending, vacuum forming and press work
(c) work by fabricating;	an understanding of temporary joints: machine screws, nuts and bolts, set pins, screw cutting; permanent joints: adhesive, dowel pin, rivet, braze, solder and weld.
(d) work by reforming;	an understanding of casting and injection moulding.
(e) assemble and fit parts correctly;	final adjustments to ensure the product functions.
(f) apply surface finishes;	an understanding of self-finishing and applied finishing; polish, lacquer, varnish, paint, dip-coat and commercial plating.
(g) use appropriate industrial applications when working with familiar materials and processes.	selecting the correct machine tool.

5.1.8 ICT Applications

 IT1.1, IT1.2, IT2.2, IT2.3

Candidates should:	**Range of activities:**
(a) understand how CAD/CAM is used in manufacturing;	i.e. industrial visits, books, videos etc.
(b) recognise that computer systems can control machines and equipment;	i.e. robotics used in production lines**.**
(c) understand how industry uses CAD/CAM in the manufacture of single items, batches and in quantity. (2d)	modern computer controlled production methods.

Candidates should use ICT where appropriate to:	
(a) desk top publish;	combine written information and graphics; produce a questionnaire.
(b) produce bar charts, pie charts etc from data;	present results in a graphical form.
(c) produce graphics;	use a paint or draw program to produce original art work including line, texture, colour.
(d) mould and size text, and/or graphics to suit requirements;	produce text in appropriate styles and sizes for presentation.
(e) aid Design and Technology activities;	use ICT appropriately to handle, model or communicate design proposals; (i) research from a database, use the internet; (ii) present data in the form of tables or graphics; (iii) use a spreadsheet for costing/modelling.
(f) utilise CAD; (1g)	create and manipulate a range of 2D/3D images, producing accurate drawings.
(g) utilise CAM.	machining centres, engravers, milling machines, lathes.

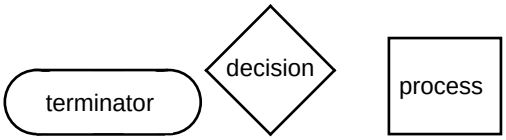
5.1.9 Industrial Applications

Candidates should be able to:		Range of activities:
(a) understand the following commercial production methods:		
job production;	(2b)	understand that this involves producing 'one off' products. Every item produced is different. It is labour intensive.
batch production;	(2c)	understand that this involves the production of a specified quantity of a product. Batches can be repeated as many times as required. This type of production method is flexible and can be used to produce batches of similar products with only a small change to the tooling. i.e. jigs, templates and patterns.
repetitive flow;		understand that this involves producing large numbers of identical products for a relatively low cost. The production is usually broken down into sub assemblies of smaller components. This form of mass production can be labour intensive or completely automated depending on the product being manufactured.
continual flow process.		understand that this involves uninterrupted 24 hrs/day production of a basic commodity such as steel, chemicals, oil or basic food products. This type of production continues because it is expensive to shut down and then re-start. Only a small workforce is needed to maintain the process.

(b)	understand the following commercial manufacturing systems:	
	cell production;	understand that this is a number of work stations grouped to produce a single component.
	in-line assembly;	understand that this is used to mass produce many everyday items especially cars. Many in-line assembly systems are fully automated and only require people to ensure continual flow.
	just in time;	this philosophy requires materials, pre-manufactured components and sub-assemblies to arrive from other factories 'just in time' for production. Finished products are despatched immediately they are made. This system reduces any storage of stock and allows for changes to the product to be made quickly without the need to use up stock items first.
	concurrent engineering;	the concept of developing a product idea from customer requirements to a finished items with maximum efficiency. The CE concept enables various specialists to contribute without waiting for the previous person to finish, enabling the whole project to evolve and progress.
	logistics.	understand that the production of products relies upon the availability of materials and components when required.
(c)	understand the packaging, marketing, and advertising implications of a product;	information about the product, consumer preference, legislation, labelling, legal requirements, storage, distribution, cultural and European influences.
(d)	understand that control is a necessary part of production and marketing. (2c)	procedures to ensure a quality product quality guarantees, consumer rights e.g. ISO 9000. understand that quality control helps to ensure that the customer is satisfied with a product. understand that a product should meet the criteria listed in the specification.

5.1.10 Good Working Practice

WO2.2, LP1.1, LP2.2, LP2.3

Candidates should be able to:	Range of activities:
devise strategies to make effective use of available resources to:	When planning their work candidates should be able to:
(a) produce process and block diagrams;	identify available materials, components, equipment and facilities; establish an order for work, identifying subtasks that need to be done first; organise their work to maximise the use of available time and resources.
(b) produce time plans and work schedules; (1d)	produce time plans, flow charts using standard symbols; 
(c) carry out testing, evaluation and modifications. (3b)	simple trialling of products; results collected, charted and analysed; relevant modifications made.

5.1.11 Product Evaluation

 C2.1a, WO1.3, WO2.3, LP2.3, PS1.3, PS2.3,

Candidates should be able to:	Range of activities:
(a) review their work at critical points and apply quality assurance techniques; (3b)	regular checks to ensure a quality outcome.
(b) evaluate the proposed manufacturing device and products against: their fitness for purpose; the design need; the needs of the intended user(s). (3c)	critical evaluation related to initial specification and use of resources.
(c) evaluate the proposed manufacturing device and products against moral, cultural and environmental issues for the intended user;	sustainable sources of material supply and disposal/recycling of redundant devices and products.
(d) review whether they have used materials and resources appropriately;	detailed testing with meaningful conclusions.
(e) carry out testing, resulting in conclusions that suggest necessary modifications; analyse the performance of the manufacturing control system.	proposal for further development, suggest modifications or improvements to: (i) product; (ii) jig, template or pattern.

5.2 KNOWLEDGE AND UNDERSTANDING

A comprehensive understanding of the nature of the materials and components available to the engineer is fundamental to the success of any engineering outcome. This specification focuses upon metals and plastic materials and components of a mechanical engineering nature. Material and component development is rapid however and the use of new 'smart' engineering materials and components other than those specified should be encouraged.

5.2.1 Materials and Pre-manufactured Standard Components (4a, 4b, 4c, 4d, 4e)

Candidates should:

- be able to identify which material is suitable for a particular situation;
- be able to identify the properties that materials (included applied finishes) need to have to fulfil an identified purpose;
- have an understanding of the nature of the materials and pre-manufactured standard components available to the engineer;
- be aware of the effects on society of using materials in terms of pollution, waste and recycleability.

Candidates should have a knowledge and understanding of metals, plastics and composites to include the following:

- **general classification of materials:** i.e. ferrous/non ferrous, hard/softwood, thermoplastic, thermosetting plastics and composites;
- **working properties:** the making of simple comparisons between these materials in relation to strength, hardness, toughness, weight, plasticity, thermal conductivity and aesthetic qualities;
- **market forms:** the shapes and sizes, (general, not specific) of sections of these materials and knowledge of their comparative cost;
- **standard pre-manufactured components:** fastenings and fittings.

Metals

In relation to metals, principally cast iron and steel (ferrous) and copper, aluminium, tin and their alloys (non-ferrous), candidates should understand:

- identification by appearance and comparative weight;
- working properties in relation to hand processes and machining;
- mechanical and physical properties;
- how the carbon content of steel affects its working properties and characteristics;
- that high carbon steel can be hardened and tempered to suit a particular application;
- how to use carbon steel in its various states of carbon content e.g. high, medium, low;
- annealing and work hardening processes in relation to non-ferrous metals;
- how copper is alloyed to zinc and tin to form a range of brasses and bronzes;
- the industrial applications of steels, copper based alloys and aluminium alloys;
- the bending and shaping of different section material including tube.

(a) Know how to shape and join various types of metals in a variety of forms:

- material preparation – marking out and checking;
- wasting – filing, sawing, cutting, drilling, machining;
- deforming – bending;
- fabrication – soldering, brazing, welding; riveting, screws, nuts and bolts;
- reforming – casting.

(b) Know how materials can be combined and processed to create more useful properties:

- heat treatment of metal to alter its properties – annealing, harden and tempering, case hardening, work hardening.

(c) Know how to prepare for manufacture ensuring economical use of material:

- material preparation – marking out;
- use of appropriate section/size of materials e.g. using standard preferred sizes.

(d) Have an awareness of the importance of self-finishing and applied finishing:

- paint;
- polishing;
- dipcoating.

(e) Understand that to achieve the best use of materials and components the interrelationship between material, form and manufacturing processes must be considered carefully:

- matching the material to the desired form;
- matching the material to the manufacturing process;
- ensuring minimal waste.

(f) Understand the use of pre-manufactured standard components:

- make use of standard types and sizes of pre-manufactured standard components;
- recognise the economic benefits(in relationship to production) from the use of pre-manufactured standard components across a range of products.

Plastics and Composites

In relation to plastics candidates should understand:

- identification by appearance and test including bending, specific gravity and scratch tests;
- applications and uses of thermoplastics including acrylonitrile butadiene styrene (ABS), polymethyl methacrylate (acrylic), polyvinyl chloride (PVC), polyamide (nylon) and high impact polystyrene (HIPS).

(a) Know how to shape and join various types of plastics in a variety of forms:

- material preparation – making out and checking;
- wasting – filing, sawing, cutting, drilling, machining;
- fabrication – joining, permanent/temporary;
- deforming – bending, laminating, vacuum forming;
- reforming – injection moulding.

(b) Know how materials can be combined and processed to create more useful properties:

- use of glass reinforced plastics;
- use of fillers in resins.

(c) Know how to prepare for manufacture ensuring economical use of material:

- material preparation – marking out;
- use of appropriate type, section and size of materials.

(d) Have an awareness of the importance of self-finishing and applied finishing:

- polishing;
- fine finishing (using silicone carbide paper).

(e) Understand that to achieve the best use of material and components the interrelationship between material, form and manufacturing processes must be carefully considered:

- matching the material to the desired form;
- matching the material to the manufacturing process;
- ensuring minimal waste.

(f) Understand the use of standard pre-manufactured components:

- use standard pre-manufactured components and parts appropriately;
- understand the economic benefits from the use of standard components across a range of products to save design and production time and therefore reduce costs.

'Smart' and Modern Materials

(a) Know that some 'Smart' materials respond in a certain way to changes in temperature or light:

- shape memory alloy (nitinol) used to give mechanical movement when a set temperature is reached;
- low temperature setting plastic (polymorph) can be moulded or reshaped using hot water.

(b) Know how materials can be combined and processed to create more useful properties:

- use of modern materials in traditional applications e.g. use of carbon fibre in fishing rods and kevlar in safety protection helmets.

(c) Be aware of other 'Smart' and modern materials as they become commercially available.

5.2.2 Systems and Control (5a)

Candidates should develop an understanding of control systems, to include:

- the knowledge that a system has three elements; input – process – output;
- the ability to analyse, design and use simple systems and sub systems;
- how control can be designed, used and sub-systems interconnected to control production processes e.g. drilling machine; machining centre;
- the importance of feedback to control their own batch production system. i.e. jig, former, template, pattern, mould or computer system;
- an analysis of the effectiveness of the performance of the system i.e. consumer feedback.

Candidates should:

- be able to understand that a mechanism transforms an input motion and force into a desired output motion and force;
- be able to select and use mechanisms to bring about required changes and control movement;
- be able to identify and describe the following types of motion in mechanical systems:
  (i) linear;
  (ii) reciprocating;
  (iii) rotary;
  (iv) oscillating.

Candidates should be able to identify and describe mechanisms that:

(i) turn motion through a right angle;
(ii) reverse the direction of motion;
(iii) change linear motion into rotary motion;
(iv) change rotary motion into reciprocating motion.

5.2.3 Products and Applications (6a)

Candidates should be able to carry out a product analysis of commercially manufactured devices and their applications. The process should include the following:

- establishing the function and application/s of the device;
- identifying the constituent parts of the device and their interrelated functions;
- establishing how the device works including any scientific principles involved;
- identifying the materials from which the device is manufactured;
- identifying the manufacturing processes used to make the device;
- establishing the intended market for the device;
- assessing the performance of devices against alternative solutions;
- testing devices using existing information regarding materials and processes.

5.2.4 Quality (2c, 3d, 3c)

Candidates should understand how to distinguish between quality of design and quality of manufacture by drawing on their experience and understanding including:

- an understanding of procedures that could be set during production to ensure control over quality;
- how far it satisfies its needs and fulfils its purpose i.e. a well made drilling jig that is dangerous to use;
- when assembling devices, candidates should understand the importance of accuracy;
- the appropriate use of resources and materials in relation to manufacture and maintenance e.g. use of aluminium for ladders and hardened steel for a drilling jig.
- how it meets manufacturability and maintenance requirements;
- social, moral, economic, environmental and aesthetic implications i.e. advantages and disadvantages of plastic injection moulding for mobile phone cases, consideration of the style of a product, its manufacture, disposal and recycling of materials and components.

5.2.5 Health and Safety (2a)

Candidates should understand health and safety as designers, manufacturers and consumers to include:

(a) as designers and consumers:

- correct selection of materials and finishes;
- safety in terms of function and product maintenance;
- producers within the working environment.

(b) as producers within the working environment

- storage and use of tools and equipment;
- materials, chemicals, solvents, finishes;
- flammable and toxic substances.

(c) personal safety:

- protective wear including eye protection, clothing;
- machine guards;
- dust and fume extraction;
- disposal of waste;
- use of barrier creams;
- accident procedure.

(d) risk assessment – using information sources:

- COSHH e.g. fumes given off by some adhesives;
- instructions relating to the use of consumables i.e. 'Loctite'; 'Tensol' cement;
- instructions relating to the use of unfamiliar equipment e.g. portable power tools;
- recognition and understanding of safety symbols (UK and European).

(e) environmental effects:

- the sustainable sources of materials;
- the disposal of chemicals used to manufacture products;
- the reduction in the use of chemicals dangerous to the environment i.e. bleaches, CFC's, toxic materials;
- the need to dispose of redundant products in a safe and environmentally friendly way;
- the need to re-cycle materials and pre-manufactured standard components appropriately.

SECTION D: COURSEWORK

6 Coursework Tasks

6.1 NATURE OF COURSEWORK

Candidates are required to produce an Industrial Technology product that can be marketed. The underlying influence on the project should be that the product will be the first of a batch of 50,realised in school/college with the facilities that are available. The candidate will realise the first, or the prototype of this product.

The evidence required to be submitted for assessment must include a 3 dimensional device with a concise portfolio (including evidence of modelling) and/or appropriate ICT evidence. Centres are reminded that ICT evidence must address the requirements of the six Internal Assessment Objectives. Evidence which does not lead to a finished product can be assessed if it is felt that it represents work appropriate to the focus of the project.

This project will be assessed positively against the following six internal assessment objectives:

1 identify a need or opportunity that leads to a design brief;

2 conduct research into the design brief which results in a specification;

3 generate possible ideas for a solution;

4 develop the product for manufacture;

5 plan and realise the product;

6 evaluate and test the product.

It is envisaged that the coursework project presented for assessment will represent 40 hours of work for the GCSE full course. Some of the work, by its very nature, may be undertaken outside school e.g. research work, testing etc.

6.2 COURSEWORK TASKS – INDUSTRIAL TECHNOLOGY CAPABILITY TASKS

This specification requires candidates to complete one of the following six Industrial Technology capability tasks (Section 6.3).

If, however, candidates wish to develop their own Industrial Technology capability task then it **must** conform to the criteria given below **and** be submitted for approval.

In order to contact coursework consultants, Centres should use Cousework Task Proposal forms supplied to Centres in a Coursework Administration Pack or download the form from the OCR website: www.ocr.org.uk.

Industrial Technology capability task criteria:

- The device produced must be capable of manufacturing or assisting in the manufacture of another product. It is the product being produced and **not** the device itself that forms the 'production in quantity' requirement of this specification.
- The device should be capable of producing the product in consistent quantity and quality.
- The device must be a quality 'engineered product'.
- The proposal should be achievable by the candidate in 40 hours.

6.3 EXPANSION OF CAPABILITY TASKS

Additional information applicable to all Industrial Technology capability tasks:

In addition to information contained elsewhere in this specification candidates' design folders should show evidence of:

- consideration of the systems and technologies associated with industrial manufacturing in quantity and an understanding of the application of control to systems both technological and process;
- the appropriate application of mathematical and scientific knowledge and understanding;
- where applicable, calculations in respect of levers, cams, pulleys, gears, velocity ratio, mechanical advantage etc;
- where pneumatic systems are employed, calculations in respect of force and system operating pressures etc;
- where electrical or electronic systems are employed, calculations in respect of voltage, current flow and components etc;
- appropriately charted results and conclusions drawn from trials and experiments that may have been carried out in relation to the performance of materials, components and/or systems etc. Data logging software and spreadsheets should be used where appropriate.

1. Embossing Tool for Business Cards

Candidates are required to design and make a hand operated embossing tool for business cards.

Candidates are **not** required to design or make the embossing die. For trialling, testing and evaluating a standard 6mm DIA mild steel washer can be used as the embossing die and this can be secured to the tool using any suitable adhesive. Candidates should be advised that for best results when embossing card, they should lightly spray the card with water to dampen it.

Points to consider in relation to Assessment Objective 1 to ensure that candidates are assisted towards a sound start:

- research should be carried out into the embossing process, the terms used in embossing, how the process is applied to a range of materials and into business cards, their uses, and their method of manufacture;
- the product design specification should be appropriate to the product and to the application of the product within a quantity production system for business cards in order that repeated quality and accuracy can be assured;
- candidates should identify and collect appropriate data from the investigation, analysis and evaluation of existing similar products.

2. An Injection Moulding Die

Candidates are required to design and make an injection moulding die to produce small plastic artefacts or components.

The component produced by the moulding die should be determined by the candidate as a result of research, but it should be one that has a three dimensional form, such as a container or connecting piece for a tubular structure. For testing and evaluating an ordinary hot melt glue gun can be used to make prototype components using PVA hot melt glue.

Points to consider in relation to Assessment Objective 1 to ensure that candidates are assisted towards a sound start:

- research should be carried out into the process of injection moulding and its wide commercial application;
- candidates should carry out experiments and trials around the injection moulding process using hot melt PVA glue;
- candidates should ensure that their product application for the injection moulding process is suitable and achievable;
- the product design specification should be appropriate to the application of the product and should take into account a system for quality production of the moulded components and how repeated quality and accuracy can be assured;
- candidates should identify and collect appropriate data from the investigation, analysis and evaluation of existing similar products.

3 A Hole Punch for Sheet Aluminium

Candidates are required to design and make a hand operated hole punch for aluminium that can be used by Key Stage 3 pupils in schools to enable them to make their own 'bolt together' modelling kit.

Points to consider in relation to Assessment Objective 1 to ensure that candidates are assisted towards a sound start:

- research should be carried out into the processes of punching holes through sheet metal materials that are used industrially in the manufacture of cars and domestic appliances such as cookers and washing machines;
- research should be carried out into the application of prototyping kits within technology education and consideration given to the following points:
- the thickness of the material that is appropriate, and/ or how thin material could be suitably stiffened; the range of sizes of sheet and strip material used for construction;
  the range of hole sizes required.
- the product design specification should be appropriate to the application of the product and should take into account a system for quantity production and how repeated quality and positional accuracy of holes can be assured;
- candidates should identify and collect appropriate data from the investigation, analysis and evaluation of existing similar products.

4. A Pneumatically Operated Clamp

Candidates are required to design and make a low pressure pneumatic clamp that will act as a 'third hand' for holding printed circuit boards to assist in their manufacture.

Candidates may use either an installed pneumatic system or a low pressure 'foot pump and pop bottle' type of system. Pneumatic cylinders or 'air muscles' may be used.

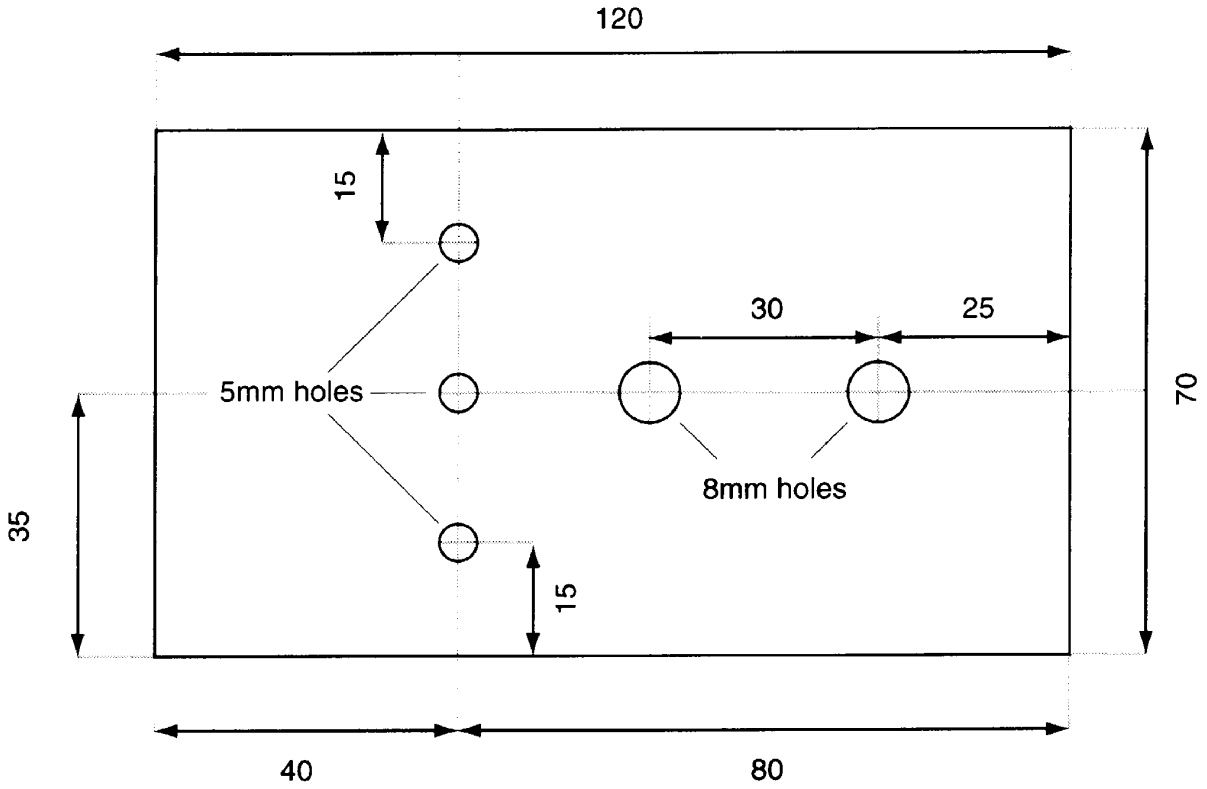
Points to consider in relation to Assessment Objective 1 to ensure that candidates are assisted towards a sound start:

- research should be carried out into the application of pneumatic systems within manufacturing industry. This research should be limited to areas associated with clamping and work holding;
- candidates should carry out experiments and trials to determine the appropriate clamping forces for holding PCB boards and how these might be achieved through mechanical interfacing using low pressure pneumatics. Low pressure can be regarded as typically 3 bar;
- the product design specification should be appropriate to the application of the product and should take into account a system for quantity production of PCBs and how repeated quality and accuracy can be assured;
- candidates should identify and collect appropriate data from the investigation, analysis and evaluation of existing similar products.

5. A Quick Release Clamp

In production situations, material often has to be secured and released quickly to carry out various operations.

A manufacturer of control panels needs to drill a series of 5mm and 8mm holes in 3mm thick plastic and plastic laminate material measuring 120mm x 70mm. (see diagram).



Because a large number of control panels have to be produced, up to four at a time will be held by a quick release clamp, for drilling. To ensure consistency of hold alignment a 6mm thick metal template, with the hole positions drilled, will be placed over the plastic sheets.

The metal template and plastic sheets will be clamped together securely before being transferred to a drilling machine where the assembly will be held by hand.

Candidates are required to design and make a suitable quick release clamp method and jig(s) that will quickly and consistently align and clamp the sheets with the template.

Because the number of plastic sheets may vary the clamp must have some way of accommodating between one and four sheets at a time along with the template.

For testing purposes the template can be made form 6mm plywood or MDF.

If the chosen design requires the use of two or more identical clamps then only one should be produced.

Points to consider in relation to Assessment Objective 1 to ensure that candidates are assisted towards a sound start:

- research should be carried out into the use of clamping devices within manufacturing industry;
- candidates should carry out experiments and trials to determine the appropriate clamping force required for the application;
- the product design specification should be appropriate to the application of the product and should take into account a system that enables the repeated processing of several control panels under one template with consistent quality and accuracy;
- it is **not** required to produce a system to mass produce the quick release clamp;
- candidates should identify and collect appropriate data from the investigation, analysis and evaluation of existing similar products.

6. An Adjustable Storage and Display System

Modern retailing requires maximum use to be made of space.

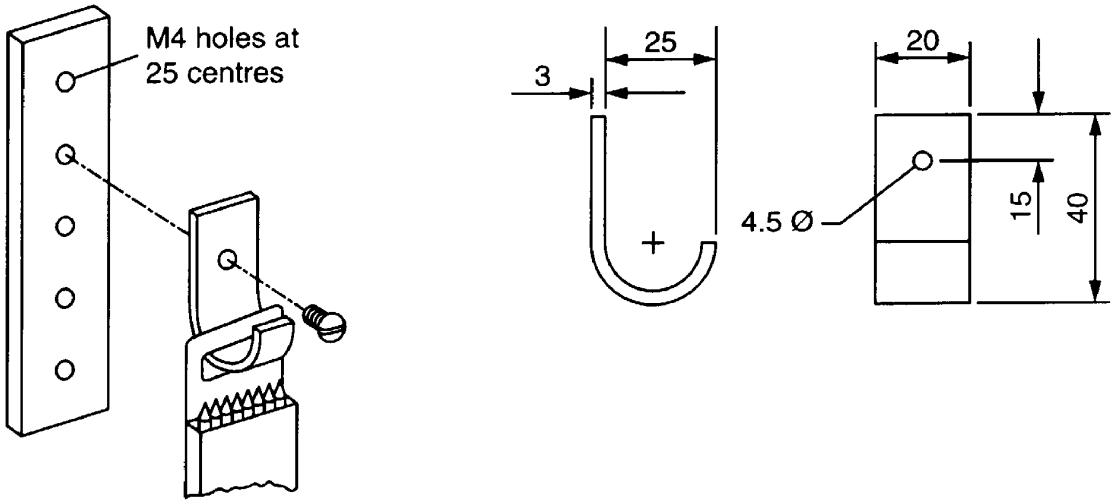
Storage and display units are often combined so that customers can see the product and easily remove it from the display.

An office consumable manufacturer has decided to package products in clear plastic sleeves. Each sleeve has an identical slotted top to enable it to be attached to a storage/display unit.

The chosen unit has a series of vertical strips with M4 tapped holes at 25mm centres.

Hooks (see diagram) are attached to the vertical bars in the required positions with an M4 round head machine screw.

The product sleeves are attached, via the slotted top, to the hook.



Since all the sleeves have the same size slot a number of identical hooks are required.

Candidates are required to:

Design and make a suitable device that will produce a number of hooks from 20 X 3mm aluminium strip.

Points to consider in relation to Assessment Objective 1 to ensure that candidates are assisted towards a sound start:

- research should be carried out into the use of folding machines within manufacturing industry;
- the product design specification should be appropriate to the application of the product and should take into account a system that enables the repeated manufacture of identical hooks;
- it is not required to produce a system to mass produce the bending device.

7 Regulations for Internal Assessment

7.1 SUPERVISION AND AUTHENTICATION OF COURSEWORK PROJECTS

OCR expects teachers to supervise and guide candidates who are undertaking work which is internally assessed (e.g. coursework project). The degree of teacher guidance in candidates' work will vary according to the work being undertaken. It should be remembered, however, that candidates are required to reach their own judgements and conclusions.

When supervising internally assessed coursework project, teachers are expected to:

Offer candidates advice about how best to approach their work.

Exercise continuing supervision of work in order to monitor progress and to prevent plagiarism.

Ensure that the work is completed in accordance with the specification requirements and can be assessed in accordance with the internal assessment objectives and procedures.

Internally assessed coursework projects should be completed in the course of normal curriculum time and supervised and marked by the teacher. Some of the work, by its very nature, may be undertaken outside the Centre e.g. research work, testing etc. As with all internally assessed work, the teacher must be satisfied that the work submitted for assessment is the candidate's own work.

7.2 PRODUCTION AND PRESENTATION OF INTERNALLY ASSESSED COURSEWORK PROJECTS

Candidates must observe certain procedures in the production of internally assessed work.

Any copied material must be suitably acknowledged.

Quotations must be clearly marked and a reference provided wherever possible.

Work submitted for moderation must be marked with the:

Centre number
Centre name
Candidate Number
Candidate Name
Specification title and code i.e: OCR GCSE in Design and Technology (Industrial Technology) 1959
Coursework project title.

7.3 MARKING CRITERIA FOR INTERNALLY ASSESSED WORK

This specification requires candidates to demonstrate fully their design and technology capability. They should combine skills with knowledge and understanding in order to design and make quality products.

The assessment objectives:

- of materials, components, processes, techniques and industrial practice (AO1)
- for designing and making quality products (AO2)
- for evaluating processes and products and examining the wider effects of design and technology on society (AO3)

are assessed, in an integrated way, through the six **Internal Assessment Objectives** shown below.

Internal Assessment Objectives		Specification Assessment Objectives		
		AO1	**AO2**	**AO3**
1	Identification of a need or opportunity leading to a design brief		**2**	**2**
2	Research into design brief resulting in a specification	**2**	**6**	**4**
3	Generation of design proposals	**2**	**8**	**2**
4	Product development	**6**	**4**	**2**
5	Product planning and realisation	**10**	**40**	**2**
6	Evaluation and testing			**8**
	Total Marks	**20**	**60**	**20**

The weighting of the marks provides an indicator of the time that candidates should spend on each part of the project.

It is envisaged that the coursework project presented for assessment will represent 40 hours work for the Full Course GCSE. Some of the work, by its very nature, may be undertaken outside school e.g. research work, testing etc.

7.3.1 Assessment of the Overall Presentation of the Coursework Project

This specification provides for an assessment of the overall presentation of the coursework project. Marks are awarded on the basis of a candidate's overall performance in presenting work throughout the project portfolio. Details are given in Section 7.3.4.

7.3.2 Guidance for Teachers

It is appreciated that for assessment purposes, the Internal Assessment Objectives have been written in a linear form. However, within focus areas of Design and Technology, some stages may interrelate and be cyclical in approach.

This specification requires candidates to produce a device that is capable of producing a batch of quality products with the facilities that are available. It is **not** the device itself that has to be produced in quantity.

Centres may chose from the capability tasks suggested by OCR (see Section 6) or they may make a submission for a suggested task, to be approved by OCR.

This capability task allows candidates to demonstrate their designing and making skills, together with providing further opportunity to demonstrate knowledge and understanding. It is important that the task chosen is appropriate to the candidates ability and is within the production capabilities of the centre. The use of appropriate engineering materials (metals and plastics) is also essential to a successful outcome.

Candidates' capability tasks should show evidence of designing and making that includes:

- problem analysis that investigates the need and then results in a clear, concise design brief;
- purposeful research that will lead to a detailed design specification, covering aspects of the device itself and the product it is to produce;
- the generation of a range of design proposals;
- develop one of or a combination of these initial proposals into a final design. Include a control system for the manufacture of a batch of products using their device;
- produce a work plan, against time, for the making of their device and control system;
- a quality engineered device that will produce quality products in quantity;
- thoughtful evaluation of the device and of the products produced, which will include review of the outcomes and suggested improvements, as well as reviews of resources and production methods used.

Folder work needs to show evidence of a range of appropriate techniques for communicating ideas and information. This will include ICT. In particular, appropriate use of CAD (computer aided design and computer aided drawing) and 2D and/or 3D modelling. The outcome may include the use of CAM (computer aided manufacture) in part of the making. Where appropriate, candidates should consider the case of ‘smart’ and modern materials.

7.3.3 Applying the Internal Assessment Objectives to Candidates' Work

Each internal assessment objective has four 'level of response' boxes containing hierarchical statements. Initially a 'best fit' should be established and the mark awarded within the appropriate mark range.

The marks have been broken down into ranges of marks for the hierarchical statements within each level of response box.

This breakdown enables positive marking of a coursework project by allowing the teacher to match statements from any of the level of response boxes against the evidence offered by the candidate.

This approach can be applied to each assessment objective using the marks in brackets [ ] as indicated.

For example when marking internal assessment objective 5, a project may reflect:

Little or no planning	[3]
Has overcome problems as they arise etc	[6]
With a normal level of supervision, has combined a range of skills and techniques etc.	[9]
The product will exhibit a reasonable standard etc	[8]
Total Mark	**26**

Internal Assessment Objective 1

TOTAL MARKS 4

Identification of a Need or Opportunity leading to a Design Brief	**Level of Response**	**Mark Range**
Candidates will need to: • provide a description of the design need using various means of communication; • identify the range of users and the market for which the manufacturing device is intended; • develop a design brief for the manufacturing device.	A statement of what is to be made.	**0-1**
	Some consideration of the design need or the intended user/users leading to a design brief.	**2**
	Consideration of both the design need and the intended user/users leading to a clear design brief for a device to manufacture products.	**3**
	Detailed description of both the design need and user/users leading to a clear and precise design brief a device to manufacture products.	**4**
	Total	**4**

Internal Assessment Objective 2

TOTAL MARKS 12

Research into the Design Brief which results in a Specification	**Level of Response**		**Mark Range**
Candidates will need to: • examine the intended purpose of the device; • undertake appropriate surveys, identifying and evaluating how existing devices fulfill their intended use; • identify and collect data relevant to the device, its product(s) and its use; • develop a detailed specification for a device with the capability for batch production of products.	Limited research of intended use. Some recognition of existing devices. A specification identifying some basic requirements.	[1] [1] [1]	**0-3**
	Intended use of the device examined with some data identified or collected. Existing devices identified with some evaluation. A specification identifying some key features including a suggestion of how the device will manufacture products in batches.	[2] [2] [2]	**4-6**
	Intended use of the device examined with data identified and collected. Existing devices identified and evaluated considering some aspects of their intended use. A detailed specification containing some reference to a system required to enable the device to manufacture products in batches.	[3] [3] [3]	**7-9**
	Intended use of device fully examined with relevant data identified and collected. Existing devices identified and fully evaluated against their intended use. Analysis of the research leading to a detailed design specification that would provide a system to ensure control over the production of its product in batches.	[4] [4] [4]	**10-12**
		Total	**12**

Internal Assessment Objective 3

TOTAL MARKS 12

Generation of Design Proposals	Level of Response		Mark Range
Candidates will need to: • generate a range of design proposals; • check design proposals against design specification and review and modify them if necessary; • identify chosen design proposal for development; • present design solutions using a range of graphic techniques and ICT including computer-aided design (CAD), to generate, develop, model and communicate design proposals.	One or more solutions proposed. Little or no evaluation. The work displays a low standard of communication techniques.	[1] [1] [1]	**0-3**
	Several solutions proposed. A cursory evaluation. Unsupported choice of design proposal. Communication will be of a reasonable standard using a limited number of techniques.	[2] [2] [2]	**4-6**
	A range of appropriate solutions proposed. Design proposal chosen, supported by clear evaluation. Communication will be of a good standard, using a range of appropriate techniques.	[3] [3] [3]	**7-9**
	A wide range of appropriate solutions proposed. A proposal chosen as a result of detailed evaluation and consideration of the design specification and design criteria. Communication will be of a high quality, using a wide range of appropriate techniques.	[4] [4] [4]	**10-12**
		Total	**12**

Internal Assessment Objective 4

TOTAL MARKS 12

Product Development	**Level of Response**		**Mark Range**
Candidates will need to: • as a result of investigation, testing or trialling, make reasoned decisions about: materials; production methods; pre-manufactured standard components. • consider how materials are prepared for manufacture and how pre-manufactured standard components are used; • by modelling, apply test procedures ensuring the device meets the original design brief and specification; • consider when developing the device, the implications for quantity manufacture of its product; • match materials and components with tools, equipment and processes, taking account of critical dimensions and tolerances when deciding how to manufacture the device; • develop a control system for the manufacture of products using their device; • be flexible and adaptable in responding to changing circumstances and new opportunities; • make any necessary modifications to the chosen design; • give details of the final design including a final specification; • present design solutions using a range of graphic techniques and ICT including computer-aided design (CAD), to develop, model and communicate design proposals.	Some materials and production methods identified. Has attempted to model part of final solution. Limited details given for final solution.	[1] [1] [1]	**0-3**
	As a result of investigations some decisions made about materials, production methods function and pre-manufactured items. Has used modelling to check that the device meets the design brief. Some important details given about the final device and how more than one of its products could be made.	[2] [2] [2]	**4-6**
	Some testing and trialling resulting in decisions about materials, production methods and pre-manufactured items. Used modelling and testing to ensure that the device meets the design brief. Most details given about final device and the control system needed to produce its product in quantity.	[3] [3] [3]	**7-9**
	Appropriate testing and trialling resulting in reasoned decisions about materials, production methods and pre-manufactured items. Has used modelling and test procedures to identify any necessary modifications and to ensure the device meets the design brief. Full details about the final device and the control system needed to produce its product in quantity.	[4] [4] [4]	**10-12**
		Total	**12**

Internal Assessment Objective 5

TOTAL MARKS 52

Product Planning and Realisation	Level of Response		Mark Range
Candidates will need to: • produce a plan of action which considers: materials, pre-manufactured items, equipment, processes and health and safety issues against an order of work and the need to match the design specification; • select and use tools, equipment and processes effectively and safely; • economically prepare materials/ pre-manufactured items for production, allowing for waste and fine finish; • complete a quality outcome suitable for its intended use, ensure that the outcome functions effectively; • be prepared to adapt working procedures in response to changing circumstances; • use a range of skills and techniques appropriate to the task; • apply a range of industrial techniques when working with familiar materials and processes.	Little or no planning. Has used a limited range of materials, tools and equipment With frequent prompting uses basic skills and techniques appropriate to the task. Little understanding of safe working practices. The device will exhibit a low standard of outcome and may not be successfully completed.	[3] [3] [3] [4]	**0-13**
	Planning will have been restricted to the immediate task and will have relied on prompting. Has overcome problems as they arise using appropriate materials, tools and equipment. With some guidance has used a range of skills and techniques appropriate to the task. Reasonable understanding of safe working procedures. The device will exhibit a reasonable standard of outcome, be mainly complete and will satisfy the specification with a limited degree of success.	[6] [6] [6] [8]	**14-26**
	Most of the realisation will have been planned in advance Has made economic and efficient use of materials, tools and equipment modifying the application of these if appropriate. With a normal level of supervision, has combined a range of skills and techniques appropriate to the task. Good understanding of safe working procedures. The device will exhibit a good standard of outcome, will be complete and will function as intended.	[9] [9] [9] [12]	**27-39**
	The realisation will have been thoroughly planned to specify an effective order for the sequence of operations. Resourceful and adaptable with materials, tools and equipment and to a high degree of precision. Has independently combined a range of skills and techniques appropriate to the task. High understanding of safe working procedures. The device will be completed to a high quality and will fully meet the requirements of the final specification.	[12] [12] [12] [16]	**40-52**
		Total	**52**

Internal Assessment Objective 6

TOTAL MARKS 8

Evaluation and Testing	Level of Response		Mark Range
Candidates will need to: • evaluate their products to ensure that they are of a suitable quality for intended users • evaluate the device and its product against the specification • carry out testing, resulting in reasoned conclusions that suggest any necessary modifications to improve the device • review whether they have used resources appropriately e.g. time, materials, equipment, and production methods. • analyse the performance of their manufacturing control system	Relevant un-supported comment with some reference to the specification. No evidence of testing.	[1] [1]	**0-2**
	Some supported comment with reference to the specification and use of resources. Superficial testing with a conclusion.	[2] [2]	**3-4**
	Relevant comments with reference to the specification and use of resources. Relevant testing with few conclusions, leading to a possible modification or improvement of the device and/or system designed to control the quality of the manufactured products.	[3] [3]	**5-6**
	Critical evaluation related to the specification and use of resources. Detailed testing with meaningful conclusions leading to proposals for further development, modification or improvement of the device and system designed to control the quality of the manufactured products.	[4] [4]	**7-8**
		Total	**8**

7.3.4 Assessment of the Overall Presentation of the Coursework Project

An assessment of the overall presentation of the project is provided for the internally assessed component of this specification.

Marks are awarded on the basis of a candidate's overall performance in presenting work throughout the project portfolio. Performance criteria are given below to assist with the allocation of marks.

Teachers should first assess the candidate's project portfolio against the six **Internal Assessment Objectives.** The performance criteria for presentation should then be applied, and marked according to the table given below.

Performance Criteria	Mark Range
Below threshold performance	**0**
Threshold performance Candidates present their ideas with reasonable care in a format that can be followed.	**1**
Intermediate performance Candidates present their ideas with care in an appropriate sequence.	**2-3**
High performance Candidates present their ideas adeptly in a logical and concise way.	**4-5**

7.4 MODERATION

All internally assessed work is marked by the teacher and internally standardised by the Centre. Marks are then submitted to OCR by a specified date, after which moderation takes place in accordance with OCR procedures. The purpose of moderation is to ensure that the standard of the award of marks for internally assessed work is the same for each Centre and that each teacher has applied the standards appropriately across the range of candidates within the Centre.

The sample of work which is presented to the Moderator for moderation must show how the marks have been awarded in relation to the internal assessment objectives defined in Section 7.3.

Where it is not clear within a project folder, by the candidate's own presentation of work, where the marks have been awarded, annotation must be carried out by the person marking the work.

7.5 MINIMUM REQUIREMENTS FOR INTERNALLY ASSESSED WORK

There should be clear evidence that work has been attempted and some work produced.

If a candidate submits no work for an internally assessed component, then the candidate should be indicated as being absent from that component on the mark sheets submitted to OCR. If a candidate completes any work at all for an internally assessed component then the work should be assessed according to the internal assessment objectives and marking instructions and the appropriate mark awarded, which may be zero.

SECTION E: FURTHER INFORMATION

8 Opportunities for Teaching

8.1 ICT

In order to play a full part in modern society, candidates need to be confident and effective users of ICT. Where appropriate, candidates should be given opportunities to use ICT in order to further their study of Industrial Technology.

The assessment of this course requires candidates to use ICT through preparing, presenting, and reviewing information as they work on their design ideas, developing models that communicate these ideas, and making products using computer-aided manufacture (CAM).

This section offers guidance on opportunities for using ICT during the course. These opportunities are also indicated within the content of Section 5 by a  symbol. Such opportunities may or may not contribute to the provision of evidence for IT Key Skills. Where such opportunities do contribute, they are identified by the use of the  symbol.

ICT Application	Opportunities for Using ICT during the Course
Database	Sections 5.1.1, 5.1.8, 5.1.11
Internet	Sections 5.1.2, 5.1.8
Word Processing	Sections 5.1.2, 5.1.8, 5.1.11
Spreadsheet	Sections 5.1.5, 5.1.8
CAD	Sections 5.1.3, 5.1.4, 5.1.6, 5.1.8
CAM	Sections 5.1.8, 5.1.9, 5.1.10

8.2 CITIZENSHIP

From September 2002, the National Curriculum for England at Key Stage 4 includes a mandatory programme of study for Citizenship. Parts of this programme of study may be delivered through an appropriate treatment of other subjects.

This section offers guidance on opportunities for developing knowledge, skills and understanding of citizenship issues during the course. These opportunities are also indicated within the content of Section 5 by a  symbol.

Citizenship	Opportunities for Teaching Citizenship Issues during the Course
Consider the needs of others	Section 5.1.1
Consider issues surrounding a particular product and its surroundings	Section 5.1.2
Seek opinions of others and be flexible and adaptable in responding to their needs	Sections 5.1.3/4
Consider the need to work together as a team	Section 5.1.9
Seek the opinions of others	Section 5.1.11
Consider the health and safety of others	Section 5.2.5

8.3 SPIRITUAL, MORAL, ETHICAL, SOCIAL AND CULTURAL ISSUES

The specification provides opportunities to promote:

- spiritual development, through helping pupils recognise their own creativity and the creativity of others in finding solutions to problems, and through recognising the tension between material and non-material needs;
- moral development, through helping pupils to reflect on how technology affects the environment so they can make informed choices when designing and making and through discussing the moral dilemmas posed by introducing new technologies within different values systems and the advantages and disadvantages of new technology to local, national and global communities;
- social development, through helping pupils recognise the need to consider the views of others when discussing design ideas;
- cultural development, through exploring the contribution of products to the quality of life within different cultures, and through valuing and reflecting on the responses of people from other cultures to design solutions.

8.4 HEALTH, SAFETY AND ENVIRONMENTAL ISSUES

OCR has taken account of the 1988 Resolution of the Council of the European Community and the Report Environmental Responsibility: An Agenda for Further and Higher Education, 1993 in preparing this specification and associated specimen assessments.

This specification provides opportunities to promote education for sustainable development, through developing knowledge and understanding of the principles of sustainable design and production systems, developing skills in creative problem solving and evaluation, and exploring values and ethics in relation to the application of design and technology. Whilst candidates will not be specifically assessed in terms of their knowledge and awareness of issues associated with energy usage it is anticipated that, whenever possible, candidates will be encouraged to consider that benefits and drawbacks associated with the use of different sources of energy.

The specification content includes a specific requirement to consider issues associated with health and safety and the environment. See Section 5.

8.5 THE EUROPEAN DIMENSION

OCR has taken account of the 1988 Resolution of the Council of the European Community in preparing this specification and associated specimen assessments. European examples should be used where appropriate in the delivery of the subject content. Relevant European legislation is identified within the specification where applicable. See Section 5.

9 Key Skills

Key Skills are central to successful employment and underpin future success in learning independently. Whilst they are certificated separately, the Key Skills guidance for this qualification has been designed to support the teaching and learning of the content. Opportunities for developing the generic Key Skills of Communication, Application of Number and Information Technology are indicated through the use of a  symbol in Section 5. The wider Key Skills of Working with Others, Problem Solving and Improving Own Learning and Performance may also be developed through the teaching programmes associated with the specification.

The following matrix indicates where coverage exists within the specification.

	Communication	Application of Number	IT	Working with Others	Improving Own Learning and Performance	Problem Solving
Level 1	✓	✓	✓	✓	✓	✓
Level 2	✓		✓	✓	✓	✓

Detailed opportunities for developing Key Skills evidence through this specification are posted on the OCR website: www.ocr.org.uk. A summary document for Key Skills coordinators showing ways in which opportunities for Key Skills arise within GCSE courses will be published during 2001.

10 Arrangements for Candidates with Special Needs

For candidates who are unable to complete the full assessment or whose performance may be adversely affected through no fault of their own, teachers should consult the Inter-Board Regulations and Guidance Booklet for Special Arrangements and Special Consideration.

In such cases, advice should be sought from the OCR Special Requirements team (tel 01223 552505) as early as possible during the course.

11 Support and In-service Training for Teachers

To support teachers using this specification, OCR will make the following materials and services available:

- A full programme of In-Service training meetings arranged by the Training and Customer Support Division (telephone 01223 552950).
- Specimen question papers and mark schemes, available from the Publications department (telephone 0870 8706622; fax 0870 8706621).
- Past question papers and mark schemes, available from the Publications (telephone 0870 8706622; fax 0870 8706621).
- Written advice on coursework proposals.
- A report on the examination, compiled by senior examining personnel after each examination session.
- Individual feedback to each Centre on the moderation of internally assessed work.