# Contents

## WJEC GCSE in DESIGN & TECHNOLOGY (RESISTANT MATERIALS)

## For Teaching from 2012
## For Award from 2014



**This is a linear specification: all assessments must be taken at the end of the course.**

# DESIGN AND TECHNOLOGY (RESISTANT MATERIALS)

## SUMMARY OF ASSESSMENT

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|---|
| **Unit 1: RESISTANT MATERIALS WRITTEN PAPER (40%)**<br>**Written Paper: 2 hours**<br>**120 marks (80 UMS)**<br>**This will consist of one paper for each focus area.** |
| **Section A 20% (60 marks)** |
| Four compulsory questions related to the world of Design and Technology and focus area specific. |
| **Section B 20% (60 marks)** |
| Four compulsory questions based on the specification content. These questions share a common structure across all focus areas. |
| **Unit 2: RESISTANT MATERIALS TASK (60%)**<br>**Controlled Assessment**<br>**180 marks (120 UMS)** |
| **Part A** Carry out an analysis of the problem, write a design specification, generate a range of ideas, develop a solution and produce the details of the final solution. (10 guided hours).<br>**Part B** Plan the making process, carry out the making and evaluate project. (20 guided hours).<br><br>Both parts of the task have to comply with the controlled assessment rules. |
| **Focus Areas Provided** |
| Food Technology<br>Graphic Products<br>Resistant Materials Technology<br>Systems and Control Technology<br>Textiles Technology<br>Product Design |

### AVAILABILITY OF ASSESSMENT AND CERTIFICATION

| | Entry Code | | June 2014 and each year thereafter |
|---|---|---|---|
| | Subject | Option* | |
| **Unit 1** | 4111 | 01 or W1 | ✓ |
| **Unit 2** | 4112 | 01 or W1 | ✓ |
| **Subject Award** | 4110 | LA or UL | ✓ |

*** Option Codes**
English Medium 01, Welsh Medium W1 - for units
English Medium LA, Welsh Medium UL - for subject award

**Qualification Accreditation Number: 500/8074/X**

**This is a linear specification: all assessments must be taken at the end of the course.**

# DESIGN & TECHNOLOGY (RESISTANT MATERIALS)

## 1 INTRODUCTION

### 1.1 Rationale

A course in Design and Technology offers a unique opportunity in the curriculum for candidates to identify and solve real problems by designing and making products or systems in a wide range of contexts relating to their personal interests. Design and Technology develops candidates' interdisciplinary skills, all six Key Skills and their capacity for imaginative, innovative thinking, creativity and independence.

The specification is based upon the view that design and technology is essentially a practical activity involving the combination of skills with knowledge and understanding in order to design and make quality products. It is intended to develop candidates' design and technological capability through a flexible and broad-based approach. The specification is planned to be sufficiently broad, balanced and relevant to interest all candidates.

Candidates should have the opportunity to analyse and evaluate situations, design and make products, and then appraise their performance. They should be provided with the opportunity to work with a range of materials and ICT.

Candidates should be presented with the subject matter in a stimulating and interesting way to promote discussion and research. They should be given the opportunity to experience the variety of roles involved in design and technology; client, designer, maker, manager, user etc. Candidates should be encouraged to consider the relationship between technology and society.

As a fundamental part of their course, candidates should design and make products. They should carry out activities related to industrial practices and the application of systems and control within their designing and making of these products.

The specification allows candidates to work in one or more of the following focus areas:

- Food Technology
- Graphic Products
- Resistant Materials Technology
- Systems and Control Technology
- Textiles Technology
- Product Design

## 1.2 Aims and Learning Outcomes

GCSE specifications in design and technology should encourage learners to be inspired, moved and changed by following a broad, coherent, satisfying and worthwhile course of study and gain an insight into related sectors, such as manufacturing and engineering. They should prepare learners to make informed decisions about further learning opportunities and career choices.

GCSE specifications in design and technology must enable learners to:

- actively engage in the processes of design and technology to develop as effective and independent learners;
- make decisions, consider sustainability and combine skills with knowledge and understanding in order to design and make quality products;
- explore ways in which aesthetic, technical, economic, environmental, ethical and social dimensions interact to shape designing and making;
- analyse existing products and produce practical solutions to needs, wants and opportunities, recognising their impact on quality of life;
- develop decision-making skills through individual and collaborative working;
- understand that designing and making reflect and influence cultures and societies, and that products have an impact on lifestyle;
- develop skills of creativity and critical analysis through making links between the principles of good design, existing solutions and technological knowledge.

## 1.3 Prior Learning and Progression

Although there is no specific requirement for prior learning, this specification builds upon the Programmes of Study for Design and Technology in Key Stages 1-3.

This specification may be followed by any candidate, irrespective of their gender, ethnic, religious or cultural background. This specification is not age specific and, as such, provides opportunities for candidates to extend their life-long learning.

This specification builds upon the Programmes of study for Design and Technology in Key Stages 1, 2 and 3 and allows candidates to fully address the knowledge, skills and understanding required by the National Curriculum Order for Design and Technology. The specification allows candidates to work in the following focus areas: Food Technology; Graphic Products; Resistant Materials Technology; Systems and Control Technology; Textiles Technology and Product Design promoting progression to a deeper level of knowledge, skill and understanding in one of the areas studied at Key Stage 3.

Whilst there is no specific requirement for prior learning in the WJEC Advanced Subsidiary / Advanced GCE specification in Design and Technology, there is a clear progression route from this GCSE specification. Candidates following the Graphic Products; Resistant Materials Technology; Textiles Technology or Product Design focus areas have an opportunity to extend their experience into the Product Design focus area at AS/Advanced level. Food Technology and Systems and Control Technology candidates have a clear progression route into focus areas with the same titles at AS/Advanced.

## 1.4 Equality and Fair Assessment

GCSEs often require assessment of a broad range of competences. This is because they are general qualifications and, as such, prepare candidates for a wide range of occupations and higher level courses.

The revised GCSE qualification and subject criteria have been reviewed to identify whether any of the competences required by the subject presented a potential barrier to any disabled candidates. If this was the case, the situation was reviewed again to ensure that such competences were included only where essential to the subject. The findings of this process were discussed with disability groups and with disabled people.

This review did not identify any potential barriers to disabled candidates within the criteria and no potential barriers have been added within the specification. It should be noted that candidates may use CAD/CAM for the making process and practical assistants may be used to support students with physical disabilities in this process.

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments. For this reason, very few candidates will have a complete barrier to any part of the assessment. Information on reasonable adjustments is found in the Joint Council for Qualifications document *regulations and Guidance: Access Arrangements, Reasonable Adjustments and Special Consideration.* This document is available on the JCQ website (www.jcq.org.uk).

Candidates who are still unable to access a significant part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award. They would be given a grade on the parts of the assessment they have taken and there would be an indication on their certificate that not all of the competences have been addressed. This will be kept under review and may be amended in future.

## 1.5 Classification Codes

Every specification is assigned a national classification code indicating the subject area to which it belongs. The classification code for this specification is 9040.

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.

Centres may wish to advise candidates that, if they take two specifications with the same classification code, schools and colleges are very likely to take the view that they have achieved only one of the two GCSEs. The same view may be taken if candidates take two GCSE specifications that have different classification codes but have significant overlap of content. Candidates who have any doubts about their subject combinations should check with the institution to which they wish to progress before embarking on their programmes.

# 2 CONTENT

## DEVELOPING, PLANNING AND COMMUNICATING IDEAS

This part of the specification is concerned with the process of designing. This will start with an initial problem and conclude with a proposed solution giving due consideration to the issues that can and should influence the outcome.

Candidates should be taught to:

**(a) develop and use design briefs and detailed specifications;**

Understand the difference between design brief and design specification.
Analyse and clarify a design brief.
Identify essential criteria for inclusion in a design specification.
Use a specification to help develop a design.
Use a design brief and design specification for evaluation.
Use existing products as a source of ideas.

**(b) consider issues that affect their research, designing and planning;**

Use different research strategies to find information.
Consider the needs and values of a range of users.
Appreciate the economic costs involved.
Consider issues of sustainability.
Consider moral, social, environmental and cultural influences.
Take into account relevant safety legislation.
Prioritise and summarise research material.
Recognise the potential of new technologies.
Consider marketing and advertising.

**(c) be flexible and adaptable in responding to changing circumstances and new opportunities;**

Recognise that there is a range of possible ways forward when designing and making.

**(d) generate, develop, model and communicate design proposals;**

Use a variety of graphic techniques to communicate ideas clearly.
Use ICT to communicate ideas clearly.
Use appropriate modelling techniques to develop proposals.
Develop designs in a progressive way.
Communicate final design proposals in an appropriate form and level of detail.

**(e) design for manufacturing in quantity;**

Consider how products are designed to facilitate manufacturing in quantity.

**(f) plan work schedules effectively;**

Produce a realistic schedule of work.
Recognise critical points and constraints.

**(g) match materials and components with tools, equipment and processes, taking account of critical dimensions and tolerances when deciding how to manufacture the product.**

Select and justify the materials, components, tools, equipment and processes needed for successful manufacture.

## PRODUCT ANALYSIS

This part of the specification is about knowing how to analyse a product.

This specification provides the opportunity for candidates, through Resistant Materials to develop a wider understanding of how products are designed and made.

Candidates should be taught to carry out a detailed analysis of a product addressing the following aspects:

(a) the probable specification for the product;
(b) the aesthetic appeal of the product;
(c) the function and/or purpose of the product;
(d) quality issues relating to the product;
(e) the size data of the product;
(f) the safety considerations of the product with reference to the end user;
(g) the materials used in the manufacture of the product;
(h) the scale of manufacture used to make the product;
(i) the commercial processes used to make and assemble the product;
(j) safety considerations for making the product;
(k) sustainability and environmental issues.

## SUSTAINABILITY and LEGISLATIVE ISSUES

This part of the specification is about knowing that sustainability and environmental issues, legislation and standards affect and influence designing and manufacturing choices and decisions and use this information in their own designing and making.

### Sustainability in Design and Technology

The specification requires candidates to develop a understanding of sustainability and environmental issues and to be able to use their understanding to guide and assist their decision making during designing in their focus area.

Candidates will have to be taught to look at the world we live in and to consider the needs of future generations and will need to consider how, as designers and manufacturers, they can minimise their environmental impact and also to show in their work how we can have a more sustainable future.

Candidates should be taught to:

(a) recognise why sustainability issues and environmental issues are important;

(b) consider sustainability issues and environmental issues when designing and manufacturing;

(c) recognise and take account of social, economic and environmental responsibility in designing and making products.

(d) understand and use the SIX Rs of sustainability, that is:

rethink
reuse
recycle
repair
reduce
refuse

(e) understand that sustainable designing is more than using recycled or recyclable materials to manufacture their products. It is about the total impact that the process of designing and making has on the environment;

(f) carry out a 'Life cycle Analysis' to determine the environmental impact of a product.

**Legislative Issues in Design and Technology**

This specification requires candidates to develop an understanding of legislative issues and standards as they affect their designing and making in their chosen focus area and to be able to use the understanding they have gained to guide and assist their decision making during designing.

Candidates should be taught to:

(a) know about the work of the British Standards Institution (BSI) does and how it is related to the Committee for European Standardisation (CEN) and how the International Standards Organisation (ISO);

(b) know how standards are produced, what they are for and how products reach the standards are marked;

(c) know about and apply the laws of Health and Safety:

- An awareness of the Health and Safety of Work Act.
- An awareness of COSHH (Control of Substances Hazardous to Health).
- Risk Assessment in school and the workplace.

## OTHER DESIGNERS / PRACTITIONERS

This part of the specification is about knowing about and understanding the work of professional designers and/or professional practitioners within the world of Design and Technology.

Candidates should be taught to recognise the influence of two Designers/ Practitioners in the world of Design and Technology with respect to:

(a) the range of work that each of the Designers/Practitioners have produced over time;

(b) how to identify the work of each of the Designers/Practitioners;

(c) the innovations and/or new ideas that the two Designers/Practitioners have introduced over time;

(d) the influence that each of the two Designers/Practitioners has had on the world of Design and Technology.

Each Focus Area will specify two Designers/Practitioners for each examination year and the awarding body will review the two Designers/Practitioners each year. Centres will be informed of the details of each of the Designers/Practitioners two years before the examination to be taken.

## COMMERCIAL MANUFACTURING PRACTICES

This section is about developing an understanding of a range of commercial Manufacturing Processes that use resistant materials in their production.

Candidates should be taught to:

**Understand manufacturing systems, including one off, batch and high volume production.**

- Use of different levels of production taking into account economic decisions.
- Understand the advantages and disadvantages of producing single, one off products.
- A knowledge of a range of products / contexts that are produced as one off single pieces.
- Understand the advantages and disadvantages of producing products in limited quantity.
- Understand the need to produce a number of identical products.
- Show an understanding of jigs and devices to control repeat activities.
- A knowledge of a range of products / contexts that are produced in batches.
- Understand the advantages and disadvantages of high volume, continuous production.
- Appreciate issues related to high volume production.
- Understand a commercial production line and its features.
- Understand the importance of CAM in modern high volume production.
- A knowledge of a range of products / contexts suitable for high volume, continuous production.

**Be aware of a range of manufacturing methods used in the production of commercially produced wood, metal and plastic products.**

**Woods**

- Understanding of the principles of producing wood products and components using the following processes:
  - Veneering.
  - Laminating.
  - Steam bending.
- Understand the processes related to the production of manufactured boards.
- A knowledge of typical wood materials used in each production method.
- A knowledge of typical products that are manufactured using each production method.
- The inherent advantages and disadvantages of each production method.

**Plastics**

- Plastics processes that use thermo and thermosetting plastics.
- Understanding of the principles of producing plastic products and components using the following processes:
  - Blow moulding.
  - Injection moulding.
  - Vacuum forming.
  - Press moulding.
  - Compression moulding.
  - Rotational moulding.
  - Extrusion.
- A knowledge of typical plastics used in each production method.
- A knowledge of typical products that are manufactured using each production method.
- The inherent advantages and disadvantages of each production method.

**Metals**

- Understanding of the principles of producing metal products and components using the following processes:
  - Forging.
  - Extruding.
  - Die casting.
  - Arc, spot, mig and oxy acetylene welding.
  - Spinning.
  - Pressing.
- A knowledge of typical metals used in each production method.
- A knowledge of typical products that are manufactured using each production method.
- The inherent advantages and disadvantages of each production method.
- Metal processes that use ferrous, non ferrous and alloys.
- Brazing, silver soldering, bending.

**Understand management systems for production of quality commercial products.**

- Understand principles of quality control and quality assurance in the design and manufacture of products.
- Understand the importance of quality assurance in the production of commercial products.
- Appreciate the role of the British Standards Institution, kite marks, CE.
- Understand a typical manufacturing and assembly line.
- Understand the need to incorporate quality control measures in the production process.

**Apply safe working practices, including identifying hazards and risk assessment.**

- Understand importance of identifying hazards and creating risk assessments in commercial and school based scenarios.
- Appreciate the need to produce products in a safe working environment.
- Understand the need to identify the risks and hazards in commercial production.
- Understand the use of the 5 Step risk assessment:
  - Identify hazard.
  - Consider who might be harmed and how.
  - Evaluate potential risk.
  - Record.
  - Review.

**Be aware of global commercial production.**

- Understanding of production and manufacturing costs, related to cost of labour, materials and production of resistant material based commercial products.

**Understand environmental impact of commercial production methods.**

- Affect on the environment of commercial production and demand for finite resources.
- Energy sources, production methods, global demand.
- Methods and approaches to reduce impact on the environment.

**Modern commercial processes and practices.**

- Appreciate microprocessor and PLC control.
- Understand the principles of JIT (Just in Time).
- Understand the advantages of Rapid prototyping in product development.
- Understand the affects labour and production costs on modern manufacturing companies.
- Understand the advantages and disadvantages to the manufacturer, customer and workforce of moving production to countries with lower labour costs.
- Understand the work of regulatory bodies to ensure products are safe and fit for purpose.
- Understand the work of:
  - BSI - British Standards Institution.
  - CE - Conformité Européenne.
  - FIRA - Furniture Industry Research Association.

## MATERIALS & COMPONENTS

This section is about developing a knowledge and understanding of a range of woods, metals and plastics and modern materials and components to make quality products.

Candidates should be taught to:

### Materials

- Select materials appropriate to the task.
- Understand the physical and working properties of a variety of common resistant materials including: Woods, Metals, Polymers, Composite materials and new and modern materials.
- Understand that materials can be modified to improve properties, finish and appearance.
- Understand that the properties of a material can be affected by its method of manufacture e.g. corrugated steel sheet.
- Identify and select materials for a particular purpose.
- Choose materials on the basis of aesthetic, physical, economic, sustainability and performance factors.
- Select and use the best material for the construction techniques used for the manufacture and the function of the product.
- Consider advances in material technology.
- Understand the physical properties of materials including:
  - Density.
  - Fusability - Melting Point.
  - Thermal Conductivity.
  - Electrical Conductivity.
- Understand the mechanical properties of materials including:
  - Strength.
  - Plasticity.
  - Malleability.
  - Ductility.
  - Hardness.
  - Durability.
- Understand how to test materials for:
  - Tensile Strength.
  - Hardness.
  - Toughness.
  - Ductility.

## Solid Timber

- Candidates should be taught about solid timber so that they know about the material it's strengths and weaknesses and be able to use the information in their designing and making.
- Understand that timber is harvested from decidious (Hardwoods) and coniferous (softwood) trees throughout the world.
- Understand that timbers are available from tropical and temperate reigions and that timbers have sustainability issues.
- Understand how trees grow and the structure of timber.
- Understand how timber is felled, converted and seasoned ready for use.
- Understand that timber suffers from defects including: -Shrinkage, Splits, Shakes, Knots, Fungial attack.
- Understand that timber is sold in the following forms: -Plank, Board, Strip, Square, and Dowel.
- Understand that timber is available as:
  - Rough saw.
  - PBS - Planed Both Sides.
  - PAR - Planed All Round.
- Understand that timber can be identified using a range of descriminators including:
  - Weight.
  - Colour.
  - Grain.
  - Texture.
  - Durability.
  - Uses.
  - Ease of working.
  - Cost.
- Understand the properties of the following Temperate Hardwoods:
  - Beech.
  - Ash.
  - Oak.
  - Birch.
- Understand the properties of the following Tropical Hardwoods:
  - Mahogany.
  - Jeluotong.
  - Teak.
  - Balsa.
- Understand the properties of the following softwoods:
  - Scots Pine.
  - Spruce.
  - Western Red Ceder.
  - Parana Pine.

**Manufactured Board**

- Know about manufactured board, it's strengths and weaknesses and be able to use the information in their designing and making.
- Understand hat manufactured board is made from solid timber.
- Understand how manufactured board are manufactured.
- Appreciate the standard sizes of the availability of manufactured boards.
- Understand that veneer is produced from solid timber.
- Understand the advantages and benefits of using veneer.
- Understand the properties of the following manufactured boards:
  - Plywood.
  - MDF - Medium Density Fibreboard.
  - Chipboard.
  - Hardboard.
  - Veneer.

**Polymers**

- Know about polymers their strengths and weaknesses and be able to use the information in their designing and making.
- Understand that polymers can be made from both natural and synthetic resources.
- That polymers are made by a process of polymerisation.
- Understand that the properties of polymers are determined and can be modified by changing the polymerisation process.
- Understand that additives are used in the manufacture of plastics including:
  - Plasticizers.
  - Fillers.
  - Colour pigments.
- Understand that polymers can be strengthened by reinforcement including:
  - Glass.
  - Carbon fibre.
  - Kevlar.
- Understand that polymers are available in expanded forms including:
  - Open cell - known as foams.
  - Closed cell - known as expanded plastics.
- Understand that polymers are available in a wide range of forms including:
  - Powders.
  - Granules.
  - Pellets.
  - Liquids.
  - Films.
  - Sheets.
  - Extruded shapes.
- Understand that polymers can be identified using a range of descriminators including:
  - Appearance.
  - Rigidity.
  - Feel.
  - Bending.
  - Heating.
  - Burning.
  - Density / Specific Gravity.
- Understand that new polymers are being developed often for specific purposes including:
  - Biodegradability.
  - Compost ability.

**Thermo Plastics**

- Know about thermo plastics their strengths and weaknesses and be able to use the information in their designing and making. Understand the properties of the following Thermoplastics:

| | | |
|---|---|---|
| LDPE | - | Low density Polythene. |
| HDPE | - | High density Polythene. |
| PP | - | Polypropylene. |
| PS | - | Polystyrene. |
| HIPS | - | High Impact Polystyrene. |
| uPVC | - | Ultra Violet Stabilised Polyvinyl-chloride. |
| PVC | - | Polyvinyl-chloride. |
| PMMA | - | Polymethyl-methacrylate (Acrylic). |
| ABS | - | Acrylonitride-butadienestyrene. |
| NYLON | | |
| PET | - | Polyethylene terephthalate. |

**Thermosetting Plastics**

- Know about thermo plastics their strengths and weaknesses and be able to use the information in their designing and making. Understand the properties of the following thermosetting plastics:

| | | |
|---|---|---|
| UF | - | Urea formaldehyde. |
| MF | - | Melamine formaldehyde. |
| PR | - | Polyester Resin. |
| ER | - | Epoxy Resin. |

**Metals**

- Know about metals their strengths and weaknesses and be able to use the information in their designing and making.
- Understand that metals are classified as Ferrous Metals, Non-Ferrous Metals and Alloys.
- Understand how Ferrous metals are made.
- Understand how Non-Ferrous metals are made.
- Understand the structure of metals.
- Understand the heat treatment of metals including:
  - Annealing.
  - Normalising.
  - Hardening.
  - Tempering.
  - Case hardening.
- Understand that metals are available in a number of common forms including:
  - Rod.
  - Square Rod.
  - Hexagonal Rod.
  - Strip.
  - Sheet.
  - Round Tube.
  - Square Tube.
  - Angle.
  - Channel.

**Ferrous Metals**

- Know about ferrous metals their strengths and weaknesses and be able to use the information in their designing and making. Candidates should to be taught about the following materials:
  - Cast Iron.
  - Mild steel.
  - Medium Carbon Steel.
  - High Carbon Steel.

**Alloy Steels**

- Know about alloy steels their strengths and weaknesses and be able to use the information in their designing and making. Candidates should to be taught about the following materials:
  - Stainless Steel.
  - High Speed Steel.
  - High Tensile Steel.

**Non-Ferrous Metals**

- Candidates should be taught about non-ferrous metals so that they know about the material it's strengths and weaknesses and be able to use the information in their designing and making. Candidates should to be taught about the following materials:
  - Aluminium.
  - Duralumin.
  - Copper.
  - Brass.
  - Bronze.
  - Pewter.
  - Silver.

**Modern Materials**

- Know about composites and functional (Smart) materials their strengths and weaknesses and be able to use the information in their designing and making. Candidates should to be taught about the following materials:
  - Tungsten Carbide.
  - GRP - Glass Reinforced Plastic.
  - Liquid crystal and thermochromic displays.
  - Electroluminescent lighting.
  - Light emitting polymers.
- Candidates should be taught about the importance of Nano technology to change and enhance the properties of materials such as:
  - High electrical and thermal conductivity.
  - Strength.
  - Stiffness and toughness.
  - Wear and scratch resistance.
- Candidates should develop and understanding of the applications for Nano technology and Nano materials such as:
  - Light emitting phosphors.
  - Nano crystalline materials such as Tungsten Carbide and Titanium.
  - Carbide to improve wear resistance in machine parts.
  - Coatings to produce self cleaning windows.
  - Paint technology.

**Components**

- Know that components include a range of pre-manufactured parts that could be included in a product.
- Select components appropriate to the task.
- Identify and select components for a particular purpose.
- Choose components on the basis of aesthetic, physical, economic, sustainability and performance factors.
- Choose components to satisfy the design requirements set out in a brief and specification.
- Candidates should be taught about components so that they know about them and their strengths and weaknesses and be able to use the information in their designing and making. Candidates should to be taught about the following components:
  - Nuts and Bolts.
  - Washers.
  - Screws.
  - Set Screws.
  - Wood Screws.
  - Rivets.
  - Nails.
  - Stays.
  - Hinges.
  - Catches.
  - Locks.
- Understand that Knock-down fittings (KDF) are used extensively in self assembly furniture.
- Understand the advantages of KDFs to the manufacturer and the consumer.
- Understand how KDFs improve the strength and rigidity of products.
- Candidates should know about the following KDFs:
  - Bloc-joint.
  - Modesty bloc.
  - Scan fittings.
  - Disc and peg.

## TOOLS, EQUIPMENT AND MAKING

This section is about developing a knowledge and understanding of how to safely use a range of tools and equipment to cut, shape, drill, form and join resistant materials.

Candidates should be taught to:

**Follow safe working procedures in the practical environment.**

- Wear appropriate protective clothing and safety equipment when working with resistant materials and equipment.
- Safely and correctly use a range of machine and handtools appropriate to the materials they are using.
- Understand and follow risk assessments for workshop procedures.

- Understand and be familiar with workshop Health and Safety signs related to:
  - Eye protection.
  - Sound levels.
  - Protective clothing.
  - Fumes and dust levels.
  - Electrical supplies.
  - Hazardous chemicals.
- Understand and apply safety procedures involved with common machine processes.
- Select methods of manufacture appropriate to the task.

**Use hand tools and equipment.**

- Select and use appropriate tools and equipment to mark out, hold, cut, shape, drill, form, bend wood, metals and plastics.

**Marking out in wood.**

- Mark out and prepare wood using the following tools and equipment:
  - Try Square.
  - Mitre Square.
  - Bradawl.
  - Rule.
  - Marking knife.
  - Marking gauge.
  - Mortise Gauge.
  - Sliding bevel.

**Marking out in metal.**

- Mark out and prepare metal using the following tools and equipment:
  - Engineers Square.
  - Scriber.
  - Centre Punch.
  - Rule.
  - Dividers.
  - Centre square.
  - Micrometer.

**Marking out in plastics.**

- Mark out and prepare plastics using the following tools and equipment:
  - Engineers Square.
  - Fibre tip pen.
  - Rule.
  - Sliding bevel.

**Cutting and shaping wood.**

- Candidates should be taught how to cut and shape wood using the following tools and equipment:
  - Tenon Saw.
  - Hand drill.
  - Coping Saw.
  - Dovetail saw.
  - Handsaw.
  - Firmer chisel.
  - Mortising chisel.
  - Jack / Smoothing plane.
  - Surform.
  - Spoke shave.
  - Rebate plane.
  - Mallet.
  - Glass paper (various grades).
  - Hand drill.
  - Hole saw.
  - Forstener bit.
  - Countersink drill.
  - Twist drill.
  - Flat bit.

**Cutting and shaping metals.**

- Cut and shape metals using the following tools and equipment:
  - Hacksaw.
  - Junior Hacksaw.
  - Tin snips.
  - Files (range of shapes and cuts).
  - Guillotine.
  - Taps and dies.
  - Emery paper.
  - Wet and dry paper (various grades).
  - Twist drill.
  - Planishing hammer / sand bag.

**Cutting and shaping plastics.**

- Candidates should be taught how to cut and shape plastics using the following tools and equipment:
  - Hacksaw.
  - Junior Hacksaw.
  - Coping saw.
  - Files (range of shapes and cuts).
  - Wet and dry paper.
  - Hole saw.
  - Countersink drill.
  - Twist drill.
  - Forstener bit.

**Holding and securing resistant materials.**

- Correctly hold and secure resistant materials in order to drill, join, shape and form using the following holding tools:
  - G cramp.
  - Sash cramp.
  - Belt cramp.
  - Mitre cramp.
  - Engineers Vice.
  - Woodworkers / Carpenters Vice.
  - Toolmakers Clamp.
  - Machine vice.
  - Hand vice.

**Use machine tools and equipment.**

- Select and use appropriate machine tools and equipment to drill, turn, mortise and mill wood, metals and plastics.
- Understand the safety precautions involved.
- Know how to mark out the work piece.
- Know how to set up and secure the work piece.
- Know how to set up and secure the cutting tool.
- Understand how to safely operate the machine.
- Use the following machines can be used to carry out the following basic processes:

**Metal**

| | | |
|---|---|---|
| Metalworking lathe | - | face off an end. |
| | - | turn down bar to reduce the diameter. |
| Milling machine | - | create a slot or face edge. |
| Pillar Drill | - | drill holes to various diameters. |

**Wood**

| | | |
|---|---|---|
| Woodworking lathe | - | turn a dome / bowl. |
| | - | turn a cylinder between two centres. |
| Mortising machine | - | make a blind mortise. |
| Pillar Drill | - | drill holes to various diameters. |

**Plastics**

| | | |
|---|---|---|
| Pillar Drill | - | drill holes to various diameters. |

- Use a range of portable power tools appropriate to the manufacture of resistant materials products including: Power drills, power screwdrivers and jigsaws.

**Jigs and formers**

- Understand that jigs and formers can be used to ensure accuracy when producing single pieces.
- Understand that jigs and formers can be used to ensure accuracy when producing multiple identical pieces.
- Understand that jigs and formers can be used for metal, wood and plastic parts.
- Understand that jigs and formers can reduce the manufacturing time of a product.
- Understand jigs and formers can be used for drilling, bending, cutting, forming and joining resistant materials.

## SYSTEMS AND PROCESSES

**This section is about developing a knowledge and understanding of a range of processes used to work, form and join resistant materials.**

Candidates should be taught to:

### Bending and forming

- Know about the important stages in order to be able to bend, form and manipulate resistant materials.

### Bending and Forming Wood

- Understand that wood can be laminated to improve its appearance and strength.
- Understand that wood can be laminated to change its form.
- Understand that wood can be steam bent.
- Understand the importance of constructing an accurate mould, jig or former.
- Understand and be able to identify the main stages in the following processes:
  - Laminating;
  - Steam Bending.

### Bending and Forming Metal

- Understand the properties of metal and that metals are most often heated before or during forming.
- Understand the correct temperatures different metals need to be heated to before forming.
- Understand the terms Annealing, Normalising, Hardening, Tempering and Case hardening.
- Understand and be able to identify the main stages in the following processes:
  - Forging.
  - Beaten metal work.
  - Sheet metal folding.
  - Casting (Pewter or Aluminium).

### Bending and Forming Plastic

- Understand that thermoplastics can be formed using a variety of processes.
- Understand the requirements of making a successful mould.
- Appreciate the most appropriate materials for each process.
- Understand and be able to identify the main stages in the following processes:
  - Line bending.
  - Vacuum forming.
  - Press forming / moulding.
  - Injection moulding.
  - Blow moulding.
  - Laminating Glass Reinforced Plastic (GRP).

**Joining Resistant Materials**

- Choose the most appropriate method of joining components together for the task in hand.
- Understand that joining materials can be mechanical or chemical.
- Understand the choice of joining method is reliant on a range of criteria to include:
  - Strength.
  - Appearance.
  - Cost.
  - Function.
  - Durability.
  - Location.
  - Material.
- Understand how to join like and unlike materials together.
- Understand that material joining can be permanent and temporary.
- Understand the health and safety requirements when using hazardous chemicals.
- Be familiar with the terms clearance hole and pilot hole.

**Wood**

- Understand that wood joints can be classified as frame or box / carcass construction.
- Understand and be able to identify the main stages in the following joining processes:

**Permanent**

Frame:
- Mitre.
- Dowel.
- Mortise and tenon.
- Halving.
- Bridle joint.

Box/carcass:
- Butt.
- Lap.
- Housing.
- Dovetail.
- Comb joint.

- PVA (wood to wood).
- Contact Adhesive.
- Epoxy Resin (wood to other materials).
- Nails.
- Biscuit joints.

**Temporary**

- Screw (Countersunk and round head).
- Knock down fittings.

**Metal**

- Understand and be able to identify the main stages in the following joining processes:

  **Permanent**

  Rivets.
  Pop rivets.
  Welding.
  Brazing.
  Silver soldering.
  Epoxy resin.

  **Temporary**

  Self tapping screws.
  Nuts and bolts.
  Scan fittings.

**Plastics**

- Understand and be able to identify the main stages in the following joining processes:

  **Permanent**

  Liquid solvent cement.
  Tensol.
  Epoxy resin.
  Contact adhesive.

  **Temporary**

  Self tapping screws.
  Nuts and bolts.

**Finishing Resistant Materials**

- Understand that finishes are applied to protect resistant materials for functional reasons including:
  Dirt.
  Liquids.
  Oxidisation.
  Scratching.
  Tarnishing.
  Weather.
  Fungal attack.
  Heat.
- Understand that finishes are applied to resistant materials for aesthetic reasons including:
  Colour.
  Quality.
  Style.
  Shine.

- Understand that choosing an appropriate finish is reliant on a range of issues including:
  - Type of material.
  - Function of the finish.
  - How it will be applied.
  - Skill of the person applying the finish.
  - Cost.
- Understand that finishes can be pre applied at or after the production stage.
- Understand that for every finishing process there are a number of stages necessary to achieve a good quality finish.

**Wood**

- Understand and be able to identify the main stages in the following wood finishing processes:
  - Varnish.
  - Primer, undercoat and paint.
  - Teak oil.
  - Thermosetting plastic laminate.

**Metal**

- Understand and be able to identify the main stages in the following metal finishing processes:
  - Paint and primer.
  - Cellulose paint.
  - Laquer.
  - Plastic coating.
  - Enamelling.
  - Oil finishing black steel.

**Plastic**

- Understand that most plastics come ready finished.
- Understand that it is important to protect the surface from marks and scratches during the manufacturing process.
- Understand that thicker plastic sheet material will often require edge finishing.
- Understand that plastics can be coloured using spray paints.

**Mechanisms and components to create moving parts in products.**

- Understand a range of components and parts that allow products to move, fold, slide, hinge, pivot, reduce and increase in size.
- Understand simple mechanisms that will enable resistant material products to move, fold, slide, hinge, pivot, reduce and increase in size, including:
  - Cams and followers.
  - Levers.
  - Linkages.
  - Gears.

## ICT, CAD AND CAM

This section is about the use of Computer Aided Design and manufacturing in the production of commercially produced products and its use and application in school.

Candidates should be taught to:

- Use computer systems with appropriate software and hardware to support their designing and manufacturing.
- Use CAM equipment but it is not mandatory; it may be used where appropriate to manufacture parts or components for products, particularly where quality control is required. Outcomes may contain elements of CAM. Wholly CAM products should not be produced.

**ICT** *(Information Communication Technology)*

- Use word processing software to create text.
- Edit text using word processing software.
- Check spelling and grammar using word processing software.
- Use spreadsheet software to collate numerical data.
- Create graphs and charts using spreadsheet software.
- Access the internet and world wide web.
- Use search engines to find information to aid the design process.
- Access relevant resources.
- Download information and resources for use.

**CAD** *(Computer Aided Design)*

- Understand the advantages and disadvantages of the use of CAD, use of appropriate CAD software to model, test, refine, develop and present ideas.
- Understand the direct link between CAD and CAM.

**CAM** *(Computer Aided Manufacture)*

- Recognise advantages and disadvantages of the use of CAM, select and prepare appropriate CAM machinery.
- Understand the main stages of manufacture from CAD drawing to manufactured component.
- Plan and set up CAM machinery.
- Use of appropriate CAM machinery.
- Understand the need to ensure efficient and cost effective use of materials when preparing to cut multiple components.
- Understand and be able to identify the main stages using a CAM Vinyl cutting device to include:
    - Preparing CAD drawing.
    - Loading material into machine.
    - Appropriate cutting settings.
    - Operate cutter.
    - Remove material from machine.
    - Applying CAM material to the product.

- Understand and be able to identify the main stages using a CAM routing / engraving or milling machine to include:
  - Preparing CAD drawing.
  - Loading material into machine.
  - Appropriate cutting settings.
  - Understand need to calculate tool paths.
  - Operate machine.
  - Remove material from machine.

- Understand and be able to identify the main stages using a Laser cutting machine to include:
  - Preparing CAD drawing.
  - Loading material into machine.
  - Appropriate cutting settings.
  - Operate machine.
  - Remove material from machine.

- Understand and be able to identify the main stages using a Rapid prototyping / 3D printing machine to include:
  - Preparing CAD drawing.
  - Loading material into machine.
  - Appropriate cutting settings.
  - Operate machine.
  - Remove material from machine.

# 3 ASSESSMENT

## 3.1 Scheme of Assessment

Assessment for GCSE **Resistant Materials** is untiered, i.e. all components/units cater for the full range of ability and allow access to grades A*-G for the subject award.

The scheme of assessment will consist of:

**UNIT 1: RESISTANT MATERIALS WRITTEN PAPER**

**Written Paper 2 hours (40 %)**

Candidates will be required to sit an examination of two hours' duration (split into two sections), set and marked by the WJEC. Specific papers will be set for each of the six focus areas.

The papers for all focus areas follow a similar structure. Section 1 is designed to be answered in 60 minutes and consists of four questions. These questions are set so as to be accessible to candidates from all focus areas and will relate to Product Analysis, Overarching Principles, Designers and Practitioners and The Design Process. The quality of written communication will be integrated into question 3 and will necessitate paragraphs or essay style responses. Section 2 consists of four questions: these are focus area specific, and designed to take 60 minutes to answer.

Differentiation will be achieved by using a variety of styles of questioning to ensure that specification content is tested in such a way as to provide a meaningful examination to candidates of different levels of ability. The principle of incline of difficulty will be built into questions so that the examination will provide an adequate test across the targeted ability range.

**UNIT 2: RESISTANT MATERIALS TASK**

**Controlled Assessment 30 hours (60%)**

The WJEC is responsible for 'task setting' and details of the controlled assessment tasks for Design and Technology will be forwarded to all centres in September each year.

Candidates are required to complete one 30 hour design, make and evaluate task. The task is divided into two sections. Section A is concerned with designing the product and Section B is concerned with planning, making and evaluating the product. The task is time limited and teachers are required to monitor and verify this time limit. Candidates will not gain additional credit by exceeding the time limit. Further details of the assessment process can be found in section 5.

## 3.2 Assessment Objectives

Candidates will be required to demonstrate their ability to:

**AO1** Recall, select and communicate their knowledge and understanding in design and technology including its wider effects.

**AO2** Apply knowledge, understanding and skills in a variety of contexts and in designing and making products.

**AO3** Analyse and evaluate products, including their design and making.

## 3.3 Weighting of Assessment Objectives

**Assessment objectives are weighted as follows across the two units:**

| | Unit 1 (Written Paper) % | Unit 2 (Controlled Assessment % | Total % |
|---|---|---|---|
| AO1 | 26.66 | 3.33 | 30 |
| AO2 | 6.66 | 48.33 | 55 |
| AO3 | 6.66 | 8.33 | 15 |
| Total | 40 | 60 | 100 |

## 3.4 Quality of Written Communication

For components involving extended writing (Written paper) candidates will be assessed on the quality of their written communication within the overall assessment of that component.

Mark schemes for these components include the following specific criteria for the assessment of written communication:

- legibility of text; accuracy of spelling, punctuation and grammar; clarity of meaning;
- selection of a form and style of writing appropriate to purpose and to complexity of subject matter;
- organisation of information clearly and coherently; use of specialist vocabulary where appropriate.

# 4 AWARDING, REPORTING AND RE-SITTING

GCSE qualifications are reported on an eight point scale from A* to G, where A* is the highest grade. The attainment of pupils who do not succeed in reaching the lowest possible standard to achieve a grade is recorded as U (unclassified) and they do not receive a certificate.

This is a linear specification in which all assessments must be taken at the end of the course. Where candidates wish to re-sit, external components must be re-taken. The controlled assessment component may also be re-taken according to guidelines given in 'Administration of Controlled Assessment'. Alternatively, the UMS mark for this component may be carried forward for aggregation with the external components when these are re-taken.

Individual unit results are reported on a uniform mark scale (UMS) with the following grade equivalences:

| GRADE | MAX. | A* | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|
| Unit 1 | 80 | 72 | 64 | 56 | 48 | 40 | 32 | 24 | 16 |
| Unit 2 | 120 | 108 | 96 | 84 | 72 | 60 | 48 | 36 | 24 |
| Subject Award | 200 | 180 | 160 | 140 | 120 | 100 | 80 | 60 | 40 |

# 5 ADMINISTRATION OF CONTROLLED ASSESSMENT

The WJEC GCSE Design and Technology specification meets all regulations for controlled assessment as laid down by the regulatory authorities.

**The controlled assessment task is worth 60% of the total marks** available for the specification.

The controlled assessment tests all the assessment objectives for GCSE Design and Technology, within the weightings stipulated by the regulatory authorities.

Candidates will be required to demonstrate their ability to:

**AO1** Recall, select and communicate their knowledge and understanding in design and technology including its wider effects.

**AO2** Apply knowledge, understanding and skills in a variety of contexts and in designing and making products.

**AO3** Analyse and evaluate products, including their design and making.

The weighting of assessment objectives across examination components is as follows:

| | AO1 | AO2 | AO3 | Total |
|---|---|---|---|---|
| **Controlled Assessment** (Marks and Percentages) | **10 (3.3%)** | **145 (48.3%)** | **25 (8.33%)** | **180 (60%)** |

## Rationale for Controlled Assessment

**The controlled assessment is a compulsory component of GCSE Design and Technology.** It complements the external examination by offering a distinct means of assessment. It is important for a number of reasons.

It enables candidates to:

- design creatively by generating, developing, planning and communicating ideas;
- make products by working safely with tools, equipment, components, materials and ingredients;
- apply systems and control. CAD/CAM, digital media and new technologies appropriate to the focus area;
- analyse and evaluate processes and products.

**Levels of Control**

The regulation of controlled assessment in GCSE Design and Technology is split into three stages:

- task setting
- task taking
- task marking

For each stage, the regulatory authorities have specified a certain level of control to ensure authenticity and reliability.

## A. Task setting (High level of control)

The WJEC is responsible for **task setting** and details of the controlled assessment tasks for Design and Technology will be forwarded to all centres in September each year. Three tasks will be offered for each focus area. Candidates will choose one of these tasks. These tasks will be reviewed on a one-year cycle. The tasks will be open to interpretation and contextualisation by the centre/candidate.

## B. Task taking (Medium level of control)

Candidates are required to complete one 30 hour design, make and evaluate task. The task is divided into two sections. Section A is concerned with designing the product and Section B is concerned with planning, making and evaluating the product. The task is time limited and teachers are required to monitor and verify this time limit. Candidates will not gain additional credit by exceeding the time limit. **Section A** of the task is to be completed in **10 hours** supervised time and **Section B** of the task is to be completed in the remaining **20 hours** of supervised time.

**Supervision**

The task must be supervised in such a way as to ensue that the contributions of individual candidates are recorded accurately and that plagiarism does not take place.

The task can be carried out in the normal classroom/workshop environment. Candidates are allowed supervised access to resources that may include information gathered outside the 30 hours of controlled assessment time.

Candidates may gather research/inspirational material prior to or during the assessment period and this can be referred to during the task but this material is not to be included in the material to be assessed**. Graphical work which has been prepared in advance by the candidate as part of an ongoing workbook or research cannot be included as part of the material assessed for the control assessment task.**

Candidates may collaborate/confer with others in relation to the task but all assessed material must be the candidates' work only.

The supervising teacher can give candidates limited guidance during the task in order to clarify what is to be done and to ensure that safe working practices are adhered to.

It is the responsibility of the centre to ensure the reliability and authenticity of all work presented for this controlled assessment. Teachers and students will be required to sign a declaration that all work presented is the work of the candidate alone. Failure to authenticate the work may result in grades being delayed or refused.

**Presentation**
All graphical and written work entered for this controlled assessment must be submitted on the pre-printed pages which are available for download from the WJEC website. Candidates are free to use ICT applications where they are appropriate. The assessment criteria for the task are detailed in section 3.

## C. Task marking

The Task is to be assessed as follows.

**Section A Designing**
10 hours (60 marks) (Weighting 20%)

| | **Marks** | **Assessment objective** |
|---|---|---|
| Analysis of the task | 5 | AO3 |
| Design specification | 5 | AO2 |
| Generation of ideas | 10 | AO2 |
| Development and modelling<br>Form/style/function (5)<br>Materials/components (5)<br>Construction/marking (5)<br>Size/quantity (5)<br>Finish/quality (5) | 25 | AO2 |
| Final solution – graphical presentation | 5 | AO1 |
| Final solution – technical details | 5 | AO2 |
| Creative thinking | 5 | AO2 |
| Total marks | 60 | |

**Section B Planning, Making and Evaluating**
(20 hours) (120 marks) (Weighting 40%)

| | **Marks** | **Assessment objective** |
|---|---|---|
| Plan the make | 10 | AO1(5) AO2(5) |
| Making<br>Range and difficulty of processes (10)<br>Quality of construction (25)<br>Dimensional accuracy (15)<br>Quality of finish/appearance (15)<br>Function (10 marks)<br>Independent working (15) | 90 | AO2 |
| Evaluation | 10 | AO3 |
| Improvements | 10 | AO3 |
| Total marks | 120 | |

**Internal Moderation**
Teachers are responsible for marking the controlled assessment by applying the criteria provided. In centres where more than one teacher is involved in a focus area and/or in centres where there is more than one focus area being taught it will be beneficial if the marking criteria are discussed before marking takes place so that some agreement on the application of the criteria can be arrived at. It is essential also that a system of cross moderation between teachers is applied before final marks are submitted to the WJEC.

**Annotation**
There is an opportunity on each page of the task for teachers to make some notes that support the marks being awarded and to record any information that may have some bearing on the candidates' performance. A note of the time taken is also recorded on each sheet.

**External Moderation**
All candidates' marks are recorded on the appropriate form and those marks are submitted in the summer term. The WJEC will select a sample of work that will be moderated externally. A visiting moderator will moderate this sample of work. This external moderation will take place **at the centre**.

WJEC's *Internal Assessment Manual* gives instructions about selecting and despatching samples of work to the moderator.

As a result of the moderation, the marks of candidates may be adjusted to bring the centre's marks into line with the national standard.

It assists the moderation process considerably if the final marks of all the candidates are submitted to the moderator in rank order. It is only if this is done that the moderator can be fully aware of the full impact of any scaling.

In the event of concern over the awarding procedures, the normal appeals process will apply.

**Authentication**
Candidates will be required to confirm in writing, with any exceptions stated, that the work has been completed unaided. This will be achieved by signing the Controlled Assessment box on the pre-printed sheet.

Teachers will be required to confirm in writing that, to the best of their knowledge, all the work submitted for moderation, with any exceptions stated, is the candidate's own unaided work. This will be achieved by signing the composite mark sheet and the Controlled Assessment sheet.

Malpractice discovered prior to the candidate signing the declaration of authentication need not be reported to WJEC but must be dealt with in accordance with the centre’s internal procedures.

Before any work towards the Controlled Assessment is undertaken, the attention of candidates should be drawn to the relevant JCQ Notice to Candidates. This is available on the JCQ website (www.jcq.org.uk) and included in *Instructions for Conducting Coursework/Portfolios.* More detailed guidance on the prevention of plagiarism is given in *Plagiarism in Examinations; Guidance for Teachers/Assessors* also available on the JCQ website.

Material that candidates may have acquired in their research such as multiple copies of questionnaires and pre-printed material should not be submitted.

**Retention of Controlled Assessment**
Centres need to retain the Controlled Assessments until the end of November following the Summer Examination.

## Details of assessment criteria

The assessment criteria provided should be applied to each controlled assessment task and are applicable to all focus areas in Design and Technology. The mark descriptors provide a general indication of the performance of candidates in each mark range.

### Section A Designing

**Analysis of the task (5 marks)**
This is an opportunity for candidates to define and contextualise the task in their own terms and to formulate an appropriate initial design brief. Candidates are free to carry out any research they consider necessary but the work presented for assessment will be confined to a summary of how their product sits in the market place together with an evaluation of a similar or competitor's product.

| Mark | Description of Attainment |
|---|---|
| 0 | No analysis presented. |
| 1 | There is a very basic analysis of where the product fits in the market place together with a limited evaluation of a similar product. The work presented shows little evidence of prior research and preparation. A simple brief may be evident. |
| 2 | There is a basic but appropriate analysis of where the product fits in the market place together with a basic evaluation of a similar product. The work presented shows limited evidence of prior research and preparation. A simple brief is evident. |
| 3 | There is a good analysis of where the product fits in the market place together with an evaluation of a similar product. The work presented shows some evidence of prior research and preparation. A clear brief is evident. |
| 4 | There is a very good analysis of where the product fits in the market place together with a detailed evaluation of a similar product. The work presented shows good evidence of prior research and preparation. A well-worded brief is evident. |
| 5 | There is a comprehensive analysis of where the product fits in the market place together with a very detailed evaluation of a similar product. The work presented shows clear evidence of detailed research and preparation. A clear and appropriate brief is evident. |

**Design Specification (5 marks)**

This is an opportunity for candidates to present a detailed design specification of the intended product.

| Mark | Description of Attainment |
|---|---|
| 0 | No specification presented. |
| 1 | A design specification comprising a list of basic attributes for the product. The specification shows little or no links with the analysis of the task. Information is poorly organised, little or no use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling. |
| 2 | A basic design specification comprising a list of relevant attributes for the product. The specification shows superficial links with the analysis of the task. Information shows evidence of structure, limited use of technical language/vocabulary. Written communication is limited in terms of organisation of material with some errors of grammar, punctuation and spelling. |
| 3 | A good design specification comprising a prioritised list of attributes for the product presented under appropriate headings. The specification illustrates clear links with the analysis of the task. Information is organised, basic use of technical language/vocabulary. Written communication is adequate in terms of organisation of material, with some errors of grammar, punctuation and spelling. |
| 4 | A comprehensive design specification comprising a prioritised list of attributes for the product presented under appropriate headings. The specification demonstrates strong links with the analysis of the task. Information is well organised, good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, with few errors of grammar, punctuation and spelling. |
| 5 | An excellent design specification comprising a prioritised list of attributes for the product presented under appropriate headings. The specification is well founded in the analysis of the task. Information is well organised, presented in a highly appropriate manner, very good use of technical language/vocabulary. Written communication is good, presenting appropriate material in a coherent manner, and largely error-free. |

**Generation of ideas (10 marks)**
This is an opportunity for candidates to present up to four initial design ideas for the product. Ideas are to be clearly sketched and annotated.

| Mark | Description of Attainment |
|---|---|
| 0 | No ideas presented. No evidence of written communication. |
| 1 - 2 | A small range of barely appropriate ideas that are poorly annotated. The ideas and annotation show little attention to the specification. Information is poorly organised, little or no use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling. |
| 3 - 4 | A range of appropriate ideas that are annotated. The ideas and annotation show some attention to the specification. Information shows evidence of structure, limited use of technical language/vocabulary. Written communication in terms of organisation of material with some errors of grammar, punctuation and spelling. |
| 5 - 6 | A range of clear ideas that are appropriately annotated. The ideas and annotation show some attention to the specification. Information is organised, basic use of technical language/vocabulary. Written communication is adequate in terms of organisation of material, with some errors of grammar, punctuation and spelling. |
| 7 - 8 | A range of good initial ideas that are well annotated. The ideas and annotation show good attention to the specification. Information is well organised, good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, with few errors of grammar, punctuation and spelling. |
| 9 - 10 | A range of excellent initial ideas that are very well annotated. The ideas and annotation show close attention to the specification. Information is well organised, presented in a highly appropriate manner, very good use of technical language/vocabulary. Written communication is good, presenting material in a coherent manner and largely error-free. |

**Development and modelling (25 marks)**

This is an opportunity for candidates to choose their best idea and to develop it into its final form. This section is an opportunity for candidates to use appropriate ICT. Marks are awarded for evidence of development under the headings shown. Candidates must offer options and make reasoned decisions under each heading. Evidence of these areas may be presented in integrated form across the 5 pages available.

**Form/Style/Function**

| Mark | Description of Attainment |
|---|---|
| 0 | No development of form presented. |
| 1 | Limited evidence of the form/style being developed or modelled. An alternative shape or style may be evident. There is no evidence of decision-making. |
| 2 | Some evidence of the form/style being developed or modelled. Several options are presented. There is evidence of decision-making but with little reasoning offered. |
| 3 | Clear evidence of the form/style being developed or modelled. Several options have been offered. There is evidence of reasoned decision-making. |
| 4 | Good evidence of the form/style being developed and modelled. Several appropriate options have been offered. There is clear evidence of informed decision making. |
| 5 | A variety of forms/styles have been presented and the shape and form of the product have been developed and modelled in a progressive way. A final decision based on sound reasoning has been made. |

**Materials/Components**

| Mark | Description of Attainment |
|---|---|
| 0 | No development of materials/components presented. |
| 1 | Limited evidence of the selection of appropriate materials/ components. Materials/components have been stated. There is no evidence of decision-making. |
| 2 | Some evidence of the selection of appropriate materials/components. Alternatives have been offered. There is some evidence of decision-making. |
| 3 | Clear evidence of the selection of appropriate materials/components. Alternatives have been offered. There is evidence of reasoned decision-making. |
| 4 | Clear evidence of the selection of appropriate materials/components. Appropriate alternatives have been offered. There is clear evidence of reasoned decision-making. |
| 5 | Full and clear evidence of the selection of appropriate materials/ components. Appropriate alternatives have been offered. There is evidence of well-reasoned decision-making. |

**Construction/Making**

| Mark | Description of Attainment |
|---|---|
| 0 | No development of the construction/making presented. |
| 1 | Limited evidence of the construction/making being developed. A construction/making method has been offered. There is no evidence of decision-making. |
| 2 | Some evidence of the construction being developed. A small variety of construction/making methods have been offered. There is some evidence of decision-making. |
| 3 | Clear evidence of the construction/making being developed. A variety of construction/making methods have been offered. There is evidence of reasoned decision-making. |
| 4 | Clear evidence of the construction/making being developed. A variety of appropriate construction/making methods have been considered. There is evidence of well-reasoned decision-making. |
| 5 | Full and clear evidence of the construction/making being developed. A range of appropriate construction/making methods has been considered. There is evidence of well-reasoned decision-making. |

**Size/Quantity**

| Mark | Description of Attainment |
|---|---|
| 0 | No development of size/quantity presented. |
| 1 | Limited evidence of sizes and or quantities being developed. Sizes or quantities may be evident. There is no evidence of decision-making. |
| 2 | Some evidence of sizes and or quantities being developed. Alternative sizes and or quantities will be evident. There is some evidence of decision-making. |
| 3 | Clear evidence of sizes and or quantities being developed. Alternative sizes and or quantities will be evident. There is evidence of reasoned decision-making. |
| 4 | Clear evidence of sizes and or quantities being developed. Sizes and or quantities have been developed in a progressive way. There is evidence of reasoned decision-making. |
| 5 | Full and clear evidence of sizes and or quantities being developed. Alternative sizes and or quantities have been systematically evaluated. There is clear evidence of well-reasoned decision-making. |

**Finish/Quality**

| Mark | Description of Attainment |
|---|---|
| 0 | No development of finish/quality presented. |
| 1 | Limited evidence of the development of finish/quality. A suitable finish may be offered. There is no reference to quality control. There is no evidence of decision-making. |
| 2 | Some evidence of the development of finish/quality. An alternative finish is offered. There is brief reference to quality control. There is evidence of decision-making. |
| 3 | Some evidence of the development of finish/quality. Alternative finishes are offered. There is reference to aspects or quality control. There is evidence of decision-making. |
| 4 | Clear evidence of the development of finish/quality. Alternative finishes are offered. There is reference to aspects of quality control. There is evidence of reasoned decision-making. |
| 5 | Full and clear evidence of the development of finish/quality. A range of alternative finishes is offered. There is reference to a variety of quality control issues. There is evidence of well-reasoned decision-making. |

**Final solution**

This is an opportunity for candidates to give full details of their final design using presentation techniques appropriate to the chosen focus area. Details of the form, dimensions, construction, components, materials and finish will be included as appropriate. This section is an opportunity for candidates to use appropriate ICT. Marks are awarded for (a) a graphical presentation of the final design and (b) The technical details that support manufacture.

**(a) Graphical presentation (5 marks)**

This is an opportunity for the candidate to present a clear and expressive graphical presentation of their final design. Any appropriate method of communication may be used.

| Mark | Description of Attainment |
|---|---|
| 0 | No graphical presentation presented. |
| 1 | A basic illustration of the final product. It is recognisable but lacks proper form. It offers little evidence of shading or colour rendering. |
| 2 | An illustration of the final product. It is recognisable and shows reasonable form. It offers evidence of shading and/or colour rendering. |

| | |
|---|---|
| 3 | A clear illustration of the final product. It is recognisable and shows good form. It offers evidence of good shading and/or colour rendering. |
| 4 | A very good graphical presentation of the final product. It uses a recognised graphical technique, is accurate in its structure and It shows effective shading and or colour rendering. |
| 5 | A very high quality graphical presentation of the final product. It uses a recognised graphical technique, is accurate in its structure and shows expressive shading and/or colour rendering. |

**(b) Technical details (5 marks)**

This is an opportunity for candidates to present the final technical details of their design. These could include dimensions, materials/components, construction and finish as appropriate to each focus area.

| **Mark** | **Description of Attainment** |
|---|---|
| 0 | No technical details presented. |
| 1 | Limited evidence of technical detail. |
| 2 | Evidence of some technical detail. |
| 3 | Evidence of many technical details. |
| 4 | Evidence of most technical detail. |
| 5 | Evidence of virtually all technical details. |

**Creative thinking (5 marks) (Throughout)**

This is an opportunity for candidates to show a measure of flair, imagination and creativity in their designing. It can be evident at any stage through the design process.

| **Mark** | **Description of Attainment** |
|---|---|
| 0 | No creative thinking presented. |
| 1 | Evidence of limited creative thinking. |
| 2 | Evidence of some creative thinking. |
| 3 | Evidence of creative thinking in several areas. |
| 4 | Evidence of much creative thinking. Some ideas show imagination and flair. Creative thinking is evident throughout the development of the product and imaginative presentational techniques are evident. |
| 5 | A high level of creative thinking. Very imaginative ideas are evident. A highly creative development of the product is evident. Presentational techniques show much flair. |

## Section B Planning, making and evaluating

### Planning the make (10 Marks)

This is an opportunity for the candidate to plan the stages and processes necessary to manufacture the product. It must be done before the candidates begins making.

| Mark | Description of Attainment |
|---|---|
| 0 | No plan for making presented. No evidence of written communication. |
| 1 - 2 | A list of manufacturing steps is evident but shows little appreciation of the work involved or the time needed. Information is poorly organised, little or no use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling. |
| 3 - 4 | A list of basic manufacturing steps is evident. The steps contain some detail of the processes required. There is little attempt to quantify the time needed. Information is organised, basic use of technical language/vocabulary. Written communication is limited in terms of organisation of material with some errors of grammar, punctuation and spelling. |
| 5 - 6 | A list of realistic manufacturing steps is evident. The steps contain some detail of the processes required. There is an attempt to quantify the time needed. Information is organised, with basic use of technical language/vocabulary. Written communication is adequate in terms of organisation of material with some errors of grammar, punctuation and spelling. |
| 7 - 8 | A list of realistic manufacturing steps is evident. The steps contain some detail of the processes required and note any constraints. There is a realistic estimate of the time needed to manufacture the outcome. Information is well organised, with good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, with few errors of grammar, punctuation and spelling. |
| 9 - 10 | A clear, appropriate and detailed list of manufacturing steps is evident. Constraints have been recognised. There is a realistic estimate of the time needed to manufacture the outcome. Information is well organised, presented in a highly appropriate manner, with very good use of technical language/vocabulary. Written communication is good, presenting appropriate material in a coherent manner, and largely error-free. |

**Making the product (90 marks)**

This is an opportunity for candidates to demonstrate the range and quality of their manufacturing skills. The 90 marks available for making are apportioned under the following headings.

**Range and difficulty of practical processes (10 marks)**

| **Mark** | **Attainment** |
|---|---|
| 0 | No practical processes evident. |
| 1 - 2 | One straightforward practical processes are evident. |
| 3 - 4 | One or two more demanding practical processes are evident. |
| 5 - 6 | A range of fairly demanding practical processes are evident. |
| 7 - 8 | A range of demanding practical processes are evident. |
| 9 - 10 | A range of challenging practical processes are evident. |

**Quality of construction/making (25 marks**)

| **Mark** | **Attainment** |
|---|---|
| 0 | No practical processes evident. |
| 1 - 5 | Little acceptable accuracy is evident in the construction/making. |
| 6 - 10 | An adequate level of accuracy is evident in only a few aspects of the construction/making. |
| 11 - 15 | An adequate level of accuracy is evident in some aspects of the construction/making. |
| 16 - 20 | A good level of accuracy is evident in all aspects of the construction/ making. |
| 21 - 25 | A high level of accuracy is evident in all aspects of the construction/ making. |

**Dimensional accuracy (15 marks)**

| **Mark** | **Attainment** |
|---|---|
| 0 | No practical processes evident. |
| 1 - 3 | The finished product bears little resemblance to the final design proposal. |
| 4 - 6 | The finished product matches some details, both visual and technical, of the final design proposal. |
| 7 - 9 | The finished product matches many details, both visual and technical, of the final design proposal. |
| 10 - 12 | The finished product matches most details, both visual and technical, of the final design proposal. |
| 13 - 15 | The finished product matches virtually all details, both visual and technical, of the final design proposal. |

**Quality of finish/appearance (15 marks)**

| Mark | Attainment |
|---|---|
| 0 | No practical processes evident. |
| 1 - 3 | No elements of the product displays an adequate finish. |
| 4 - 6 | Some elements of the product display an adequate finish. |
| 7 - 9 | Most elements of the product display an adequate finish. |
| 10 - 12 | Most elements of the product display a good finish. |
| 13 - 15 | Great care is taken to achieve a very high quality finish on all elements of the product. |

**Function (10 marks)**

| Mark | Attainment |
|---|---|
| 0 | The product does not function on any level. |
| 1 - 2 | The product functions in a very limited or partially finished way. |
| 3 - 4 | The product functions to a limited extent. |
| 5 - 6 | The product functions fairly well. |
| 7 - 8 | The product functions well. |
| 9 - 10 | The product functions perfectly. |

**Independent working (15 marks)**

| Mark | Attainment |
|---|---|
| 0 | The candidate cannot work without constant support and advice. |
| 1 - 3 | The candidate has required considerable support and advice during the making of the product. |
| 4 - 6 | The candidate has required fairly frequent support and advice during the making of the product. |
| 7 - 9 | The candidate has required some support and advice during the making of the product. |
| 10 - 12 | The candidate has required only minor support and advice during the making of the product. |
| 13 - 15 | The candidate has worked almost entirely unaided whilst making the product. |

**Evaluation (10 marks)**

This is an opportunity for the candidate to evaluate the final product and to suggest any improvements that could be made. Evaluations must compare the final outcome with the initial intention.

**Evaluation of practical outcome (10 marks)**

| Mark | Attainment |
|---|---|
| 0 | No evaluation presented. No evidence of written communication. |
| 1 - 2 | A basic evaluation of the outcome is evident. Comments are general and do not relate back to the initial specification. Information is poorly organised, little or no use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling. |
| 3 - 4 | An evaluation of the outcome is evident. Comments offer some detail and relate in part back to the initial specification. Information shows evidence of structure, limited use of technical language/vocabulary. Written communication is limited in terms of organisation of material, with some errors of grammar, punctuation and spelling. |
| 5 - 6 | A critical evaluation of the outcome is evident. Comments offer some detail and relate in part back to the initial specification. Information is organised, with basic use of technical language/vocabulary. Written communication is adequate in terms of organisation of material, with some errors of grammar, punctuation and spelling. |
| 7 - 8 | A critical evaluation of the outcome is evident. The comments are perceptive and detailed and relate back to the initial specification. Information is well organised, with good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, with few errors of grammar, punctuation and spelling. |
| 9 - 10 | A critical evaluation of the outcome is evident. The comments are perceptive and detailed and relate in full back to the initial specification. Information is well organised, presented in a highly appropriate manner, very good use of technical language/vocabulary. Written communication is good, presenting appropriate material in a coherent manner, and largely error-free. |

**Suggested improvements (10 marks)**

This is an opportunity for candidates to put forward suggestions for improving the design and/or suggesting any improvement of techniques to ensure better quality of manufacture.

| Mark | Attainment |
|---|---|
| 0 | No improvements presented. No evidence of written communication. |
| 1 - 2 | An improvement to the design and/or manufacturing process has been suggested. Written communication is limited in terms of organisation of material, with many errors of grammar, punctuation and spelling. |
| 3 - 4 | Several suggestions for improvements to the design together with a suggestion of how quality of manufacture could be improved. Written communication is limited in terms of organisation of material, with some errors of grammar, punctuation and spelling. |
| 5 - 6 | Several relevant suggestions for improvements to the design together with suggestions of how quality of manufacture could be improved. Quality of written communication is basic, some errors of grammar, punctuation and spelling. |
| 7 - 8 | Well-founded suggestions for improvements to the design together with suggestions of how quality of manufacture could be improved. Information is well organised, with good use of technical language/vocabulary. Written communication is good, presenting mainly appropriate material in a coherent manner, few errors of grammar, punctuation and spelling. |
| 9 - 10 | Well-founded suggestions for improvements to the design together with detailed suggestions of how quality of manufacture could be improved. Information is well organised, with very good use of technical language/vocabulary. Quality of written communication is good, presenting appropriate material in a coherent manner, and largely error-free. |

# 6 GRADE DESCRIPTIONS

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content specified by 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 candidates' performance in the assessment may be balanced by better performances in others.

**Grade A**

Candidates recall, select and communicate detailed knowledge and thorough understanding of design and technology, including its wider effects.

They apply relevant knowledge, understanding and skills in a range of situations to plan and carry out investigations and tasks effectively. They test their solutions, working safely and with a high degree of precision.

They analyse and evaluate the evidence available, reviewing and adapting their methods when necessary. They present information clearly and accurately, making reasoned judgements and presenting substantiated conclusions.

**Grade C**

Candidates recall, select and communicate sound knowledge and understanding of design and technology, including its wider effects.

They apply knowledge, understanding and skills in a range of situations to plan and carry out investigations and tasks. They test their solutions, working safely and with precision.

They review the evidence available, analysing and evaluating some information clearly, and with some accuracy. They make judgements and draw appropriate conclusions.

**Grade F**

Candidates recall, select and communicate knowledge and understanding of basic aspects of design and technology, including its wider effects.

They apply limited knowledge, understanding and skills to plan and carry out simple investigations and tasks, with an awareness of the need for safety and precision. They modify their approach in the light of progress.

They review their evidence and draw basic conclusions.

# 7 THE WIDER CURRICULUM

## Key Skills

Key Skills are integral to the study of GCSE Design and Technology and may be assessed through the course content and the related scheme of assessment as defined in the specification. The following key skills can be developed through this specification at levels 1 and 2:

- Communication
- Problem Solving
- Information and Communication Technology
- Working with Others
- Improving Own Learning and Performance
- Application of Number

Mapping of opportunities for the development of these skills against Key Skills evidence requirement is provided in 'Exemplification of Key Skills for Design and Technology', which are available on the WJEC website.

## Opportunities for use of Technology

This specification gives candidates the opportunity to use their ICT skills for practical purposes, especially in the production of their design folios and associated products. These opportunities will apply particularly to the generation of information together with its processing and presentation though, depending on resources and the specific project in question, may include CAD and/or CAM work.

## Spiritual, Moral, Ethical, Social and Cultural Issues

This specification provides opportunities for candidates, through the study of their chosen focus area, to develop an understanding of spiritual, moral, ethical, social and cultural issues as they relate to the designer, manufacturer or user. The specification provides a framework and includes specific content through which individual courses may address these issues

Project work may serve to extend understanding of these issues in order that a balanced appreciation of the conflicts and dilemmas involved in the design and manufacture of products or systems may be encouraged.

Design and Technology also provides opportunities to promote enterprise and entrepreneurial skills through the process of identifying an opportunity to design a product or system to meet a specific need, investigating the work of professional designers, the manufacturing industry, developing their own product or system and finally evaluating the whole process. Tasks linked to the project provide opportunities to develop independent thinking skills, through candidates identifying relevant sources of information and developing specific performance criteria for their designs to guide their thinking.

## Citizenship

In this context citizenship is taken to include the development of social and moral responsibility, participation in community activity and development of political literacy. This specification is designed to make a contribution to the development of the knowledge, skills and understanding of citizenship. In particular, the coursework element will encourage pupils to take an effective part in school-based and community-based activities, showing a willingness and commitment to evaluate such activities critically. Aspects of the project, for example, could be directly related to the needs of the school or local community, which would provide candidates with the opportunity to tackle problems which are real and meaningful to themselves. In doing so, they will be encouraged to demonstrate personal and group responsibility in their attitudes to themselves and others: they would also need to consider critically and constructively the views of others when developing and evaluating possible solutions.

## Environmental Issues

This specification supports all aspects of environmental education. Candidates are expected to develop and appreciate a deeper understanding of the environment. The specification has been developed to consider environmental issues and candidates will be examined on their knowledge and understanding in section A of the written paper.

## Health and Safety Consideration

This part of the specification is about ensuring the safety of everyone working in the school Design and Technology rooms.

Health and safety is vital and centres must take into account all relevant safety legislation and observe all appropriate safety procedures in the working environment.

It is essential for centres to ensure that health and safety and related issues are applied and consideration of these issues must therefore be an integral part of all teaching in Design and Technology.

The specification provides candidates with the opportunity to learn about Health and Safety as it applies to them in the Design and Technology rooms and to become familiar with the processes of ensuring that safe working practices are always employed.

Candidates are should know:

(a) the safety procedures that apply in the Focus Area that they are studying;
(b) how to carry out a risk assessment for the tools and equipment they use;
(c) how to carry out a risk assessment for the machines they use;
(d) how to carry out a risk assessment for the manufacturing processes they use;
(e) how to carry out a risk assessment for the materials that they use;
(f) how to set up, adjust and use tools and equipment safely;
(g) how to set up, adjust and use machines safely;
(h) how to carry out manufacturing processes safely;
(i) how to minimise the risk to themselves and others in the working environment.

## The European Dimension

This specification supports environmental education, the European dimension and health education, consistent with EC agreements.

The approach used in constructing the specification lends itself to the establishment of links with other areas of study, particularly those involving problem solving or the use of ICT skills, knowledge and understanding, for example in the completion of tasks and assignments for other GCSE specifications.

The above approach conforms with the aspirations expressed in the 1998 Resolutions of the European Community and the Ministers of Education meeting within the Council, concerning the European dimension in education and environmental education, particularly those intended at the level of member states.