

# Higher Design and Manufacture Course Support Notes



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Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

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# Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Higher Design and Manufacture Course. They are intended for teachers and lecturers who are delivering the Course and its Units. They should be read in conjunction with the *Course Specification*, the *Course Assessment Specification* and the *Unit Specifications* for the Units in the Course.

# General guidance on the Course

## Aims

As stated in the *Course Specification*, the aims of the Course are to enable learners to develop:

- skills in design and the manufacturing of models, prototypes and products
- knowledge and understanding of commercial manufacturing processes and materials
- an understanding of the impact of design and manufacturing technologies on our environment and society

Underpinning these aims are the activities which support them — creative and iterative thinking, problem solving, understanding the relationship between cause and effect of decisions taken, an engagement with a variety of technologies in both design and manufacture, dialogue and discussion, and the articulation, communication and realisation of ideas.

## Progression into this Course

Entry to this Course is at the discretion of the centre. However, learners would normally be expected to have attained the relevant skills and knowledge required by one or more of the following or equivalent qualifications and/or experience:

- ◆ National 5 Design and Manufacture Course

### Other SQA qualifications

- ◆ National 5 Art and Design Course
- ◆ National 5 Graphic Communication Course
- ◆ National 5 Practical Metalworking Course
- ◆ National 5 Practical Woodworking Course

### Other experience

Learners may have relevant skills and knowledge gained through other education systems or from their own interests and informal learning.

## Skills, knowledge and understanding covered in this Course

This section provides further advice and guidance about skills, knowledge, and understanding that could be included in the Course.

Note: teachers and lecturers should refer to the *Course Assessment Specification* for mandatory information about the skills, knowledge and understanding to be covered in this Course.

The mandatory skills may be developed throughout the Course. The table below shows where there are likely to be significant or some opportunities to develop mandatory skills in or across the Units. This, however, in no way suggests that these mandatory skills and knowledge can be covered in totality in any singular Unit. Centres must be clear on this. The delivery model adopted and the

approaches to learning and teaching will determine how and where the opportunities actually arise.

| <b>Skills</b>  | <b>Knowledge and Understanding</b>   | <b>Design</b> | <b>Materials and Manufacture</b> | <b>Added Value</b> |
|--|--|---------------|----------------------------------|--------------------|
| Researching  | Research techniques  | ✓             |                                  |                    |
| Analysing research findings  | Evaluation techniques, specifications  | ✓             |                                  |                    |
| Idea generation  | Idea generation techniques   | ✓             |                                  | ✓                  |
| Applying knowledge of design factors to explore and refine ideas         | Design factors   | ✓             |                                  | ✓                  |
| Applying graphic techniques to explore and refine ideas                  | Graphic techniques   | ✓             |                                  | ✓                  |
| Applying modelling techniques to explore and refine ideas                | Modelling techniques   | ✓             |                                  | ✓                  |
| Applying knowledge of commercial manufacture to explore and refine ideas | Materials, manufacturing methods and assembly methods                                      | ✓             |                                  | ✓                  |
| Evaluating design decisions  | Evaluation techniques  | ✓             |                                  | ✓                  |
| Planning the production of a commercial product                          | Materials, manufacturing methods and assembly methods. Model-making techniques             | ✓             | ✓                                | ✓                  |
| Analysing the production of a commercial product                         | Materials, manufacturing methods and assembly methods. Sustainability and the environment. |               | ✓                                |                    |

## Progression from this Course

This Course or its components may provide progression to:

- ◆ Advanced Higher Design and Manufacture Course
- ◆ other technological Courses at Higher
- ◆ Skills for Work Courses in manufacturing or design
- ◆ employment, apprenticeships and/or training in manufacturing or design related fields

and ultimately, for some, to:

- ◆ a range of Design or Design Engineering-related Higher National Certificates (HNCs) and Higher National Diplomas (HNDs)
- ◆ degrees in Design or Design Engineering and related disciplines

Success in the Course may support entry to similar areas of study in further education or in employment.

## Hierarchies

**Hierarchy** is the term used to describe Courses and Units which form a structured progression involving two or more SCQF levels.

It is important that any content in a Course and/or Unit at one particular SCQF level is not repeated if a learner progresses to the next level of the hierarchy. The skills and knowledge should be able to be applied to new content and contexts to enrich the learning experience. This is for centres to manage.

This Course is designed in hierarchy with the corresponding Course at SCQF level 5 (National 5) and has the same structure of two Units with corresponding titles.

Each of the two Units, *Design*, and *Materials and Manufacturing*, together with the Course assessment, is in hierarchy with the corresponding Unit at SCQF level 5. The design of the Units means that teachers with a multi-level class may be able to design learning activities that are appropriate for a group of learners working at different levels.

Teachers should also refer to the Outcomes and Assessment Standards for each level when planning delivery. A table is provided in Appendix 2, which demonstrates the comparison between the Design and Manufacture National 5 and Higher Courses.

Further advice on multi-level delivery is given in the Higher Design and Manufacture *Unit Support Notes*.

# Approaches to learning and teaching

The Higher Design and Manufacture Course allows learners to combine practical and technological skills with creative thinking in order to design products that meet the needs and wants of people and society while accounting for responsibilities to issues of environmental stewardship and sustainability. It is intended to be delivered through a wide and varied range of teaching and learning strategies in order that all learners can engage in interesting, exploratory, and experiential learning activities that encourage active and participative learning.

The Higher Design and Manufacture Course consists of two Units — *Design*, and *Materials and Manufacturing* — and the Course assessment (assignment and question paper). The order in which the *Design* and the *Materials and Manufacturing* Units are taught is not prescribed, and it is for the centre to decide which will best support the learners in achieving their goals. Whatever approach is taken should not jeopardise the aims, intentions and essence of the Course. Professional knowledge of the learners and their needs may dictate specific avenues of approach, and careful planning partnered with strategic delivery will ensure that the learning experience will be as rich as possible.

Unit Specifications indicate a range of factors, materials and processes which are familiar and common to most centres in the contexts of design and manufacturing. Centres should however not limit themselves to these processes or materials alone if others are available. Where centres have available specific experience, expertise, equipment, materials and resources for additional or contemporary processes, then they are encouraged to make effective use of these to enhance and enrich the learners' experiences. Where the centre does not possess or have access to examples of the latest manufacturing technology, then use of multimedia and web-based resources might be effectively employed to demonstrate the operation and application of these technologies.

Close attention to issues of sustainability is encouraged, as is the potential to use alternative or reused materials in lieu of those from a raw source. Learners should be encouraged to consider the six R's: 'rethink, reuse, recycle, repair, reduce, and refuse' and a circular economy, cradle to cradle design approach when making designing and manufacturing decisions.

## **Connecting the learning**

Practitioners should help learners to make connections between what is 'being' learned technologically and what is and has been learned generally. Technological knowledge draws on knowledge from a wide range of disciplines and there are clear connections that can be made with the expressive arts, mathematics, sciences, and social subjects. Active, engaging technological learning provides a natural vehicle for building confidence in language, writing, interpretative, argument and analytical skills. In addition, good technological activity lends itself to visiting and considering the close relationships between the social, geographical and historical dimensions of the activity as well as contemporary influences and effects. Opportunities should be taken to raise learners' awareness of these connections.

Historically Scotland has provided a rich source of technological learning and development, and its contribution to design, technology and manufacturing globally has been significant and forms a considerable part of our heritage. An appreciation of this heritage and of how Scotland continues to contribute to world markets, and its relationship with design and manufacturing technologies across the globe, will help learners to make strong connections to their learning in other areas.

### **Extending the learning: personalisation and choice**

The scope of design tasks should be sufficiently 'open' to ensure that learners are required to make decisions on their own. These decisions should encourage creativity and be based on the learner's knowledge and understanding of materials, manufacturing, design factors and the environment. Tasks should be presented in such a way as to allow the learner to personalise the activity and gain ownership of it. Practitioners should be mindful of the ability of each learner and be able to help them identify when they need new knowledge to meet the breadth and depth required at Higher. The nature of this knowledge and the skills needed to solve such open tasks may well be unique to each learner; therefore practitioners should also be in a position to direct and develop each learner's ability to learn independently.

Learners are likely to find tasks that have some relevance or personal meaning to them or to their community engaging and enjoyable.

### **Sequence of delivery**

While there is no prescribed delivery sequence for Higher Design and Manufacture, centres should make a considered judgement as to which approach will best support the needs of their learners. However, there is a strong recommendation that centres adopt an integrated approach to allow the depth and breadth necessary at Higher to be fully experienced by all learners. This can be achieved through activities such as case studies, focused tasks, proficiency development, extended projects and product analysis.

For example, three or four separate design tasks could be set over the duration of the Course and these would run sequentially. Each task may have a different emphasis but nevertheless would cover Outcomes from each of the two Units. Some of the Outcomes or even part Outcomes may be experienced more rigorously and in much greater depth than others in each of the different design tasks. Such an approach will mean that each learner will have experienced each Outcome more than once. This has the advantage of enabling the learner to experience Outcomes in different ways and in different contexts, building a much deeper and broader understanding for them.

Another approach may involve the centre setting one task that would run over an extended period. Alongside this, other shorter and more focused projects could be undertaken concurrently. This approach would require the learner to work on two projects at the same time while experiencing different approaches to solving design tasks. Again the intention would be that each Outcome would be experienced more than once and in different ways.

Centres may find both of these approaches beneficial to learners who join the Course late or learners who are working in a multi-level situation and make sufficient progress during the year to move from working at National 5 to Higher. Such an approach may provide these learners with more than one opportunity to

meet the standard required by the Outcomes at Higher level. It also provides the opportunity to extend learning beyond Higher in each Outcome.

An integrated approach will bring significant benefits to the learner, presenting opportunities for broader, deeper and more connected learning. It is likely that learners will be able to observe and relate to the implicit and explicit connections between the knowledge and experiences of different Units and more importantly different activities. Well planned projects and activities will provide learners with the opportunity to demonstrate effective application of skills, knowledge and understanding during problem-solving activities.

Whichever way the Unit Outcomes are delivered, the centre must ensure that the learner is experiencing, exploring and engaging meaningfully in both design and practical activities.

Teaching and learning should be balanced and contextualised. Manufacturing and design activities are to be found throughout Scotland and where practicable local expertise and contributions might be employed well to invigorate learning. Online resources are plentiful and should be evaluated and used to support learning and context.

Effective strategies for learning and teaching should be designed to support the Assessment Standards required from each Unit. These Assessment Standards can be found within each Unit Specification:

### **Creativity**

Designing is universally regarded as a creative activity, and therefore learners should be given the opportunity to make important decisions about their own ideas. They should not be restricted to making superficial changes that have little impact on a product's function, performance, appeal or manufacture. Learners should be active in exploring their own new ideas and those of others, discussing the uncertainty and perceived impacts that these ideas present, developing solutions that can be evaluated and refined, and presenting final concepts supported by reasoned arguments for the decisions they have taken.

Learners should have the opportunity to demonstrate creativity throughout the Course, in particular in generating, exploring and refining ideas.

### **Advice on distribution of time**

The needs of the learners and the centre will largely determine the allocation of time for each of the activities and experiences and hence the overall Unit duration. Each Unit carries equal credit points. As it is likely that centres will adopt an integrated approach, the specific time allocation per Unit is less of a concern as long as the balance of activities is appropriate to the Course and that the needs of the learners are met in achieving the standards required.

### **Assessment**

Assessment activities, used to support learning, may usefully be blended with learning activities throughout the Course. By using an integrated approach to delivering the Outcomes of the Course and adopting a range of activities such as case studies, extended projects, focused tasks and product analysis, centres should be able to combine a range of assessment techniques to ensure that it becomes a natural part of teaching and learning. The principles of formative assessment for the purposes of learning should be employed throughout learners' experiences on this Course.

The Higher Design and Manufacture Course and its Units provide ample opportunity to utilise these principles. The use of feedback, self- and peer-critique with regards to design ideas, concepts, solutions and practical activity will be invaluable to the learner's progress and understanding of the issues that will need to be resolved within the contexts of design and manufacture. Centres should ensure that where peer-feedback is being used, it is practicably and theoretically correct. This may be achieved through follow-up discussions or exploring the feedback responses in greater depth. Learners may often present an opinion as a preconception or a misconception — this however can be a springboard for further experimental activities in testing those opinions. It is often more beneficial for the learners to 'arrive' at the correct destination by themselves.

The use of appropriate assessment strategies will, in addition, support learning by:

- ◆ sharing learning intentions/success criteria
- ◆ using assessment information as a basis for directing learners to improve performance, and adapting teaching and learning activities appropriately
- ◆ boosting learners' confidence by providing supportive feedback

Teachers and lecturers are expected to prepare learners adequately for the Course assessment via their approaches to learning and teaching during the Units. Learners should be made aware of the expectations and standards required for success. The methods of preparation are left to the professional. Careful planning, timing, delivery and assessment methods should support each individual learner in achieving their goal. Centres may wish to apply more formal, timed activities to assess the readiness of the learner to undertake the Course assessment. Carefully structured home learning activities will also support this aim. Learners should be aware of their progress in learning, with clear strategies agreed to maximise their success.

### **Technology and Higher Design and Manufacture**

Where centres have access to CNC technology for manufacturing or modelling, they should be assured that it is acceptable to use these in the testing or realisation of ideas that learners have generated. Learners may use the technology available to them to produce appropriate models and will not be penalised if they use entirely manual modelling techniques.

## **Developing skills for learning, skills for life and skills for work**

Learners are expected to develop broad generic skills as an integral part of their learning experience. The *Course Specification* lists the skills for learning, skills for life and skills for work that learners should develop through this Course. These are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and must be built into the Course where there are appropriate opportunities. The level of these skills will be appropriate to the level of the Course.

Guidance on the development of skills for learning, skills for life and skills for work is to be found in the support notes for each of the component Units.

# Approaches to assessment

Additional information on Unit assessment approaches is given within each of the Unit Specifications.

The approach to the delivery of Units should make the gathering of evidence a natural activity. Assessment evidence does not need to be generated as part of a complete folio or as a presentation piece. It is important that the evidence demonstrates that the learner has displayed the skill or knowledge and understanding at the appropriate level and in the correct context.

Centres may design their own methods for recording this evidence — it might be in note form or logs, digital records, eg audio-visual, photographic, spreadsheets, conversations, dialogue, discussion, and of course the physical evidence itself or a system unique to the learner. The evidence must however be valid and prove that the learner's achievements are accurate and valid.

Higher Design and Manufacture provides ample opportunity for learners and teachers to make effective use of ICT in learning, teaching and assessment activities. There are many effective and established ways in which this can be done. Centres may wish to consider how technology and ICT could be used to support and record learners' progress in the Unit Outcomes or indeed to capture and present a picture of the learner's journey. Where materials are stored electronically, centres, as always, should ensure they are secure and if necessary backed up. In constructing folios, sketches, notes, images, screen capture and text may all be incorporated electronically if desired.

## Preparation for Course assessment

Each Course has additional time which may be used at the discretion of the teacher or lecturer to enable learners to prepare for Course assessment. This time may be used near the start of the Course and at various points throughout the Course for consolidation and support. It may also be used for preparation for Unit assessment, and towards the end of the Course, for further integration, revision and preparation and/or gathering evidence for Course assessment.

Information given in the *Course Specification* and the *Course Assessment Specification* about the assessment of added value is mandatory.

Centres are free to consider how they will prepare learners to undertake the Course assessment to ensure that they will be as successful as possible. Although this will vary between centres, it is likely that learners will also have opportunities presented throughout the Unit activities to consolidate and prepare. That aside, for the Course assessment, time will be required for:

- ◆ preparation for the assignment, including completion of Detailed Information Record
- ◆ carrying out the stages of the assignment, with teacher guidance and support
- ◆ assessing the design work
- ◆ preparation for the question paper

## **Combining assessment across Units**

If centres are delivering Units concurrently then there should be opportunities to seek evidence for assessment across Units. Centres should carefully consider their intended delivery model and plan accordingly, looking to the Outcomes and Assessment Standards in each Unit for opportunities for obtaining evidence across the Units.

Centres may also find the combination of assessments across Units beneficial to a learner's development as this supports the links in learning between the Units of work in Design and Manufacture. This structure may also maximise the time for teaching and learning and avoiding the potential for repetition. Parts of or whole Outcomes or Units may be partnered with other Units and assessed where appropriate.

Where centres are using a themed or integrated approach to learning tasks and activities, it is likely that opportunities will arise to gather cross-Unit assessment evidence, however, where many discrete activities are used, this is unlikely to be the case.

# Equality and inclusion

Within any design and manufacturing-styled Course there are specific activities with which individual learners may experience particular challenges; there may also be specific issues with equipment. In such cases reasonable adjustments may be appropriate for example:

- ◆ specific learners could be supported, where required, under the direction of the learner, provided this does not affect the integrity of the qualification
- ◆ adaptive or assistive technologies should be explored as a means to facilitating greater independence
- ◆ using jigs or alternative techniques to assist with three-dimensional physical modelling

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Course Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Course.

It is important that centres are aware of and understand SQA's assessment arrangements for disabled learners, and those with additional support needs, when making requests for adjustments to published assessment arrangements. Centres will find more guidance on this in the series of publications on Assessment Arrangements on SQA's website: [www.sqa.org.uk/sqa/14977.html](http://www.sqa.org.uk/sqa/14977.html).

# Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- ◆ Assessment Arrangements (for disabled learners and/or those with additional support needs) — various publications are available on SQA’s website at: [www.sqa.org.uk/sqa/14977.html](http://www.sqa.org.uk/sqa/14977.html)
- ◆ [\*Building the Curriculum 4: Skills for learning, skills for life and skills for work\*](#)
- ◆ [\*Building the Curriculum 5: A framework for assessment\*](#)
- ◆ [Course Specifications](#)
- ◆ [Design Principles for National Courses](#)
- ◆ [Guide to Assessment \(June 2008\)](#)
- ◆ Principles and practice papers for curriculum areas
- ◆ [SCQF Handbook: User Guide](#) (published 2009) and SCQF level descriptors (reviewed during 2011 to 2012): [www.sqa.org.uk/sqa/4595.html](http://www.sqa.org.uk/sqa/4595.html)
- ◆ [\*SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work\*](#)

## Appendix 2: National 5 and Higher comparison

This table shows the relationship between the mandatory National 5 and Higher knowledge and understanding. This table may be useful for:

- ◆ designing and planning learning activities for multi-level teaching
- ◆ ensuring seamless progression between levels
- ◆ identifying important prior learning for learners at Higher

Teachers should also refer to the Outcomes and Assessment Standards for each level when planning delivery. The tables are split into those topic areas which are sampled for assessment in the question paper and those most likely to be applied (as required) in the assignment.

| <b>Component 1 — Assignment</b>   |                                    |  |            |        |  |  |
|---|------------------------------------|--|------------|--------|--|--|
| This comparison table shows those topic areas within design study and/or activities most likely to be observed within the assignment. These tables must be read in conjunction with the published versions of the respective Course Assessment Specifications (CAS) for National 5 and Higher Design and Manufacture. |                                    |  |            |        |  |  |
|   | National 5                         |  | Higher     |        | Cuts across N5/Higher  | Not applicable in this component at this level |
| Design topic areas (from CAS)   |                                    |  | National 5 | Higher |  |  |
| <b>Design process</b><br>The application of knowledge, understanding, and skills to key elements within the processes of designing  | <b>Identification of a problem</b> |  |            |        | Situation analysis.  |  |
|   | <b>Brief</b>                       |  |            |        | Purpose, statement of problem, target market. Open brief, closed brief. Design brief analysis.   |  |
|   | <b>Research</b>                    | Such as use of search engines, measuring and recording, asking questions, surveys, using data. |            |        | Sources of recorded and non-recorded information, methods of gathering information. Analysis, application and presentation of researched material. |  |

|   |  |  |   |
|---|--|--|---|
|   | <b>Specification</b>                       |  | Types and purpose of specifications: brief, product design specification, performance specification, marketing specification and technical specification. Application of researched material to produce a product design specification. |
|   | <b>Idea generation</b>                     | Morphological analysis, thought showers, technology transfer, analogy, and lateral thinking. Application of idea generation techniques. Mood and lifestyle boards. |   |
|   | <b>Development and refinement of ideas</b> | Synthesis of ideas. Justification and recording of decisions taken. Presentation techniques. Modelling techniques.   |   |
|   | <b>Evaluation</b>                          | Comparisons with specifications and standards, the concept of function and fitness for purpose.  | Surveys, questionnaires, user trips/trials, observation, testing, test rigs, comparison to other products, and comparison to specification. Application of evaluation techniques, presentation of results.                              |
| <b>Design factors</b><br>The application of knowledge and understanding to design factors and limited by the context of a given brief or design task. | <b>Function</b>                            | Primary and secondary functions, fitness for purpose.  | Primary and secondary functions, fitness for purpose, safety in use.  |
|   | <b>Performance</b>                         | Ease of maintenance, strength and durability, ease of use, material selection, construction, size.   | Design for reuse, for recycling, planned obsolescence, value for money, ease of maintenance, environmental aspects.   |
|   | <b>Market</b>                              | Consumer demands, social expectations, niche marketing, branding, introduction of new products, product life cycle, needs, wants, technology push, market pull.    |   |
|   | <b>Aesthetics</b>                          | Shape, proportion, size, colour, contrast, harmony, texture, materials, fashion.   | Factors influencing aesthetics (line, shape, form, colour, proportion, contrast, pattern, texture, harmony, balance), influences of fashion, market trends, style.  |
|   | <b>Ergonomics</b>                          | Establishing critical sizes, basic understanding of how humans interact with products, anthropometrics.  | Anthropometrics, psychology, physiology.  |

|  |   |  |  |
|--|---|--|--|
| <p><b>Communication techniques and modelling</b></p> <p>The application of communication and modelling techniques, as required, in responding to a given brief or design task.</p> | <p><b>Graphic techniques</b></p>                          | <p>Working drawings, annotated sketches and drawings, perspective sketches, illustration and presentation techniques, scale and proportion, simple orthographic drawings.</p>  | <p>The use of graphic techniques, as required, in communicating design ideas, information and detail effectively eg the use of annotated sketches, orthographic drawings, isometric, oblique, one point and two point perspective, exploded views, dimensioned views, illustration techniques, CAD, use of scale.</p> <p>Use of graphic techniques to: develop, communicate and resolve ideas.</p>                               |
|  | <p><b>Range of modelling techniques and materials</b></p> | <p>Scale models, mock-ups, and computer generated models. Use of appropriate modelling materials such as paper, card, corrugated card, MDF, wire, pipe cleaners, foam, clay, modelling compound, balsa wood, expanded foam, sheet plastic, construction kits, smart materials.</p> | <p>The use of modelling, as required, as it supports designing eg the use of scale models, mock-ups, fully crafted prototypes, test models, computer generated models, part product models, simulations and rapid prototyping.</p> <p>Use of appropriate modelling materials , as required, such as paper, card, corrugated card, MDF, wire, pipe cleaners, foam, clay, modelling compound, balsa wood, expanded foam, sheet</p> |

### Component 1 — Assignment

This comparison table shows those topic areas within materials and manufacturing study and/or activities most likely to be observed within the assignment. These tables must be read in conjunction with the published versions of the respective Course Assessment Specifications (CAS) for National 5 and Higher Design and Manufacture.

| National 5   |  | Higher  | Cuts across N5/Higher           |  | Not applicable in this component at this level   |
|--|--|---|---------------------------------|--|--|
| Materials and manufacturing topic areas (from CAS)   |  |   |                                 |  |  |
| National 5   |  |   | Higher                          |  |  |
| <b>Planning for manufacture</b><br>Application of planning techniques as required by the response to a brief   |  | Preparing materials, planning for practical tasks, assembly, selecting appropriate tooling and finishes, reading of working drawings and diagrams, including an appreciation of orthographic projection.                          | <b>Planning for manufacture</b> | <b>Production and planning systems</b> | One-off, batch, mass, line, flow. Gantt charts, flow charts, project planning, JIT, jigs, patterns, standard components, CAD/CAM, CNC machining (automation) and rapid prototyping.  |
| <b>Tools, materials and processes</b><br>The use of appropriate tools, materials and processes, as required, in the manufacturing of a prototype as required | <b>Knowledge and understanding of common tools and equipment</b> | A range of common and acceptable hand tools for:<br><br>Measuring, marking, cutting, shaping and forming of materials<br><br>A range of common and acceptable tools or equipment for: holding, clamping and restraining materials | <b>Materials and processes</b>  | <b>Plastics(including composites)</b>  | Polythene (high and low density), polyvinyl chloride, polystyrene, nylon, cellulose acetate, acrylic, polypropylene, ABS, epoxy resin, melamine formaldehyde, urea formaldehyde, polyester resin, glass-reinforced plastic, carbon-fibre plastics, elastomers including, where appropriate, labelling and symbols. |

|  |  |   |  |                           |   |
|--|--|---|--|---------------------------|---|
|  |  | A range of common and acceptable machine tools for:<br><br>Sanding, shaping, drilling or other similar activities   |  | <b>Metals</b>             | Mild steel, carbon steel, stainless steel, high-speed steel, cast iron, brass, bronze, aluminium and aluminium alloys, copper, tin, lead, zinc.   |
|  |  |   |  | <b>Woods</b>              | Beech, oak, ash, mahogany, teak, walnut, balsa, Scots pine, red cedar, Parana pine, spruce.   |
|  |  |   |  | <b>Timber derivatives</b> | Manufactured boards- fibreboards, plywood, block-board, chip-board, hard-board, and veneer.   |
|  | <b>Fixing and joining techniques</b>         | A range of standard and recognised jointing/joining techniques for woods, metals and plastics including thermal joining and adhesive bonding  |  |                           |   |
|  | <b>Metalworking and associated processes</b> | Cutting, shearing, notching, parallel and step turning, taper turning, drilling, knurling, annealing, hardening, tempering, filing, folding, bending, fitting and fixing, and in industry — casting, die-casting. |  |                           |   |
|  |  |   |  | <b>Metal processes</b>    | Cutting, turning, milling, die-casting, sand casting, lost wax casting, pressing, stamping, punching, extrusion, spot welding, arc welding, adhesive bonding, riveting, fitted joints, bolts, screws, piercing and blanking, drop forging, finishing. |

|  |   |   |  |   |   |
|--|---|---|--|---|---|
|  | <b>Woodworking and associated processes</b> | Cutting, sizing, drilling, shaping, turning.  |  | <b>Wood processes</b>                         | Cutting, drilling, turning, routing, laminating, spindle moulding, adhesive bonding, knock-down fittings, finishing.  |
|  | <b>Plastic work</b>                         | Cutting, drilling, filing, forming, bending and twisting, moulding and, in industry, vacuum forming, injection moulding, and rotational moulding. |  | <b>Plastic processes</b>                      | Cutting, injection moulding, extrusion, rotational moulding, vacuum forming, blow-moulding, laminating, joining, compression moulding, calendering, casting, bending, fabrication, coating, forming, adhesive bonding, finishing.     |
|  |   |   |  | <b>Identification of commercial processes</b> | Form, material, split lines, injection points, ejector points, shrinkage, draft angle, intricate form, clean and precise, flash, thinning of sheet material, shear marks, cross-section over length, surface finish (texture/detail). |
|  | <b>Surface finishing</b>                    | Sanding/abrading, polishing, varnishing, oiling, staining, waxing, painting/lacquering, dip coating.  |  |   |   |

|   |  |  |  |  |
|---|--|--|--|--|
| <p><b>The properties of common materials</b></p> <p>In supporting design proposals, in response to a brief, and selecting appropriate materials for a prototype</p> | <p>Softwoods, hardwoods, manufactured boards, ferrous and non-ferrous metals, thermoplastics and thermosetting plastics.</p> |  | <p><b>Properties of materials</b></p>  | <p>Justification of the selection of materials based upon their properties in the design, manufacturing and use of products.</p> |
| <p><b>Health and safety</b></p> <p>Adherence to safe working practice when undertaking design and manufacturing tasks</p>   | <p>Safe working practices and systems applicable to manufacturing activities, workshops or environments.</p>                 |  |  |  |
|   |  | <p><b>Society, environment and the world of work</b></p> | <p><b>The impact of design and manufacturing technologies on society and the environment and the world of work</b></p> | <p>Energy efficiency, sustainability, pollution, materials innovation, design for recyclability, design for reuse.</p>           |

| <b>Component 2 — question paper</b>  |                                    |   |   |
|--|------------------------------------|---|---|
| The purpose of the question paper is to assess the learner's ability to retain and integrate knowledge and understanding from across the Course. The question paper Component of Course Assessment will require learners to draw upon and apply knowledge and understanding of a sample from the topic areas listed below. |                                    |   |   |
| <b>National 5</b>  | <b>Higher</b>                      | <b>Cuts across N5/Higher</b>  | <b>Not applicable in this component at this level</b>   |
| <b>Design topic areas</b>  |                                    | <b>National 5</b>   | <b>Higher</b>   |
| <b>Members of a design team</b>  |                                    | Designers, market researchers, accountants, engineers, manufacturers, marketing teams, ergonomists, consumers, retailers, economists. | Designers, market researchers, accountants, engineers, manufacturers, lawyers, materials technologists, production specialists, marketing teams, ergonomists, consumers, retailers economists, sub-contractor. Relationships between team members and types of teams. |
| <b>Design process</b><br><br><b>The uses and/or roles (or function) of key elements within the processes of designing.</b>   | <b>Identification of a problem</b> | Situation analysis, needs and wants, and product evaluation.  |   |
|  | <b>Brief</b>                       | Statement of problem, target market, design brief analysis.   | Purpose, statement of problem, target market. Open brief, closed brief. Design brief analysis.  |
|  | <b>Research</b>                    | Such as use of search engines, measuring and recording, asking questions, surveys, using data.  | Sources of recorded and non-recorded information, methods of gathering information. Analysis, application and presentation of researched material   |
|  | <b>Specification</b>               | Generation of a specification.  | Types and purpose of specifications: brief, product design specification, performance specification, marketing specification and technical specification. Application of researched material to produce a product design specification.                               |

|   |  |  |  |
|---|--|--|--|
|   | <b>Idea generation</b>                     | Morphological analysis, thought showers, technology transfer, analogy, and lateral thinking. Application of idea generation techniques. Mood and lifestyle boards. |  |
|   | <b>Development and refinement of ideas</b> | Synthesis of ideas. Justification and recording of decisions taken. Presentation techniques. Modelling techniques.   |  |
|   | <b>Evaluation</b>                          | Surveys, user trials, comparisons with specifications and standards, the concept of function and fitness for purpose.  | Surveys, questionnaires, user trips/trials, observation, testing, test rigs, comparison to other products, and comparison to specification. Application of evaluation techniques, presentation of results. |
| <b>Design factors</b><br>The role of key design factors as they influence design and manufacturing decisions and activities | <b>Function</b>                            | Primary and secondary functions, fitness for purpose.  | Primary and secondary functions, fitness for purpose, safety in use.   |
|   | <b>Performance</b>                         | Ease of maintenance, strength and durability, ease of use, material selection, construction, size.   | Design for reuse, for recycling, planned obsolescence, value for money, ease of maintenance, environmental aspects.  |
|   | <b>Market</b>                              | Consumer demands, social expectations, niche marketing, branding, introduction of new products, product life cycle, needs, wants, technology push, market pull.    |  |
|   | <b>Aesthetics</b>                          | Shape, proportion, size, colour, contrast, harmony, texture, materials, fashion.   | Factors influencing aesthetics (line, shape, form, colour, proportion, contrast, pattern, texture, harmony, balance), influences of fashion, market trends, style  |
|   | <b>Ergonomics</b>                          | Establishing critical sizes, basic understanding of how humans interact with products, anthropometrics.  | Anthropometrics, psychology, physiology.   |

|   |  |   |   |
|---|--|---|---|
| <b>Communication techniques and modelling</b><br><br>The purpose and role of communication as an integral part of designing | <b>Graphic techniques</b>                          | Working drawings, annotated sketches and drawings, perspective sketches, illustration and presentation techniques, scale and proportion, simple orthographic drawings.  | The role of graphic techniques in communicating design ideas.   |
|   | <b>Range of modelling techniques and materials</b> | The role of simple modelling as it supports designing — scale models, mock-ups, fully crafted prototypes, computer generated models. Use of appropriate modelling materials such as paper, card, corrugated card, MDF, wire, pipe cleaners, foam, clay, modelling compound, balsa wood, expanded foam, sheet plastic, construction kits, smart materials. | The role of modelling as it supports designing.   |
| <b>The impact of design technologies on the society and the environment</b>   |  | Rise of consumerism, affordable and accessible products, and potential impact of design and manufacturing decisions on society and the environment.   | Energy efficiency, sustainability, pollution, materials innovation, design for recyclability, design for reuse, employment patterns, consumer choices and new or different skills required. |

**Materials and manufacturing topic areas (from CAS)**

Learners should be able to demonstrate knowledge of materials and processes used in the commercial manufacture of products. They should be able to demonstrate knowledge of the characteristics of materials which make them suitable for producing particular products. They should be able to identify materials used in existing products and apply their knowledge of materials to the design of new products. It should be noted that learners may refer to materials outside of the list given providing the material has appropriate characteristics for the intended use.

| National 5  |   | Higher   | Cuts across N5/Higher                  |   | Not applicable in this component at this level  |
|---|---|--|--|---|---|
| National 5  |   |  | Higher                                 |   |   |
| <p><b>Planning for manufacture</b></p> <p>Application of planning techniques as required by the response to a brief</p>   |   | <p>Preparing materials, planning for practical tasks, assembly, selecting appropriate tooling and finishes, reading of working drawings and diagrams, including an appreciation of orthographic projection.</p>                          | <p><b>Planning for manufacture</b></p> | <p><b>Production and planning systems</b></p> | <p>One-off, batch, mass, line, flow. Gantt charts, flow charts, project planning, JIT, jigs, patterns, standard components, CAD/CAM, CNC machining (automation) and rapid prototyping.</p>  |
| <p><b>Tools, materials and processes</b></p> <p>The use of appropriate tools, materials and processes, as required, in the manufacturing of a prototype as required</p> | <p><b>Knowledge and understanding of common tools and equipment</b></p> | <p>A range of common and acceptable hand tools for:</p> <p>Measuring, marking, cutting, shaping and forming of materials</p> <p>A range of common and acceptable tools or equipment for: holding, clamping and restraining materials</p> | <p><b>Materials and processes</b></p>  | <p><b>Plastics(including composites)</b></p>  | <p>Polythene (high and low density), polyvinyl chloride, polystyrene, nylon, cellulose acetate, acrylic, polypropylene, ABS, epoxy resin, melamine formaldehyde, urea formaldehyde, polyester resin, glass-reinforced plastic, carbon-fibre plastics, elastomers including, where appropriate, labelling and symbols.</p> |

|  |  |   |  |                           |   |
|--|--|---|--|---------------------------|---|
|  |  | <p>A range of common and acceptable machine tools for:</p> <p>Sanding, shaping, drilling or other similar activities</p>  |  | <b>Metals</b>             | Mild steel, carbon steel, stainless steel, high-speed steel, cast iron, brass, bronze, aluminium and aluminium alloys, copper, tin, lead, zinc.   |
|  |  |   |  | <b>Woods</b>              | Beech, oak, ash, mahogany, teak, walnut, balsa, Scots pine, red cedar, Parana pine, spruce.   |
|  |  |   |  | <b>Timber derivatives</b> | Manufactured boards- fibreboards, plywood, block-board, chip-board, hard-board, and veneer.   |
|  | <b>Fixing and joining techniques</b>         | A range of standard and recognised jointing/joining techniques for woods, metals and plastics including thermal joining and adhesive bonding  |  |                           |   |
|  | <b>Metalworking and associated processes</b> | Cutting, shearing, notching, parallel and step turning, taper turning, drilling, knurling, annealing, hardening, tempering, filing, folding, bending, fitting and fixing, and in industry — casting, die-casting. |  | <b>Metal processes</b>    | Cutting, turning, milling, die-casting, sand casting, lost wax casting, pressing, stamping, punching, extrusion, spot welding, arc welding, adhesive bonding, riveting, fitted joints, bolts, screws, piercing and blanking, drop forging, finishing. |

|  |   |   |  |   |   |
|--|---|---|--|---|---|
|  | <b>Woodworking and associated processes</b> | Cutting, sizing, drilling, shaping, turning.  |  | <b>Wood processes</b>                         | Cutting, drilling, turning, routing, laminating, spindle moulding, adhesive bonding, knock-down fittings, finishing.  |
|  | <b>Plastic work</b>                         | Cutting, drilling, filing, forming, bending and twisting, moulding and, in industry, vacuum forming, injection moulding, and rotational moulding. |  | <b>Plastic processes</b>                      | Cutting, injection moulding, extrusion, rotational moulding, vacuum forming, blow-moulding, laminating, joining, compression moulding, calendering, casting, bending, fabrication, coating, forming, adhesive bonding, finishing.     |
|  |   |   |  | <b>Identification of commercial processes</b> | Form, material, split lines, injection points, ejector points, shrinkage, draft angle, intricate form, clean and precise, flash, thinning of sheet material, shear marks, cross-section over length, surface finish (texture/detail). |
|  | <b>Surface finishing</b>                    | Sanding/abrading, polishing, varnishing, oiling, staining, waxing, painting/lacquering, dip coating.  |  |   |   |

|   |  |  |  |  |
|---|--|--|--|--|
| <p><b>The properties of common materials</b></p> <p>In supporting design proposals, in response to a brief, and selecting appropriate materials for a prototype</p> | <p>Softwoods, hardwoods, manufactured boards, ferrous and non-ferrous metals, thermoplastics and thermosetting plastics.</p>   |  | <p><b>Properties of materials</b></p>  | <p>Justification of the selection of materials based upon their properties in the design, manufacturing and use of products.</p> |
| <p><b>The impact of manufacturing technologies and activities on the world of work and society</b></p>  | <p>Reduction in workforce, skilled workforce, cost of equipment, impact on environment (energy and pollution) and the measures that can be taken to support sustainability</p> | <p><b>Society, environment and the world of work</b></p> | <p><b>The impact of design and manufacturing technologies on society and the environment and the world of work</b></p> | <p>Energy efficiency, sustainability, pollution, materials innovation, design for recyclability, design for reuse.</p>           |

# Administrative information

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## History of changes to Course Support Notes

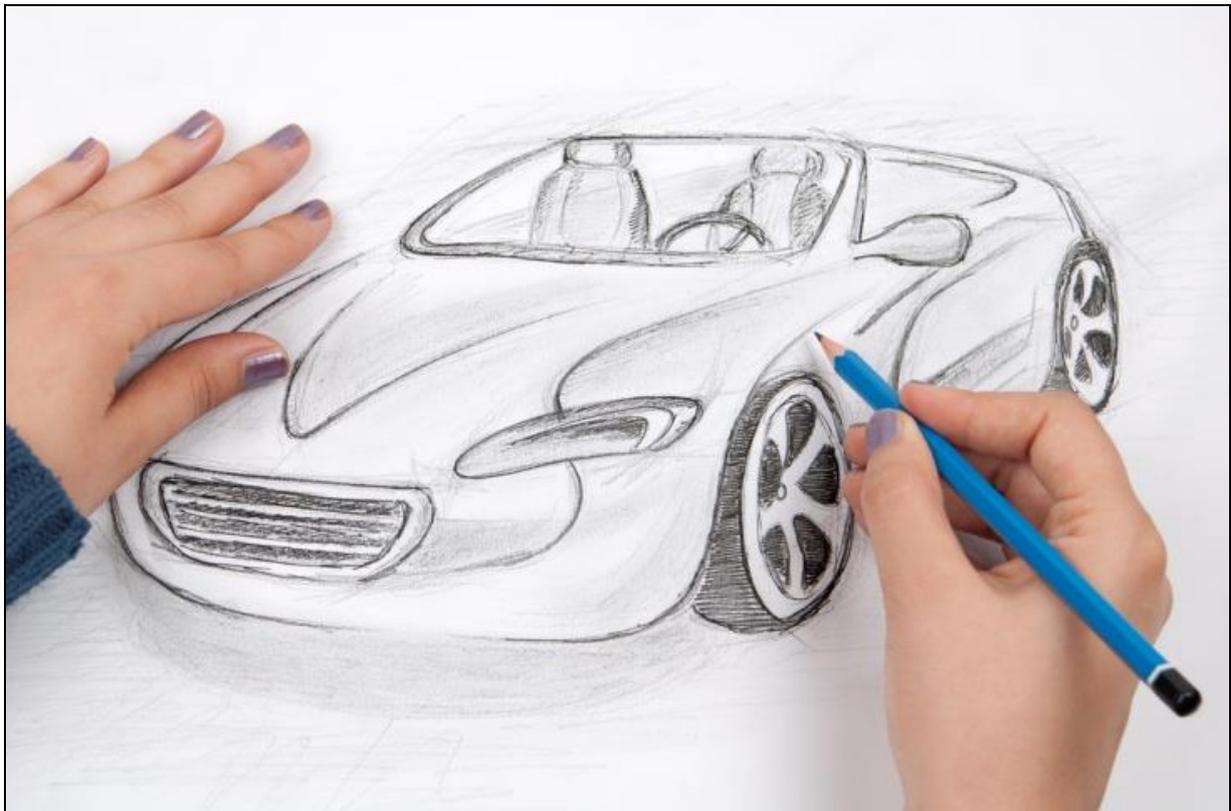
| Version | Description of change  | Authorised by                      | Date      |
|---------|--|------------------------------------|-----------|
| 2.0     | Information re sustainability and circular economy added.<br><br>National 5/Higher comparison table updated/clarified to align with Course Assessment Specification (exam/assignment split).   | Qualifications Development Manager | June 2014 |
| 3.0     | To reflect previous changes to the Unit Specifications, the 'Aims' and the table showing 'Skills, knowledge and understanding covered in this Course' have been amended. Text has been deleted and minor additions have been made to the rest of the sections. | Qualifications Manager             | May 2016  |
|         |  |                                    |           |
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## Unit Support Notes — Design and Manufacture: Design (Higher)



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Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

# Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the *Design and Manufacture: Design (Higher) Unit*. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- ◆ the *Unit Specification*
- ◆ the *Course Specification*
- ◆ the *Course Assessment Specification*
- ◆ the *Course Support Notes*
- ◆ appropriate assessment support materials

# General guidance on the Unit

## Aims

The general aim of this Unit is to develop the learner's skills in analysing briefs and producing specifications; and in developing and communicating proposals to meet a specification.

Learners will gain skills and experience carrying out research and analysing the results. Learners will develop skills in generating, exploring and refining ideas. In order to carry out exploration and refinement learners will develop knowledge and understanding of design issues, materials, manufacturing and evaluation techniques. Learners will also develop their skills in applying this knowledge and understanding to design tasks.

By undertaking this Unit, learners will develop a variety of skills in communication, in particular the application of graphic and modelling techniques.

Numeracy skills will be developed and drawn on as learners make informed use of information such as anthropometric data, costings, economies of scale, etc.

The development of thinking skills is an essential element of the learning in this Unit and learners will progress, build on and justify the design decisions they are making.

Learners will apply their skills and knowledge in problem-solving activities in response to realistic and relevant situations.

The Unit can be delivered:

- ◆ as a stand-alone Unit
- ◆ as a component of the Higher Design and Manufacture Course

This Unit is a mandatory Unit of the Higher Design and Manufacture Course.

## Progression into this Unit

Entry to this Unit is at the discretion of the centre, though learners would normally be expected to have demonstrated relevant experience and successes in:

- ◆ National 5 Design and Manufacture Course
- ◆ National 5 Design and Manufacture Unit: Design

Where learners' experiences derive from employment or other areas, centres should satisfy themselves as to the appropriateness of the Unit for study, the capabilities of the learner, and hence the likelihood of success.

## Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the Higher Design and Manufacture *Course Support Notes*.

If the Unit is being delivered as part of the Higher Design and Manufacture Course, the teacher should refer to the 'Further mandatory information on Course coverage' section within the *Course Assessment Specification* for detailed content.

If this Unit is being delivered on a free-standing basis, teachers and lecturers are free to select the skills, knowledge, understanding and contexts which are most appropriate for delivery in their centres.

## Progression from this Unit

Experience and skills obtained in this Unit will support progression to:

- ◆ Advanced Higher Design and Manufacture Course or its relevant component Units

In addition, success in this Unit may also support progression to:

- ◆ Higher Graphic Communication Course
- ◆ Higher Art and Design Course
- ◆ other technology, design or manufacture-based Courses and activities

This Unit may support a learner's access to further education or employment as part of a wider entrance portfolio.

Centres should take account of the learner's strengths and the appropriateness of this Unit for entry to other Courses or programmes of study.

# Approaches to learning and teaching

Centres should ensure teaching and learning strategies provide access for all learners to this Unit. The effective and strategic use of resources including ICT, a differentiated approach, learning aids and adapted resources where appropriate might be considered in providing an inclusive learning environment. Resources used for analysis or evaluation are likely to be those which learners are familiar with on a day-to-day basis, although aspects of unfamiliar artefacts and products may provide useful stimulus for discussion.

Advances in technology have introduced options that can extend access and opportunity as well as personalisation and choice to all learners.

Encouraging personalisation and choice is a recurring theme for qualifications developed to support Curriculum for Excellence. Where learners wish to use their own materials for case study or evaluative purposes, this is to be encouraged. Lecturers and teachers should ensure that they are appropriate for the learning task in terms of complexity, safety and allowing learners to demonstrate the required standard.

Some approaches to learning and teaching are given below but are suggestions only. Teachers and lecturers are encouraged to develop and plan their own strategies appropriate to the needs and strengths of learners in their centres.

- ◆ personal investigation and research
- ◆ audio/visual presentations
- ◆ external visits/field trips
- ◆ guest speakers
- ◆ demonstration of practical tasks
- ◆ outdoor learning
- ◆ active learning
- ◆ co-operative and collaborative learning
- ◆ peer education
- ◆ use of ICT
- ◆ project-based
- ◆ effective use of out-of-school learning activities

Support materials and resources can be found on Education Scotland's website.

## Sequence of Outcomes

There is no prescribed order in which centres must deliver the Unit Outcomes. Resources and techniques will vary between centres, so it is likely that a preferred approach will emerge quickly. However, a few possibilities are shown.

There are two Outcomes to this Unit.

1. Analyse a design brief and produce a detailed specification
2. Develop and communicate a proposal to meet a design specification

Some centres may find wish to deliver both Outcomes concurrently. Using a project-based approach may facilitate this. With this, it would be advisable to see

the project through to prototype and completion. In doing so it is likely that the relevant skills, knowledge and understanding pertaining to this Unit will be captured for assessment. It will also provide a natural opportunity to capture some evidence for other Units.

Centres should spend sufficient time developing the necessary designing skills. This could be done in the form of 'mini-projects' or three or four separate tasks which allow the learner to focus on specific aspects of design. Such activities could either be carried out in a range of contexts or in a single context according to the focus. For example, a focused study on ergonomics and anthropometrics might provide higher levels of interest and engagement from learners in a mini-project context.

Where a centre approaches learning and teaching in a set of project-based activities, evidence of the learner's best work for each Outcome may be obtained from a variety of practical design tasks.

Whatever approach is adopted, centres must satisfy themselves that the planned delivery best supports their own needs and in particular those of their learners. More information is given in the *Course Support Notes* to assist in strategies for cross-Unit planning — with particular reference to tasks.

#### **Meeting the needs of all learners**

The Higher Design and Manufacture Course is designed to be hierarchical. This should support multi-level teaching where required. It is likely that most centres will already be familiar with strategies for multi-level approaches in design and manufacture styled Courses, such as: Intermediate Courses for Product Design or Standard Grade Craft and Design and be able to draw upon this good practice.

Many of the skill sets between Higher and National 5 are similar, with Higher generally requiring greater independence on the part of the learner, increased breadth, depth and study in techniques and knowledge. There is also a greater emphasis on commercial manufacture in Higher.

## **Developing skills for learning, skills for life and skills for work**

Learners are expected to develop broad generic skills as an integral part of their learning experience. The *Unit Specification* lists the skills for learning, skills for life and skills for work that learners should develop through this Unit. These are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and must be built into the Unit where there are appropriate opportunities. The level of these skills will be appropriate to the level of the Unit.

The table below highlights opportunities to develop these skills during this Unit.

|  |  |
|--|--|
| <b>2 Numeracy</b>                                  |  |
| 2.2 Money, time and measurement                    | Cost and value, measurement, dimension, anthropometrics, Gantt charts                          |
| <b>4 Employability, enterprise and citizenship</b> |  |
| 4.4 Enterprise                                     | Working creatively to resolve design problems, co-operative working                            |
| <b>5 Thinking skills</b>                           |  |
| 5.3 Applying                                       | Design knowledge to complex problems, modelling and conceptual thinking in communicating ideas |
| 5.4 Analysing and evaluating                       | Situational analysis, product evaluation, thinking and analysing through modelling             |
| 5.5 Creating                                       | Ideas, innovation and conceptual solutions to problems   |

# Approaches to assessment and gathering evidence

## Outcome 1

The learner will:

### 1 Analyse a design brief and produce a detailed specification by:

- 1.1 Carrying out relevant research into appropriate design factors
- 1.2 Incorporating valid findings of research into a detailed specification

### Notes on Outcome 1

The brief may be given to the learners or they may generate their own. It is very important that the brief contains enough information to allow them to generate appropriate evidence for both Assessment Standards. A very vague or open brief is likely to leave the learner carrying out invalid research, resulting in a poor specification.

Learners should select enough design factors to allow them to fully analyse the brief and produce a specification which details the requirements of the proposal. Research carried out should be aimed at producing a detailed specification and not be generic. Learners should be given direction when their research is misguided.

The research evidence may be presented in a number of ways; though it is most likely it will appear in a portfolio of work which includes text, photographs, charts and graphs. The specification is likely to be in the form of a list of the requirements of each of the design factors researched.

## Outcome 2

The learner will:

### 2 Develop and communicate a proposal to meet a design specification by:

- 2.1 Using knowledge of commercial manufacturing
- 2.2 Producing creative and diverse ideas
- 2.3 Carrying out on-going evaluation of design decisions
- 2.4 Using knowledge of design factors to explore and refine ideas effectively
- 2.5 Using appropriate graphic techniques to explore and refine ideas effectively
- 2.6 Using appropriate modelling techniques to explore and refine ideas effectively

### Notes on Outcome 2

The starting point for this Outcome may be the specification generated from Outcome 1 or may be another specification supplied by the centre. It is very important that the specification provides enough detail to allow the learners to explore and refine ideas. A vague specification will make it more difficult for learners to display the skills required to meet the Assessment Standards of this Outcome.

Learners may demonstrate their skills throughout the development of the proposal.

It should be noted that the skills are in *the use of* knowledge or techniques.

## Combining assessment within Units

It may be possible to develop learning/assessment activities which provide evidence that learners have achieved the standards for more than one Outcome within the Unit, thereby reducing the assessment burden on learners. Combining assessment of Outcomes (or parts of Outcomes) in this way is perfectly acceptable, but needs to be carefully managed to ensure that all Assessment Standards and Outcomes for the Unit are covered.

### Unit assessment

The learner must demonstrate attainment of **all** of the Outcomes and their associated Assessment Standards. Assessment must be valid, reliable and fit for purpose.

SQA does not specify the methods of assessment to be used; teachers should determine the most appropriate method for their learners. In many cases, evidence (which may be oral or observational, depending on the standard being assessed) will be gathered during normal classroom activities, rather than through formalised assessment tasks.

Centres are expected to maintain a detailed record of evidence, including oral or observational evidence. Evidence in written or presentation format should be retained by the centre.

### Authentication of evidence

All evidence should be gathered under supervised conditions.

In order to ensure that the learner's work is their own, the following strategies are recommended:

- ◆ personal interviews with learners where teachers can ask additional questions about the completed work
- ◆ asking learners to do an oral presentation on their work
- ◆ ensuring learners are clear about acknowledging sources
- ◆ using checklists to record the authentication activity

# Equality and inclusion

Some learners may have difficulty in the production of traditional design folios. They should be allowed to demonstrate their skills in developing and communicating a design concept in whatever form is most suited to their needs. ICT, when and where appropriate, should be used to support active learning. Learners should be allowed to make use of word processing software and text-to-speech software if necessary. Learners should be given access to learning materials in electronic format if necessary to their needs so that it can be adapted to make it accessible.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Unit Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approaches to assessment will, in fact, generate the necessary evidence of achievement.

# Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- ◆ Assessment Arrangements (for disabled learners and/or those with additional support needs) — various publications on SQA’s website: [www.sqa.org.uk/sqa/14977.html](http://www.sqa.org.uk/sqa/14977.html).
- ◆ [\*Building the Curriculum 4: Skills for learning, skills for life and skills for work\*](#)
- ◆ [\*Building the Curriculum 5: A framework for assessment\*](#)
- ◆ [\*Course Specifications\*](#)
- ◆ [\*Design Principles for National Courses\*](#)
- ◆ [\*Guide to Assessment \(June 2008\)\*](#)
- ◆ *Principles and practice papers for curriculum areas*
- ◆ *Research Report 4 — Less is More: Good Practice in Reducing Assessment Time*
- ◆ *Coursework Authenticity — a Guide for Teachers and Lecturers*
- ◆ [\*SCQF Handbook: User Guide\*](#) (published 2009) and SCQF level descriptors (reviewed during 2011 to 2012): [www.sqa.org.uk/sqa/4595.html](http://www.sqa.org.uk/sqa/4595.html)
- ◆ [\*SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work\*](#)
- ◆ *Template and Guidance for Unit Assessment Exemplification*
- ◆ SQA Guidelines on e-assessment for Schools
- ◆ SQA Guidelines on Online Assessment for Further Education
- ◆ SQA e-assessment web page: [www.sqa.org.uk/sqa/5606.html](http://www.sqa.org.uk/sqa/5606.html)

# Administrative information

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**Published:** May 2016 (version 3.0)

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## History of changes to Unit Support Notes

| Version | Description of change   | Authorised by                      | Date      |
|---------|---|------------------------------------|-----------|
| 2.0     | Assessment Standards aligned with Unit Specification.   | Qualifications Development Manager | June 2014 |
| 3.0     | To reflect previous changes to the Unit Specifications, the 'Aims' have been amended. 'Approaches to learning and teaching' and 'Approaches to assessment and gathering evidence' sections have been rewritten accordingly. | Qualifications Manager             | May 2016  |
|         |   |                                    |           |
|         |   |                                    |           |

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## Unit Support Notes — Design and Manufacture: Materials and Manufacturing (Higher)



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Please refer to the note of changes at the end of this template for details of changes from previous version (where applicable).

# Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the *Design and Manufacture: Materials and Manufacturing* (Higher) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- ◆ the *Unit Specification*
- ◆ the *Course Specification*
- ◆ the *Course Assessment Specification*
- ◆ the *Course Support Notes*
- ◆ appropriate assessment support materials

# General guidance on the Unit

## Aims

The general aim of this Unit is to develop the learner's knowledge and understanding of commercial manufacture. The aim includes developing an understanding and application of the properties and uses of manufacturing processes and materials.

Learners will manufacture models and prototypes in order to plan production of a commercial product. The Unit is designed to enable the learner to develop an understanding of the impact of materials and manufacturing processes on design and the environment.

Learners will develop an understanding of manufacturing processes and of the various factors that influence the design and manufacture of products. Learners will have to consider the manufacturing techniques and processes that would apply in an industrial/commercial context.

Throughout this Unit, learners will develop skills in technological literacy through the development of knowledge and understanding and by practice in manipulating materials through common processes. Through discussion, dialogue, problem-solving and reflective activities, learners will continue to develop their skills in listening and talking and the skills needed to work with others co-operatively.

Learners will utilise and build on their numeracy skills as they undertake activities involving measuring and marking, judging, gauging, counting, distributing and creating numerical or quantitative lists as they apply them to their project or product requirements.

Opportunities should be created to allow learners to demonstrate their ability to think creatively in assisting learners to demonstrate their abilities in problem solving, meeting perceived needs, and using resources effectively. By using relevant and realistic scenarios, learners will be able to apply these skills in context.

The Unit can be delivered:

- ◆ as a stand-alone Unit
- ◆ as a component of the Higher Design and Manufacture Course

This Unit is a mandatory Unit of the Higher Design and Manufacture Course.

## Progression into this Unit

Entry to this Unit is at the discretion of the centre, though learners would normally be expected to have demonstrated relevant experience and successes in:

- ◆ National 5 Design and Manufacture Course
- ◆ Design and Manufacture Unit: Materials and Manufacturing (National 5) Unit

Where learners' experiences derive from employment or other areas, centres should satisfy themselves as to the appropriateness of the Unit for study, the capabilities of the learner and hence the likelihood of success.

## **Skills, knowledge and understanding covered in this Unit**

Information about skills, knowledge and understanding is given in the Higher Design and Manufacture *Course Support Notes*.

If the Unit is being delivered as part of the Higher Design and Manufacture Course, the teacher should refer to the 'Further mandatory information on Course coverage' section within the *Course Assessment Specification* for detailed content.

If this Unit is being delivered on a free-standing basis, teachers and lecturers are free to select the skills, knowledge, understanding and contexts which are most appropriate for delivery in their centres.

## **Progression from this Unit**

Experience and skills obtained in this Unit will support progression to:

- ◆ Advanced Higher Design and Manufacture Course

In addition, success in this Unit may also support progression to:

- ◆ Higher Graphic Communication Course
- ◆ Higher Art and Design Course
- ◆ other technology, design or manufactured-based Courses and activities

This Unit may support a learner's access to further education or employment as part of a wider entrance portfolio.

Centres should take account of the learner's strengths and the appropriateness of this Unit for entry to other Courses or programmes of study.

# Approaches to learning and teaching

Centres should ensure teaching and managing strategies provide access for all learners to this Unit. The effective and strategic use of resources including ICT, a differentiated approach, learning aids and adapted resources, where appropriate, might be considered in providing an inclusive learning environment.

Advances in technology have introduced options that can extend access and opportunity as well as personalisation and choice to all learners.

Encouraging personalisation and choice is a recurring theme for qualifications developed to support Curriculum for Excellence. Teachers and lecturers are encouraged to use different learning and teaching strategies to support the needs of all learners.

Some approaches to learning and teaching are given below but are suggestions only. Teachers and lecturers are encouraged to develop and plan their own strategies appropriate to the needs and strengths of learners in their centres.

- ◆ personal investigation and research
- ◆ audio/visual presentations
- ◆ external visits/field trips
- ◆ guest speakers
- ◆ demonstration of practical tasks
- ◆ outdoor learning
- ◆ active learning
- ◆ co-operative and collaborative learning
- ◆ peer education
- ◆ use of ICT
- ◆ project-based
- ◆ effective use of out-of-school learning activities

Support materials and resources can be found on Education Scotland's website.

## Sequence of Outcomes

There is no prescribed order in which centres must deliver the Unit Outcomes. Resources and techniques will vary between centres, so it is likely that a preferred approach will emerge quickly. However, a few possibilities are shown.

There are two Outcomes to this Unit.

- 1 Analyse the production of a commercial product
- 2 Plan the production of a commercial product

Centres should spend sufficient time developing model-making skills in working with a variety of materials, tools and manufacturing techniques. This could be done in the form of 'mini-projects' that focus on developing skills in context. It is expected that all centres will continue to develop skills in modelling and manufacturing using manual methods — where a centre has access to contemporary manufacturing technology, they may be assured that this can be

used to support learning and teaching. Further information can be found in the *Course Support Notes*.

Centres should also commit sufficient time to developing knowledge and application of the breadth of modelling and manufacturing processes, tools and equipment needed to manufacture a detailed prototype/model. These will differ somewhat from National 5, and time given over in adequately preparing learners through the use of proficiency tasks will allow them to meet the high standards required.

If centres use a project-based approach to learning and teaching, evidence of the learner's best work for each Outcome is likely to be captured from across a range of activities. It is likely also that this Unit will be delivered partially alongside the *Design and Manufacture: Design* (Higher) Unit, in supporting the skills, knowledge and application thereof in learners' design work.

There are a number of options available, though delivery is not limited to those described.

### **Outcomes 1 and 2 delivered concurrently**

This approach would likely require learners to generate evidence using at least two products. They would analyse at least one product while working on the planning for the production of at least one other. Although this method may provide a variety of activity for learners, clear structure and management of the activities would be required.

### **Outcomes 1 and 2 delivered consecutively**

This approach would allow learners to apply the knowledge and understanding gained from Outcome 1 to their planning in Outcome 2. Although the same type of product could be used for both Outcomes it is recommended that different products are used, as this will widen the learning experience and is likely to be more engaging.

If this Unit is being delivered as part of the Higher Design and Manufacture Course, then it may be that Outcomes 2 is delivered in an integrated fashion supporting the *Design* Unit.

Whatever approach is adopted, centres must satisfy themselves that the planned delivery best supports their own needs and in particular those of their learners. More information is given in the *Course Support Notes* to assist in strategies for cross-Unit planning — with particular reference to tasks.

### **Meeting the needs of all learners**

The Higher Design and Manufacture Course is designed to be hierarchical. This should support multi-level teaching where required. It is likely that most centres will already be familiar with strategies for multi-level approaches in design and manufacture styled Courses such as: Intermediate Courses for Product Design or Standard Grade Craft and Design and be able to draw upon this good practice.

Many of the skill sets between Higher and National 5 are similar, with Higher generally requiring greater independence on the part of the learner, increased breadth, depth and study in techniques and knowledge. There is also a greater emphasis on commercial manufacture in Higher as opposed to the emphasis on workshop manufacture.

These different contexts will produce some challenges in a multi-level setting and centres must take care to provide a clear differentiation of the two. It is likely that, in this Unit, some learning activities, processes, study notes and materials may well be different.

It should be noted that the model-making skills required at Higher may allow centres opportunity to use teaching and learning activities which bridge all levels.

## **Developing skills for learning, skills for life and skills for work**

Learners are expected to develop broad generic skills as an integral part of their learning experience. The *Unit Specification* lists the skills for learning, skills for life and skills for work that learners should develop through this Unit. These are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and must be built into the Unit where there are appropriate opportunities. The level of these skills will be appropriate to the level of the Unit.

The table below highlights opportunities to develop these skills during this Unit.

|  |                                    |   |
|--|------------------------------------|---|
| <b>2 Numeracy</b>                                  |                                    |   |
| <b>2.2</b>   | <b>Money, time and measurement</b> | Cost and value, measurement, dimension, Gantt charts, weight  |
| <b>4 Employability, enterprise and citizenship</b> |                                    |   |
| <b>4.4</b>   | <b>Enterprise</b>                  | Working creatively to resolve design problems, co-operative working.                                  |
| <b>5 Thinking skills</b>                           |                                    |   |
| <b>5.3</b>   | <b>Applying</b>                    | Manufacturing knowledge to complex problems, modelling and conceptual thinking in communicating ideas |
| <b>5.4</b>   | <b>Analysing and evaluating</b>    | Situational analysis, process evaluation, thinking and analysing through modelling and manufacturing  |
| <b>5.5</b>   | <b>Creating</b>                    | Ideas, innovation and conceptual and solutions to problems  |

# Approaches to assessment and gathering evidence

## Outcome 1

The learner will:

### 1 Analyse the production of a commercial product by:

- 1.1 Exploring the suitability of the materials used
- 1.2 Exploring the suitability of the manufacturing and assembly processes used
- 1.3 Exploring the product's sustainability and its impact on the environment

Learners should select a product or a range of products which allows them to fully analyse the production. Centre may give advice to learners on the suitability of products.

Suitable research and evaluation techniques should be used in order to generate the level of research evidence required. Learners should be given direction when their research is misguided.

The research evidence may be presented in a number of ways; though it is most likely it will appear in a portfolio of work which includes text, photographs, charts and graphs. Conclusions should be drawn from the research.

## Outcome 2

The learner will:

### 2. Plan the production of a commercial product by:

- 2.1 Manufacturing an accurate and detailed prototype/scale model
- 2.2 Using information gathered from the prototype/scale model
- 2.3 Selecting and justifying suitable materials
- 2.4 Selecting and justifying suitable manufacturing and assembly processes

The starting point for this Outcome may be the proposal developed in Outcome 2 of the Design Unit. Alternatively, a discrete task may be used to meet the Outcome.

Whichever method is used, it is important that learners understand the level of detail required and centres should provide guidance.

It should be noted that the purpose of the prototype/model is to aid the planning of a commercial product and therefore it should have appropriate accuracy and detail.

Assessment of this Unit can and should take many forms. It is important to adhere to the purpose of the assessment — consider the rigour, validity and learning purposes of the assessment as it applies to the Unit and the level.

Teachers/lecturers should ensure that they pay close attention to the Outcomes and Assessment Standards and Evidence Requirements in the *Unit Specification*.

Due to the nature of the skills being developed and assessed in this Unit, it is reasonable for learners to be aware of the assessment task from the onset to allow them to develop and prepare towards it. Learners should be permitted access to a variety of sources of information and learning resources to enable them to research design factors appropriately. Therefore an open-book approach to assessment is appropriate.

## **Combining assessment within Units**

It may be possible to develop learning / assessment activities which provide evidence that learners have achieved the standards for more than one Outcome within the Unit, thereby reducing the assessment burden on learners. Combining assessment of Outcomes (or parts of Outcomes) in this way is perfectly acceptable, but needs to be carefully managed to ensure that all Assessment Standards and Outcomes for the Unit are covered.

### **Unit assessment**

The learner must demonstrate attainment of **all** of the Outcomes and their associated Assessment Standards. Assessment must be valid, reliable and fit for purpose.

SQA does not specify the methods of assessment to be used; teachers should determine the most appropriate method for their learners. In many cases, evidence (which may be oral or observational) will be gathered during normal classroom activities, rather than through formal assessment instruments. Centres are expected to maintain a detailed record of evidence, including oral or observational evidence. Evidence in written or presentation format should be retained by the centre.

### **Authentication of evidence**

All evidence should be gathered under supervised conditions.

In order to ensure that the learner's work is their own, the following strategies are recommended:

- ◆ personal interviews with learners where teachers can ask additional questions about the completed work
- ◆ asking learners to do an oral presentation on their work
- ◆ ensuring learners are clear about acknowledging sources
- ◆ using checklists to record the authentication activity

# Equality and inclusion

Where learners have accessibility needs then all efforts should be made to support and accommodate their learning and successes in the Course.

Learners should be allowed to make use of templates and jigs to assist them to complete tasks where required.

Full use should be made of ICT where appropriate to assist learners to develop skills in knowledge and understanding of materials and processes. Learners should be allowed to make use of word processing software and text-to-speech software if necessary. Learners should be given access to learning materials in electronic format if necessary to their needs so that they can be adapted to make them accessible.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Unit Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approaches to assessment will, in fact, generate the necessary evidence of achievement.

# Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- ◆ Assessment Arrangements (for disabled learners and/or those with additional support needs) — various publications on SQA’s website:  
[www.sqa.org.uk/sqa/14977.html](http://www.sqa.org.uk/sqa/14977.html)
- ◆ [\*Building the Curriculum 4: Skills for learning, skills for life and skills for work\*](#)
- ◆ [\*Building the Curriculum 5: A framework for assessment\*](#)
- ◆ [\*Course Specifications\*](#)
- ◆ [\*Design Principles for National Courses\*](#)
- ◆ [\*Guide to Assessment\* \(June 2008\)](#)
- ◆ *Principles and practice papers for curriculum areas*
- ◆ *Research Report 4 — Less is More: Good Practice in Reducing Assessment Time*
- ◆ *Coursework Authenticity — a Guide for Teachers and Lecturers*
- ◆ [\*SCQF Handbook: User Guide\* \(published 2009\)](#) and SCQF level descriptors (reviewed during 2011 to 2012):  
[www.sqa.org.uk/sqa/4595.html](http://www.sqa.org.uk/sqa/4595.html)
- ◆ [\*SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work\*](#)
- ◆ *Template and Guidance for Unit Assessment Exemplification*
- ◆ SQA Guidelines on e-assessment for Schools
- ◆ SQA Guidelines on Online Assessment for Further Education
- ◆ SQA e-assessment web page: [www.sqa.org.uk/sqa/5606.html](http://www.sqa.org.uk/sqa/5606.html)

# Administrative information

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## History of changes to Unit Support Notes

| Version | Description of change   | Authorised by                      | Date      |
|---------|---|------------------------------------|-----------|
| 2.0     | Assessment Standards aligned with Unit Specification.   | Qualifications Development Manager | June 2014 |
| 3.0     | To reflect previous changes to the Unit Specifications, the 'Aims' have been amended. 'Approaches to learning and teaching' and 'Approaches to assessment and gathering evidence' sections have been rewritten accordingly. | Qualifications Manager             | May 2016  |
|         |   |                                    |           |
|         |   |                                    |           |

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