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National 5 DESIGN AND MANUFACTURE



BrightRED Study Guide

Curriculum for Excellence

N5



DESIGN AND MANUFACTURE



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INTRODUCING NATIONAL 5 DESIGN AND MANUFACTURE

HOW WILL THIS BOOK HELP YOU?

This book has been carefully researched and designed to help you improve your chances of success within the National 5 Design and Manufacture course, and to act as a supplement to your learning in school. The key priorities when writing the book were to make sure that the material fully supported your learning, while helping you to secure success as you work through the course.

All of the content within the book has been matched to the key knowledge and understanding you are required to learn for the National 5 Design and Manufacture course. Throughout this guide, advice and useful tips on answering exam questions and completing coursework are given, along with extension materials including self-study resources, online tests, exam-style questions and video clips to help you develop and practise your skill and understanding across the course.

WHAT DO YOU NEED TO LEARN?

Each chapter within this book covers the content you need to know and to understand for the course. If you go through the Contents page, you will see that there are chapters covering each unit of the course as well as all of the key content within them. In addition to this, a Glossary of key terminology is provided at the end to help you easily find the information you are looking for. The content you must learn is broken down as follows:

Design

Within this subject area, you will cover the product-design process from the initial design brief to the final design of a feasible proposal (solution). Working through this unit, you are required to develop skills in, and understanding of, these aspects:

- the design process and its importance within society
- the role of design factors and how they affect design
- the need for research and the techniques required to carry out necessary research
- the need for specifications and how to generate them
- how to communicate initial ideas and develop them towards final proposals using idea generation, graphics and modelling techniques
- the design/make/test process
- the importance of evaluating and resolving design proposals on an ongoing basis, as well as the skills required to do this.

Materials and manufacture

Within this subject area, you will cover the product-design process from the final solution through to the manufacture of a prototype or product. This will help you to understand how to 'close the design loop' by taking a proposal forward for manufacture. Working through this unit, you are required to develop skill in, and understanding of, these aspects:

- the materials available for manufacture
- the equipment and processes used to manufacture using these materials
- the practical skills required in the accurate manufacture of items

contd

- how to plan effectively for manufacture by evaluating, refining and resolving plans
- the role of commercial manufacture in design
- the impact of manufacturing technologies on the environment and our society.

Further course and unit information, as well as a breakdown of the 'Course Specification' (this is the SQA's checklist of everything you must learn), can be found at the following link.

http://www.sqa.org.uk/sqa/files_ccc/DesignAndManufactureCourseSpecN5.pdf



ONLINE

For all SQA documentation on the course, visit www.brightredbooks.net

ARE YOU READY FOR SUCCESS?

That's what this guide is all about. Don't feel daunted by the prospect of learning all of these new and unfamiliar terms and skills that the National 5 Design and Manufacture course will ask you to. Instead, use this guide to help you develop your understanding and to resolve any questions or uncertainties you may have. And, to make the process of preparation easier for you, every page has the following key features that you should look out for:

- **Don't Forget** text boxes that provide you with bite-size reminders of essential facts and tips.
- **Things to Do and Think About** text boxes require you to carry out some self-study to further develop your learning.
- **Online** links will provide you with further research and study materials.
- **Video Links** provide online links to videos to support your understanding.
- **Online Tests** provide you with access to tests that allow you to challenge yourself and assess how well you have learned topics.

Onwards and upwards

So, that's it. You are about to undertake new learning in a very exciting course that will provide you with a range of challenging and unique learning experiences. If you apply yourself and work hard, you will thoroughly enjoy the work being undertaken and will guarantee your success in achieving the National 5 award.

Good luck!

DESIGN AND THE DESIGN PROCESS

EVALUATION TECHNIQUES

EVALUATION TECHNIQUES

The following evaluation techniques can be used throughout the design process, helping the design team to find product opportunities or to evaluate their solutions. This is extremely beneficial in testing solutions for refinement or in confirming the solution is suitable for its intended purpose.

Questionnaires/surveys

As described previously, on page 12, questionnaires are a quick and effective way to canvas consumer opinion. In the same way, they can be used to find potential markets they can also be used to help you evaluate your solution.

Focus groups

A focus group is a form of research in which a group of people are asked about their opinions on a given product. The group of people chosen could be specific to a target market or members of the general public. Questions are asked to prompt discussion about the product, and the group's answers are recorded. A focus group allows people to get hands-on with the product, which often stimulates more effective discussion when evaluating **function** and **aesthetics**.



User trials

Different from 'user trips', user trials require the consumer to test a product. This is an excellent method for evaluating **function** and **ergonomics**. The person completing the user trial is usually given a series of tasks to complete. For example, if we were testing a kettle, the user may be asked to evaluate:

- How easy it is to understand and use?
- How easy it is to lift and move?
- How easy are the buttons to press?
- How comfortable is the handle to grip?

The results would then be recorded and conclusions drawn.

Test rigs (product testing)

A test rig is a way of physically testing the **performance**, extremities and limitations of a product's **function**, **durability**, **materials** and **safety**. The product will be put through a series of tests that aim to provide results based on the aforementioned design factors. Using the same example, if we performed a test rig on the kettle, we may test:

- How quickly it can boil water?
- How do the materials perform if the kettle is left boiling continually without switching off?
- Do the materials break easily if the kettle is dropped?



Testing a chair using high-pressure pneumatics to assess its strength under different weights

contd

Measuring and recording

This is an effective method for evaluating **function**, **ergonomics** and **performance**. For example:

- **Function:** If designing a bookshelf, we could measure and record a range of book sizes, allowing us to work out the best possible dimensions for shelving space.
- **Ergonomics:** Measuring and recording allows us to effectively measure the dimensions of the human body, which are crucial in ensuring that products are suited for their human users. See 'Ergonomics' (pp. 34–35).
- **Performance:** In combination with a test rig, we could measure and record aspects such as sound and weight in portable speakers, allowing us to establish how well the product performs.

Online searches

Online searches using the internet can be useful in helping to find information about competitor products and items such as consumer reviews of products. Images and data can then be collated, and conclusions can then be drawn from them.

Product comparison

A product comparison compares similar products within a similar market area and price range. This can be useful for evaluating many factors such as **function**, product features and **aesthetics** to establish what is currently on the market and what our competitors are doing. However, it is particularly effective in evaluating **value for money** and **cost**. For example, if we compare toasters, we could conduct the following evaluation:

Features	Product 1	Product 2	Product 3
			
Colours range	Black/silver	Red/black	Gold/white
Speed of toasting	2 minutes	1.5 minutes	1 minute
Slices held	2	2	3
Product guarantee	1 year	1 year	2 years
Cost	£20	£40	£32

From the comparison, we can conclude that toaster 3 is the best option based on cost and value for money, as it clearly has more attractive features at a lower price. It is important, however, that we do not compare products designed for different markets.

Comparison to the specification

One of the most assured methods of evaluating your product's suitability for its intended markets, is to compare it back to the specification. This should happen continuously throughout the design process and will ensure that your final design meets the requirements as it set out in the original specification.



THINGS TO DO AND THINK ABOUT

During the course of National 5 you will have to learn to evaluate products and design factors for developing items such as specifications. You should conduct some of the evaluation techniques outlined above to help you do this effectively and further develop your understanding of these.



ONLINE TEST

Test your knowledge of evaluation techniques at www.brightredbooks.net

MANUFACTURE

WOODWORKING JOINTS: FRAME CONSTRUCTION

FRAME CONSTRUCTION

Frame construction refers to any wooden product that is constructed as a frame. This includes window frames, picture frames, table and chair frames. It is important to note that **butt**, **mitre** and **dowel** joints can all be used in frame construction as well as the following specific frame joints:

Corner halving joint

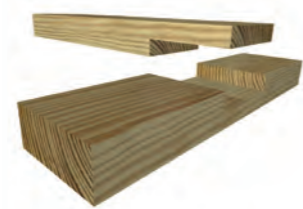
Used to join the corners of frames together, the corner halving joint is reasonably strong. A channel is cut along the end of one piece of the wood being joined to no more or less than half the depth of the wood, and to the full width of the adjoining piece of wood. This ensures structural strength.



Disassembled corner halving joint



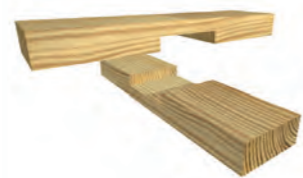
Assembled corner halving joint



Disassembled tee halving joint



Assembled tee halving joint



Disassembled cross halving joint



Assembled cross halving joint

Tee halving joint

Used to join internal parts of the frame, e.g. the middle sections of a traditional window frame. It is manufactured in the same way a corner halving joint is, with the only difference being the position.

Cross halving joint

Used to join parts of the frame that must cross one another. These are manufactured in the same way that corner and tee halving joints are; however, both pieces of wood are cut in the exact same way to allow them to cross and join.

Mortise and tenon joint

Perhaps the strongest frame joint, the mortise and tenon joint can be used for corners and partitions. A mortise (hole) is cut in one piece of wood manually using a mortise chisel and mallet, or automatically using a mortise machine. The tenon (connecting piece) is cut out using a tenon saw to create a section of wood on the adjoining piece that fits the exact size of the mortise.



Disassembled mortise and tenon joint



Assembled mortise and tenon joint

DON'T FORGET



You must learn the properties and purpose of each joint, and be able to explain how they would be manufactured manually.

ANSWERING QUESTIONS ON WOODWORKING JOINTS

In the exam, you are likely to be asked questions on how particular joints are manufactured. The question will normally refer to a specific product and indicate what joints have been used. You will have to be able to describe how the joint is cut. To answer these questions effectively, ensure that:

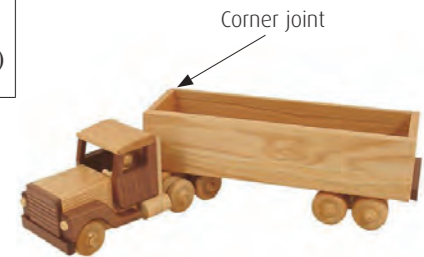
- you know each of the joints described above
- you know the common woodworking tools required to cut the joint
- you have prepared answers that describe how each joint can be manufactured.

An example is given below to help you in preparing for these types of question.

EXAMPLE:

1. A toy truck manufactured from wood is shown here.
(a) Name a suitable corner joint for the construction of the back trailer. (1 mark)

Advice: You could select a butt joint; however, this would not be durable enough to survive the kind of use it would be subjected to by a child. You could also select a finger joint, which would offer good durability; however, this could increase the cost of manufacture, and the aesthetic value offered would not be of high importance to a child.



ANSWER:

Lap joint. This would be suitable, as it is relatively cheap and quick to produce, is reasonably strong and can be further strengthened by pins or screws to increase its durability.

- (b) Describe how the joint you selected previously would be manufactured. (3 marks)

Advice: if the question is worth three marks, then try to make three or more points that explain how the joint would be manufactured. Remember that every joint will require:

- marking out
- cutting
- finishing and gluing.

You can use these four points to build your answer, and refer to tools as you do so.

ANSWER:

1. Mark out the area to be removed on the end of the required piece of wood using a rule, try square and marking gauge. Ensure the markings are: no more than half the depth, the correct width of the wood to be joined, square and parallel to the edges.
2. Using a tenon saw, cut out the area to be removed by firstly sawing down no more than halfway. Then saw down the line used to mark the length of the joint, to remove the waste material.
3. Using a bevel-edged chisel, remove any excess material to ensure that the joint surface is flat.
4. Finally, assemble, glue and clamp the joint.

ONLINE

Learn more about wood joints by exploring the link at www.brightredbooks.net

ONLINE TEST

Head to www.brightredbooks.net to test yourself on this topic.



THINGS TO DO AND THINK ABOUT

1. For each of the frame joints listed here, prepare answers on how to manufacture them, including the tools that would be required to do so. This will help you in preparing for answering questions that ask you to describe how a joint would be manufactured.
2. Using YouTube, search for the names of some of the joints listed over the previous few pages. You will find videos that will explain how these joints are cut and assembled.

MANUFACTURING IN INDUSTRY AND SOCIETY

THE IMPACT OF MANUFACTURING ON SOCIETY

As manufacturing technologies improve, so do the products we make. However, this continual advancement in technology can impact positively and negatively on society. For this reason, it is extremely important that you are aware of how manufacturing impacts on society.



Automated car production line

REDUCTION IN WORKFORCE AND THE LOSS OF A SKILLED WORKFORCE

As our demand for high-quality, low-cost products increases, designers and manufacturers have to think about how they can achieve this for us. One way is to use CAM systems, as mentioned previously. More and more, robots and automated production lines are becoming the preferred option for manufacturers, as these ultimately reduce manufacturing costs and speed up the production process. Humans are therefore being replaced by robots, leading to job losses, as a few people can operate an entire robotic production line without the need for specialist skills. This also reduces the need for skilled workers, as computer-control specialists are the only skilled workers required to help maintain the robotic machinery when necessary. Overall, this leads to insecure jobs, the loss of specialist and traditional manufacturing skills, high unemployment rates and the economic decline of industry in villages, towns and countries.

COST OF EQUIPMENT

Setting up a CAM production line is not cheap, as was outlined in the previous chapter. Companies planning to switch to this form of industry must ensure they will gain economic return on their investment. Some workers may also need retraining, which costs money; or companies may have to employ specialist staff to maintain the robots. These workers will require higher salaries – and, even if this maintenance work is outsourced, companies will have to pay a high fee for this service. This can ultimately affect the cost of the end product, driving up prices. This may also be the reason for companies to seek cheaper manufacturing in other countries.

Globalisation and social/moral implications in global manufacturing

The **rise in consumerism** due to more affordable products, and an ever-increasing global population that demands more products, has created a worldwide market for designers and their products. This is good for designers and companies; however, there are problems that **globalisation** has created. Companies are forever looking at ways to reduce manufacturing costs to make more affordable products. As manufacturers look for cheaper ways to build products, they often outsource work to factories in other countries where production costs are lower. Although this is good for companies, it is not always good for the workers and our economy.

Some countries have fewer restrictions on health and safety and workers' rights. Workers in these countries are often subject to lower wages, higher pollution and longer working hours; and sometimes the quality of the end product can suffer, as sufficient regulations are not in place. This also creates a problem for home-based industry. For example, Britain has seen much of its manufacturing industry outsourced to companies in Asia. This has led to the economic decline of Britain's industry and has caused widespread job losses as well as the loss of skilled workforces. There is a large moral issue here that companies must consider, as well as consumers, in ensuring that people the world over are treated fairly. Globalisation also creates environmental problems due to countries having differing standards for green/clean manufacturing, the disposal of waste, transporting products and recycling products.



ENVIRONMENTAL IMPACT AND SUSTAINABILITY

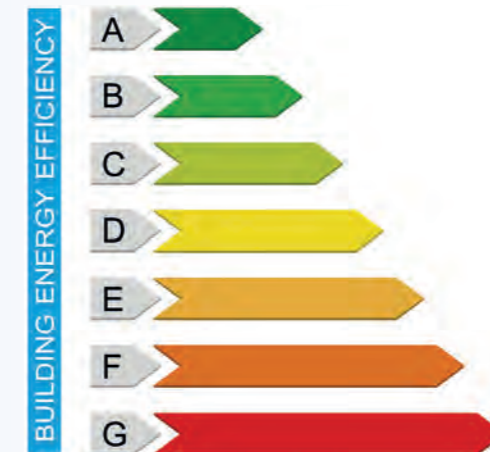
As consumers, we are now more aware than ever of the need to slow down climate change and protect our environment. This has been a positive change in what we want from products, as we want not only products that are of good quality but also products that are more environmentally friendly. Designers, manufacturers and companies therefore have to think about how they can achieve this.

Transport:

- Reducing the size of products and their packaging, or flat-packing products, means that more products can be transported, thereby reducing the number of journeys required.
- Using recyclable/reusable packaging creates less waste.
- Using energy-efficient vehicles will reduce harmful emissions.

Energy efficiency

- Products may be made more energy-efficient to consume less electricity or other fuel.
- Products often come with an energy-efficiency rating to make us aware of this.
- Other ways of powering products, such as solar power, may be investigated.



Sustainable materials and manufacturing:

- Using more sustainable or recyclable materials (see also p. 37).
- Using recycled materials or components to build new products rather than raw materials.
- Reducing the amount of components used in products.
- Reducing emissions from manufacturing processes and factories.
- Reducing toxic waste from the by-products of manufacturing processes.
- Recycling waste, such as waste water, to be reused in production.
- Using renewable energies, such as wind and solar energy, to power factories.
- Better planning for manufacturing, so that exact numbers of products are made on time without any delays, waste or damage.
- Ensuring the product can be easily dismantled at the end of its useful life for easier recycling and reuse.



THINGS TO DO AND THINK ABOUT

1. Watch the video by IKEA (available on the Digital Zone and using URL <http://bit.ly/1zVFEYr>). It outlines their approach to improving the issues outlined above. This will provide you with an excellent insight into how companies can improve design and manufacturing to benefit society.
2. Select any product found at home. Think about the issues raised in this chapter, and write down how you could redesign to reduce the product's negative impacts.

VIDEO LINK

Check out the clips at www.brightredbooks.net for more about recycling materials and improving manufacturing.

ONLINE

Head to www.brightredbooks.net to explore this topic further.

DON'T FORGET

Make sure you can explain globalisation as well as the environmental/sustainability issues surrounding manufacturing.

ONLINE TEST

Test yourself on manufacturing's impact on society at www.brightredbooks.net

DESIGN AND MANUFACTURE

Scott Atkins

This BrightRED Study Guide is just the thing you need to tackle your course and gain the exam skills essential to succeed at National 5 Design and Manufacture. Written by trusted author and experienced teacher Scott Atkins, this book is packed with brilliant examples, tasks and advice. It is the perfect companion to your studies.

- ▶ **Contains all of the essential course information**, arranged in easily digestible topics.
- ▶ **Designed in full colour, highly illustrated, accessible and engaging** to make sure all that study sticks!
- ▶ **Don't forget!** pointers offer advice on key facts and on how to avoid common mistakes.
- ▶ **Things to do and think about** sections at the end of each topic allow for further practice and research.
- ▶ **Worked examples** show you how to approach a range of concepts and questions.
- ▶ **A glossary of key terms** helps you really learn and revise important course concepts.

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