N5

National 5 PRACTICAL METALWORKING

BrightRED PUBLISHING

BrightRED Study Guide

Curriculum for Excellence

N5

PRACTICAL METALWORKING

NEW AND UP-TO-DATE WITH SQA CHANGES

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INTRODUCTION

INTRODUCTION TO THE COURSE

National 5 Practical Metalworking is largely workshop-based, combining elements of theory and practical metalworking techniques. Throughout the course, as well as learning how to use a range of tools, equipment and materials safely, you will also develop an ability to read drawings and diagrams, measure and mark out, cut, shape and finish material.

COURSE CONTENT

The National 5 Practical Metalworking course encourages you to gain a range of theoretical and practical metalworking skills relating to tools, equipment, processes and materials. You will also develop skills in reading and interpreting working drawings and related documents as well as an understanding of health and safety. You will encounter a lot of practical technology that will enable you to develop skills, knowledge and understanding of:

- metalworking techniques
- measuring and marking out metal sections and sheet materials
- safe working practices in workshop environments
- practical creativity and problem-solving skills
- sustainability issues in a practical metalworking context
- (SQA, National 5 Course Specification Practical Metalworking, p2 and p4)

The course develops skills in three main areas – Bench Skills, Machine Processes and Fabrication and Thermal Joining. Each area helps you to understand safe working practices, sustainability issues and good practice in recycling within a workshop environment. Each area covers a different set of metalworking skills and all areas include skills and associated knowledge in measuring, marking out, cutting and joining techniques. The areas of study are set out below.

Bench skills

You will develop skills, knowledge and understanding in the use of metalworking hand tools, bench-fitting work, routine sheet-metal work, measuring and marking out, involving complex features. Whilst developing these skills you will also develop your ability to read and use drawings and diagrams depicting both familiar and unfamiliar metalwork tasks.

Machine processes

In this area you will develop skills, knowledge and understanding in the use of metalworking machines, equipment, related processes, materials, measuring and marking out, involving complex features.

Fabrication and thermal joining

When fabricating and thermal joining, you will develop skills, knowledge and understanding in fabrication, forming and joining of metalwork components with some complex features. You will also develop skills in thermal joining techniques and in measuring and marking out.

ONLINE

Go to our Digital Zone at www.brightredbooks.net/subjects and click the link to view the full course assessment information.

DON'T FORGET

Practical Metalwork encourages you to become responsible and creative in your use of technologies and to develop attributes such as flexibility, enthusiasm, perseverance, reliability and confidence. You will also learn how to work effectively alongside others in a shared workshop environment.

SKILLS, KNOWLEDGE AND UNDERSTANDING FOR THE COURSE

Listed below is a broad overview of the subject skills, knowledge and understanding developed in the course:

- using a range of metalworking tools, equipment and materials safely and correctly for metalworking tasks with some complex features
- adjusting tools where necessary, following safe practices
- reading and interpreting drawings and diagrams in familiar and some unfamiliar contexts
- measuring and marking out metal sections and sheet materials in preparation for cutting and forming tasks with some complex features
- practical creativity in the context of familiar metalworking tasks with some complex features following, with autonomy, given stages of a practical problem-solving approach to metalworking tasks
- applying knowledge and understanding of good working practice in a workshop environment
- knowledge and understanding of the properties and uses of a range of metalworking materials
- knowledge and understanding of sustainability issues in a practical metalworking context

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COURSE ASSESSMENT STRUCTURE

The course assessment is currently split into two main sections: the question paper and the practical activity. The majority of your marks for the course will be awarded for the work you complete on the practical activity. The question paper element is being modified in the 2025/2026 session, with the external assessment element being removed.

Question paper

From 2025/2026 session onwards, an internal test covering topics that can't be assessed within the practical activity will replace the external assessment paper.

Practical activity

The practical activity requires you to manufacture a product and complete a log book. The log book will be provided as part of the assessment task.

Marks are awarded for:

- Log book
- Bench work
- Machining
- Fabrication
- Finishing
- Overall assembly

The practical activity will give you an opportunity to demonstrate the following skills, knowledge and understanding:

- selecting and using a range of metalworking tools, equipment and materials.
- reading, interpreting and following given working drawings, outline specification information and cutting lists.
- marking out, cutting and shaping component parts.
- fabricating and joining metalwork components.
- manufacturing a finished product to given drawings and standards.
- working and using tools and equipment in accordance with recognised procedures and safe working practices.

DON'T FORGET

The practical activity will allow you to demonstrate the application of skills and knowledge developed during the course to produce a finished product to a given standard and specification.

ONLINE

Go online to our Digital Zone at www.brightredbooks.net/subjects and click the link to check out what careers make use of metalworking skills and knowledge. Engineering and manufacturing | My World of Work

THINGS TO DO AND THINK ABOUT

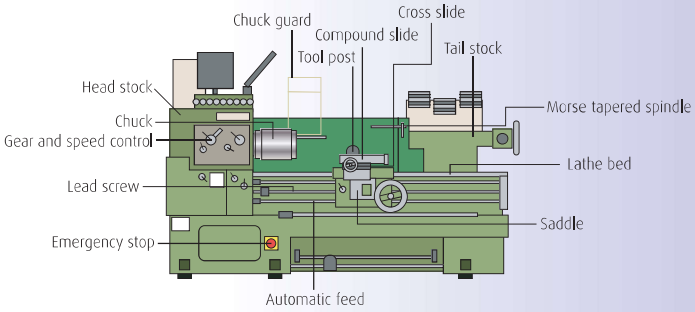
Success in the Practical Metalworking course can allow you to progress to many exciting courses and professions. Careers in fabricating, metalworking and machining are just a few of the options open to you in the engineering and manufacturing sector using your Practical Metalwork qualification.

Go online and research careers you could consider and have a think about which might suit you best.

THE CENTRE LATHE

The centre lathe spins metal at various speeds allowing it to be shaped. The centre lathe speed can be adjusted to allow for different metal types, diameters and processes to be carried out successfully.

THE CENTRE LATHE WITH PARTS LABELLED



DRIVING FORCE

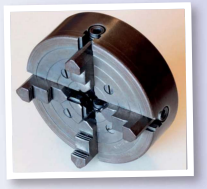
The work piece in a centre lathe is held in a chuck. The chuck can have three or four jaws that grip the metal securely. Some chucks have self-centring jaws, which means that when you turn the key all the jaws move at the same time. Others have jaws that move independently of each other. This allows holes to be drilled off centre on round bars or allows odd shapes to be held securely.

Three and four jaw self-centring chuck

In self-centring chucks, all of the jaws move to the centre together.

Three and four jaw chuck with independent adjustment

In these chucks, the jaws can move independently of each other.



TOOL BITS

The metal is shaped using shaped tools known as bits. Some bits are made with Tungsten Carbide Tips (TCTs). These tips are held in a special holder and are easily replaced when blunt. Once blunt they are discarded.

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DON'T FORGET

High Speed Steel (HSS - usually high carbon tool steel) can be sharpened and reused.

Jacobs Chuck and Running Centre

Some pieces of equipment are held in the tail stock. The Jacobs chuck and the running centre are examples of these. The Jacobs chuck is used to hold drill bits of varying sizes allowing holes to be drilled centrally on spindles. The running centre is used to support the ends of long pieces of metal to stop it from waving about when being cut.

Morse tapered spindle

Chucks and running centres are secured in the tail stock using a Morse taper system. The outer surface of the locating pin is ground to a very specific angle. This angle exactly matches the taper on the inside of the spindle. The tight fit and taper allow a fast easy secure way to hold tools and boring equipment.

Knurling tool

Knurling is the process where a pattern is created on the surface of the metal using a specially designed tool known as a knurling tool. This pattern creates a rough surface giving a better grip for tightening, or holding turned items.

Drilling and drill bits

Drilling on the lathe uses two different drill bits. The centre bit is short but very strong. It is always used first when drilling holes because of its strength. The hole is then finished using a twist drill. The depth of the hole is judged using the scale printed on the spindle. For a larger diameter, holes are usually drilled in stages with a smaller diameter hole being drilled first. The hole is drilled in stages with the bit being withdrawn regularly to clear swarf (cuttings) to prevent jam ups, which can break the drill bit.

ONLINE

Go online and click the link at our Digital Zone (www.brightredbooks.net/subjects) to watch an introductory video on how to use a lathe in class.

THINGS TO DO AND THINK ABOUT

There are many types of lathes that are specialised for different materials and techniques. Become familiar with the type of lathe in your workshop and find out exactly what you can do with it.

As always, safety is key when using a machine tool like a lathe. It is easy to drift off a little when carrying out repetitive tasks so make sure you are fully concentrated on the job in front of you at all times. As well as this you should always be sure to:

- be wearing an apron and safety glasses with side protectors (or maybe even a face shield)
- tie up your hair if it is long and roll up any long sleeves
- never wear gloves, rings or a watch when doing lathe work
- make sure to check all guards and shields before starting
- keep all of your lathe tools sharp and check them before starting
- switch the power off before making any adjustments
- ask your teacher if you have any doubts at all about what you are doing.

METALS AND HOT JOINING

AN INTRODUCTION TO METALS

Many different metals can be used in metalworking. Some are strong, some heavy, some rare, some stable and some reactive – therefore unstable! This section looks at some of the more common metals, their forms of supply and their uses.

EACH METAL HAS A ROLE

Metals are selected for different tasks based on the properties of the individual metal. For example, brass is a yellow-coloured metal that cuts reasonably well. Its main properties are that it is hard wearing and self-lubricating. It is used in bearings supporting shafts that have to rotate. Brass inserts called bushes are used rather than making whole items out of brass. These are forced into place under pressure and, once worn, they can easily be replaced with new bushes.

Metals come in various forms. In ingot form they are melted down and poured into moulds to make things like engine blocks. Some products are formed by pressing and forcing metal to shape, while others like aluminium foil are rolled until very thin.

DON'T FORGET

Replacement parts like this prolongs the life of a machine and removes the need to replace complex parts more often.

MAIN CATEGORIES OF METAL

There are four main categories of metal. They are pure, alloy, ferrous and non-ferrous.

Ferrous

Ferrous derives from the Latin word *ferrum* meaning iron. This means the all-ferrous metals contain iron and are affected by magnetism. Whether or not a metal contains iron is the most common method of classification. Almost 90% of manufactured metals are ferrous metals – steel being a good example. Key characteristics of ferrous metals include durability, strength, conductivity and recyclability.

Ferrous metals have been in use for thousands of years and have a huge range of different applications, from the largest structures to the smallest nuts and bolts.

Because ferrous metals such as steel contain iron, they are prone to corrosion. Metals without iron content do not possess any magnetic properties and are termed non-ferrous metals.

Non-ferrous

This is a group of metals that have no (or very little) iron in them and are not affected by magnetism. They tend to be lighter in weight than ferrous metals and examples include aluminium, lead, brass, copper and zinc. Key characteristics of non-ferrous metals are their non-magnetic properties, high resistance to corrosion and ease to fabricate.

Pure

Pure metals are exactly that - pure. They do not have any other metals or minerals added to them and so are used in their unadulterated natural form. The only ferrous pure metal is iron. Many pure metals are expensive as they are either rare or precious such as gold, silver, platinum, cobalt, mercury, tungsten, lithium and zirconium.

Nuggets of pure gold, copper and silver.

Alloy

Alloys are made up of two or more metals, or other elements and minerals, such as carbon in steel. Alloying improves the qualities of pure metals as it combines mechanical properties.

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A good example of a valuable alloy is duralumin. It consists of around 95% aluminium but is stronger and more durable than pure aluminium. This is because it also contains magnesium, manganese and copper to improve its working qualities. It can therefore be shaped and machined better than pure aluminium.

Duralumin is used extensively in the aircraft industry making robust body shells of large airliners like the Airbus A380. Adding small amounts of different metals changes the working properties and qualities of metals and can make them more versatile and useful.

Some metals like zinc and tin are used to coat metals that are liable to rust. Tin cans are actually made from steel that is coated with a thin layer of tin. Tin is used because it coats the metal to protect it from the elements and not taint the contents. Zinc is used to coat larger steel items like wheelbarrows, car bodies and chassis. This process is known as galvanising.

A selection of common metals and their categories are shown in the table below for easy reference.

Metal	Ferrous/non-ferrous	Alloy and additions	Pure
Iron	Ferrous	No	Yes
Steel	Ferrous	Yes – alloy of iron with carbon, titanium and chromium.	No
Copper	Non-ferrous	No	Yes
Aluminium	Non-ferrous	No	Yes
Bronze	Non-ferrous	Yes – is an alloy of copper and tin.	No
Brass	Non-ferrous	Yes – is an alloy of copper and zinc.	No
Zinc	Non-ferrous	No	Yes
Gold	Non-ferrous	Yes – most gold is alloyed with less expensive metals like silver.	Yes – when 24-carat gold is pure
Duralinum	Non-ferrous	Yes – is alloyed with magnesium, manganese and copper.	No

ONLINE

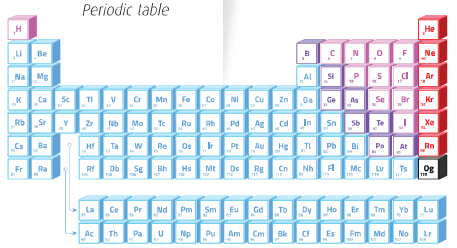
Go online and click the link at our Digital Zone (www.brightredbooks.net/subjects) to watch a video and find out a lot more about duralumin.

FORMS OF SUPPLY

Forms of supply are the different ways that metals can be delivered or produced for using. These range from round, hex, octagonal, square, rectangular bars, not to mention tubular, and in sheet form. In industry, to minimise waste, sheet steel can be delivered rolled up. These rolls can be up to 500 m long. The different shapes can be ordered in a range of sizes depending on what is being made.

THINGS TO DO AND THINK ABOUT

There are many different types of metals in our environment - metals account for three-quarters of elements in the periodic table! All of the blue tiles in the table on the right are metal or metalloid. Metals such as iron, steel, copper, bronze, brass, aluminium, titanium and lead feature in our daily lives in thousands of different applications. Think about all of the metal products that you encounter in your day-to-day life and also about where that metal might come from.



Periodic table

Blue = metals

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PRACTICAL METALWORKING

Brian Kennedy

This BrightRED Study Guide is just the thing you need to tackle your course and succeed in National 5 Practical Metalworking. Written by experienced Technical teacher Brian Kennedy, this book is packed with brilliant content and advice. It is the perfect companion for your course.

- **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.
- **A glossary of key terms** helps you really learn and revise important course concepts.

Let BrightRED lead you to success in your National 5 studies and beyond!

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