

ENGINEERING MANUFACTURE



Specification

DRAFT

OCR Level 1/Level 2

Cambridge National in Engineering Manufacture

J823

Version 2 (July 2021)

ocr.org.uk/cambridgenationals



Key updates to specification

As a result of regulatory feedback, we have made the following changes to this specification:

Section	Change	Version and date issued
Section 2: Qualification overview Section 6.4.4: Resubmitting moderated work for (summative) assessment to improve the grade before submitting a final mark Section 7.2 Terminal Assessment	Wording added to clarify: For Non examined assessed (NEA) units, there is one resubmission opportunity.	Version 2 July 2021
Section 2.3: Purpose statement	The purpose statement has been updated to add clarity on the topic areas included in each unit. The progression routes diagram has now been included here (which has resulted in the removal of Section 8).	
Section 4: Assessment Guidance – Externally Assessed (EA) unit	Further details of external assessment added.	
Section 4: Assessment Guidance – Non examined assessed (NEA) units	Guidance has been updated.	
Section 4: NEA Marking criteria and Section 6.4.1 Use of a 'best fit' approach to marking criteria	Statement added to clarify that if a student's work does not meet Mark Band 1 (MB1) criteria for any task, you must award zero marks for that task.	
Section 5.1 Overview of the assessment	Materials permitted for external assessment clarified.	
Section 5.4 Grading and awarding grades	A table has been added showing Raw marks and UMS marks for each unit.	
Section 6.2 Requirements and guidance for delivering and marking the OCR-set assignments	Guidance on the scope of assessment modification has been updated.	
Section 6.3: Feedback	This section has been updated to clarify feedback permitted and some examples have been added.	
Appendix B: Command words	Definition of 'Create' has been added. Definition of 'Explain' has been updated.	
All	Minor changes have been made to wording and formatting throughout the Specification.	

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1 Why choose OCR?

Choose OCR and you've got the reassurance that you're working with one of the UK's leading exam boards. We have developed our specifications in consultation with teachers, employers and subject experts to provide students with a qualification that's relevant to them and meets their needs.

We're part of Cambridge University Press & Assessment. We help millions of people worldwide unlock their potential. Our qualifications, assessments, academic publications and original research spread knowledge, spark curiosity and aid understanding around the world.

We work with a range of education providers, including schools, colleges, workplaces and other institutions in both the public and private sectors. Over 13,000 centres choose our A Levels, GCSEs and vocational qualifications including Cambridge Nationals and Cambridge Technicals.

1.1 Our specifications

We believe in developing specifications that help you bring the subject to life and inspire your students to achieve more. We've created teacher-friendly specifications based on extensive research and

engagement with the teaching community. They're designed to be straightforward and accessible so that you can tailor the delivery of the course to suit your needs.

1.2 Our support

We have a range of support services to help you at every stage, from preparation to delivery.

- A wide range of high-quality creative resources including resources created by leading organisations within the industry.
- Textbooks and teaching and learning resources from leading publishers. For more information about all the published support for the Cambridge Nationals that has been endorsed by OCR please go to the [Cambridge Nationals page](#) on our website.
- Professional development for teachers to fulfil a range of needs. To join our training (either face-to-face or online) or to search for training materials, please go to the [Professional Development page](#) on our website.
- [Active Results](#) is our free results analysis service to help you review the performance of individual students or whole schools.
- [ExamBuilder](#) is our free question-building platform that helps you to build your own tests using past OCR exam questions.
- OCR subject advisors provide information and support to centres including specification and non examined assessment advice, updates on resources developments and a range of training opportunities. They work with subject communities through a range of networks to share ideas and expertise to support teachers.

Further help and support

Whether you are new to OCR or already teaching with us, you can find useful information, help and support on our [website](#). Or get in touch:

support@ocr.org.uk

@ocr_exams

01223 553998

1.3 Aims and learning outcomes

Our Cambridge National in Engineering Manufacture will encourage students to:

- understand and apply the fundamental principles and concepts of Engineering Manufacture, including manufacturing processes, engineering materials, manufacturing requirements and developments in engineering manufacture
- develop learning and practical skills that can be applied to real-life contexts and work situations
- think creatively, innovatively, analytically, logically and critically
- develop independence and confidence in using skills that would be relevant to the engineering, manufacturing, process and control sector and more widely
- plan manufacturing production through practical experience of manufacturing for one-off products and manufacturing in quantity
- determine the sequence of operations required, recognising hazards and risks so that control measures can be implemented for safe working
- interpret engineering drawings to facilitate manufacture, using a range of tools and equipment, including Computer Numerical Control (CNC) machines.

1.4 What are the key features of this specification?

The key features of OCR's Cambridge National in Engineering Manufacture for you and your students are:

- a simple and intuitive assessment model, consisting of an externally assessed unit that focuses on knowledge and understanding and two skills-based, non examined assessment units (NEA)
- a specification developed with teachers specifically for teachers. The specification lays out the subject content clearly
- a flexible support package formed after listening to teachers' needs. The support package will help teachers to easily understand the requirements of the qualification and how it is assessed
- a team of OCR Subject Advisors who support teachers directly and manage the qualification nationally
- the specification has been designed to progress onto Level 3 Vocational Engineering, Design and Technology at A Level, or a range of related Apprenticeships in the sector.

This qualification will help students to develop:

- valuable practical skills in engineering manufacture that are highly sought after in the workplace
- a deep understanding of the processes, materials, tools and equipment used within the engineering, manufacturing, process and control sector.

All Cambridge Nationals qualifications offered by OCR are regulated by Ofqual, the Regulator for qualifications offered in England. The qualification number for OCR's Cambridge National in Engineering Design is QN 603/7087/7.

2 Qualification overview

2.1 OCR Level 1/Level 2 Cambridge National in Engineering Manufacture at a glance

Qualification number	603/7087/7	OCR Entry code	J823
First entry date	01/09/2022	Approved age range	14-16
Guided learning hours (GLH) (page 12)	120	Performance information (page 12)	We've designed this qualification to meet the Department for Education (DfE) requirements for qualifications in the Technical Award category of the 14-16 performance tables.
Total qualification time (TQT) (page 12)	142	Eligible for funding	It's designed to meet the funding requirements of a 14-16 study programme.
This qualification is suitable for students	<ul style="list-style-type: none"> aged 14-16 on a full-time study programme wanting to develop applied knowledge and practical skills in engineering manufacture who want to progress onto other related study, such as qualifications in Engineering or Design and Technology as it is designed to meet the Department for Education's characteristics for a Technical Award. 		
Entry requirements	There is no requirement for students to achieve any specific qualifications before taking this qualification.		
Qualification requirements	Students must complete three units: <ul style="list-style-type: none"> one externally assessed unit two NEA units 		
Assessment method/model (page 34)	Unit R014 is assessed by an exam and marked by us. You will assess the NEA units and we will moderate them.		
Assessment series each year (page 50)	<ul style="list-style-type: none"> January June 		
Terminal assessment (page 50)	The exam must be taken in the final assessment series before qualification certification. The result from the exam taken in the final series will be the one that counts towards a student's overall grade.		
Grading (page 35)	All results are awarded on the following scale: Level 2 – Distinction* (*2), Distinction (D2), Merit (M2), Pass (P2) Level 1 – Distinction (D1), Merit (M1), Pass (P1) and Fail/Unclassified.		
Exam resits (page 50)	Students can resit the exam but the result from the exam taken in the series where students certificate would be the result to count towards performance measures.		
Repeat submission of students' NEA work (page 48)	If you and your students feel they have not performed at their best during assessment of the NEA units, the students can, at your discretion, improve their work and resubmit it to you for assessment. You must be sure it's in the students' best interests to re-attempt the assessment. There is one re-submission opportunity. For information about feedback see section 6 . The final piece of work must be completed solely by the student and teachers must not detail specifically what amendments should be made.		

2.2 Qualification Structure

For this qualification, students must achieve **three** units: one externally assessed and two Non Examined Assessment (NEA) units.

Key to units for this qualification:

M = Mandatory	Students must achieve this unit
E = External assessment	We set and mark the exam
N = NEA	You assess this and we moderate it

Unit no.	Unit title	Unit ref. no. (URN)	Guided learning hours (GLH)	How are they assessed?	Mandatory or optional
R014	Principles of engineering manufacture	R/618/5832	48	E	M
R015	Manufacturing a one-off product	Y/618/5833	36	NEA	M
R016	Manufacturing in quantity	D/618/5834	36	NEA	M

2.3 Purpose statement

OCR

Oxford Cambridge and RSA

OCR Level 1/Level 2 Cambridge National in Engineering Manufacture

Qualification number: 603/7087/7

Type of qualification: Technical Award

Purpose Statement

Overview

Who is this qualification for?

The OCR Level 1/Level 2 Cambridge National in Engineering Manufacture is aimed at students aged 14-16 and will develop knowledge, understanding and practical skills that would be used in the engineering, manufacturing, process and control sector.

You may be interested in this if you want an engaging qualification where you will use what you learn in practical, real-life situations, such as:

- The materials used in engineering manufacture
- Safely producing a one-off product
- The use of Computer Numerical Control (CNC) to produce in quantity.

This will help you to develop independence and confidence in using skills that would be relevant to the engineering manufacturing and development sector.

The qualification will also help you to develop learning and skills that can be used in other life and work situations, such as:

- Solving problems by exploring different engineering manufacture processes, tools and equipment
- Planning a sequence of processes. This will involve managing your time and identifying the resources you will need, as well as reviewing your plans if necessary

This qualification will complement other learning that you're completing for GCSEs or vocational qualifications at Key Stage 4 and help to prepare you for further study.

What will you study as part of the qualification?

You will study the key aspects of engineering manufacture, and have the opportunity to apply what you learn through a number of practical experiences. This will involve you studying three mandatory units:

- **R014: Principles of Engineering Manufacture**
This is assessed by an exam.
In this unit you will learn about the different types of manufacturing processes, and the different materials that can be used within manufacturing.
Topics include:
 - Manufacturing processes
 - Engineering materials
 - Manufacturing requirements
 - Developments in engineering manufacture.
- **R015: Manufacturing a One-off Product**
This is assessed by a set assignment.
In this unit you will learn how to safely plan and produce a one-off product by using appropriate processes, tools and equipment.

Topics include:

- Planning the production of a one-off product
 - Measuring and marking out
 - Safely use processes, tools and equipment to make a product.
- **R016: Manufacturing in Quantity**
In this unit you will learn how to manufacture using simple jigs and templates to support manufacturing in volume using Computer Aided Design (CAD) software and Computer Numerical Control (CNC) equipment. Topics include:
 - Preparing for manufacture
 - Develop programmes to operate CNC equipment
 - Safely use processes and equipment to make products in quantity.

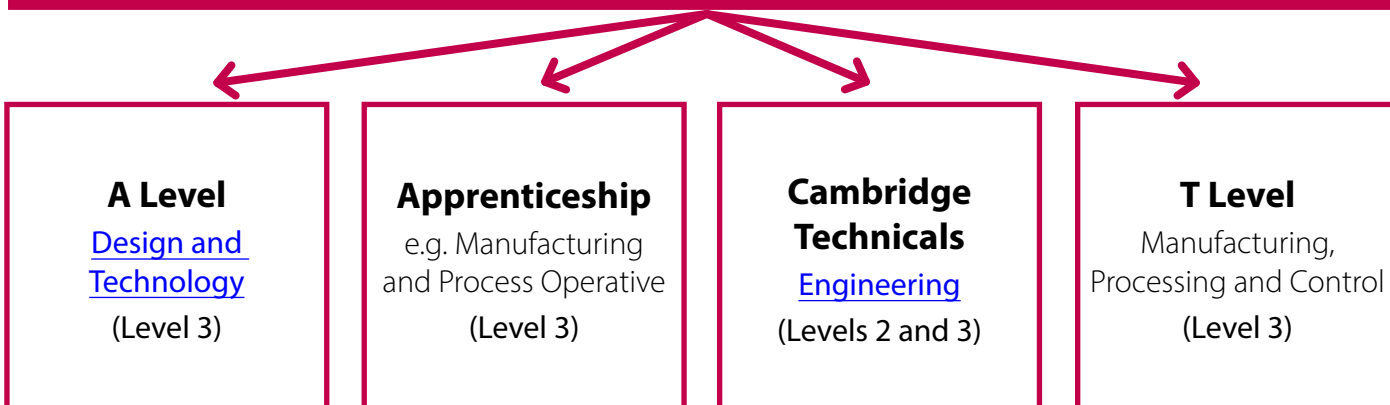
What knowledge and skills will you develop as part of this qualification and how might these be of use and value in further studies?

This qualification will enable you to learn about the process of engineering manufacture, and understand the different materials that can be used to manufacture products. You will develop the ability to plan the production of a one-off product using a range of hand-held pieces of equipment and machining methods. You will also learn how to program CNC equipment to manufacture.

These skills will help you progress onto further study in the engineering, manufacturing, process and control

sector. This may be Level 3 vocational qualifications, such as the Cambridge Technical in Engineering, A-Levels, such as A-Level Design and Technology, or one of the number of Fabrication and Welding Operative/Technician or Manufacturing and Process Operative Apprenticeships. It is anticipated that these qualifications will also enable you to progress onto a T Level such as Manufacturing, Processing and Control when they are available.

Cambridge National in Engineering Manufacture (Level 1/Level 2)



The diagram below shows the possible progression routes for your further study:

Which subjects will complement this course?

Other subjects that supplement or complement this qualifications include:

- Cambridge National in Engineering Design
- Cambridge National in Engineering Programmable Systems
- GCSE Design and Technology
- GCSE Science.

Further details

More information about the Cambridge National in Engineering Manufacture can be found in these documents:

[Specification](#)

[Sample Assessment Material \(SAM\)](#)

[Guide to our Sample Assessment Material](#)

[Student guide to NEA assignments](#)

[Understanding the assessment: examined and moderated](#)

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3 About this qualification

3.1 Qualification size (GLH and TQT)

The size of the qualification is described in terms of Guided Learning Hours (GLH) and Total Qualification Time (TQT).

GLH indicates the approximate time (in hours) the teacher will spend supervising or directing study and assessment activities. We have worked with people who are experienced in delivering related qualifications to determine the content that needs to be taught and how long it will take to deliver.

TQT includes two parts:

- GLH
- an estimate of the number of hours a student will spend on unsupervised learning or assessment activities (including homework) to successfully achieve their qualification.

OCR Level 1/Level 2 Cambridge National in Engineering Manufacture is 120 GLH and 142 TQT.

3.2 Language

This qualification and its assessment materials are available in English only.

Only answers provided in English will be assessed.

3.3 Performance information

We've designed this qualification to meet the Department for Education (DfE) requirements for qualifications in the Technical Award category of the 14-16 performance tables.

You'll find information on performance tables for England on the Department for Education [website](#).

4 Units

4.1 Guidance on unit content

This section describes what must be taught so that students can access all available marks.

4.1.1. Externally Assessed Unit (R014)

The externally assessed unit is made up of a number of topic areas. Each topic area has related teaching content that must be taught. A direct question may be asked about any content in the teaching content column.

The breadth and depth column helps to clarify the breadth and depth of teaching needed, and indicates the range of knowledge and understanding that may be assessed in the exam. This column also confirms any aspects that you do **not** need to teach in relation to the content as 'does not include' statements.

Knowledge and understanding

Students will need to **understand** the content unless the breadth and depth column identifies it as knowledge only.

- Any item(s) that should be taught as knowledge only will start with the word 'know' in the breadth and depth column.
- All other content is expected to be taught as understanding.

The table below explains what we mean by knowledge and understanding.

Knowledge	<ul style="list-style-type: none">• Be able to identify or recognise a given item, for example on a diagram• Use direct recall to answer a question, for example the definition of a term.
Understanding	<ul style="list-style-type: none">• To assess and evidence the perceived meaning of something in greater depth than straight identification or recall.• Understanding will be expressed and presented using terms such as: how; why; when; reasons for; benefits and drawbacks of; advantages and disadvantages of; purpose of; suitability of; recommendations for improvement; pros and cons; appropriateness of something to/in different contexts.

Students need to be taught the information in both the teaching content and breadth and depth columns.

4.1.2 NEA Units (R015 and R016)

The NEA units are made up of a number of topic areas with associated teaching content which details what must be taught as part of each topic area. The NEA units also have an exemplification column that provides

more information about, and examples relating to, the teaching content. This helps to exemplify the teaching expected so that students are equipped to successfully complete their assignments.

4.1.3 Command words

[Appendix B](#) gives information about the command words that will be used in both the external assessments and the NEA marking criteria and the expectations of them.

4.1.4 Performance Objectives (POs):

Each Cambridge National qualification has related Performance Objectives. There are four Performance Objectives in the OCR Level 1/Level 2 Cambridge National in Engineering Manufacture.

Performance Objectives	
PO1	Recall knowledge and show understanding
PO2	Apply knowledge and understanding
PO3	Analyse and evaluate knowledge, understanding and performance
PO4	Demonstrate and apply skills and processes relevant to the subject area

PO1 is only relevant to the exam. PO4 is only relevant to the NEA assessments.

The weightings of the Performance Objectives across the units is:

Performance Objective	Externally Assessed unit (range)	NEA units	Overall weighting
PO1	14.5%–17.5%	n/a	30.5%–33.5%
PO2	12.5%–19.5%	18.5%	31%–38%
PO3	5%–7%	14%	19%–21%
PO4	n/a	27.5%	27.5%
Overall weighting of assessments	40%	60%	100%

4.2 Unit R014: Principles of engineering manufacture

Aims

Products are manufactured using a wide variety of processes and materials. In order to understand the manufacturing requirements for products, it is important to consider the requirements presented by the product design, the scale of manufacture, and the quality requirements that have been set out.

In this unit you will learn about the different types of manufacturing processes, the materials that can be used to manufacture products using these processes, and the factors to be considered when determining the manufacturing requirements of an engineered product. You will consider the different types of manufacturing

process that are typically used in engineering, using specific examples of each process type. The engineering materials include ferrous and non-ferrous metals, polymers, ceramics, composites, and smart materials. You will understand how the properties of these materials relate to their manufacturing characteristics. In addition you will also develop an understanding of some of the current developments in engineering manufacture.

Unit R014: Principles of engineering manufacture

Topic Area 1: Manufacturing processes

Teaching content

Exemplification

1.1 Types of manufacturing processes

1.1.1 The types of manufacturing processes

- Wasting
- Shaping
- Forming
- Additive processes
- Joining
- Finishing

To include:

- Recommend with justification the most appropriate process to create a manufactured form

1.1.2 How each process type changes the form of materials to create a product

1.2 Details of different manufacturing processes

1.2.1 Wasting processes

- Sawing
- Shearing
- Drilling
- Filing
- Threading
- Routing
- Laser-cutting
- Turning
- Milling

To include:

- Tools and equipment required
- Steps carried out to manufacture a product
- Safety measures
- Shearing is restricted to manual use of a guillotine and tin snips
- Threading is restricted to manually using a tap and die

Unit R014: Principles of engineering manufacture

<p>1.2.2 Shaping processes:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Sand casting <input type="checkbox"/> Die casting <input type="checkbox"/> Injection moulding <input type="checkbox"/> Powder metallurgy for ceramic product 	<p>To include:</p> <ul style="list-style-type: none"> • Tools and equipment required • Steps carried out to manufacture a product • Safety measures • Differences between sand and die casting, including the types of mould used
<p>1.2.3 Forming processes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Forging <input type="checkbox"/> Press forming metal <input type="checkbox"/> Strip heating of polymers <input type="checkbox"/> Vacuum forming <input type="checkbox"/> Moulding of composite materials 	<p>To include:</p> <ul style="list-style-type: none"> • Tools and equipment required • Steps carried out to manufacture a product • Safety measures • The characteristics of vacuum forming moulds
<p>1.2.4 Additive manufacturing</p> <ul style="list-style-type: none"> <input type="checkbox"/> 3D Printing (fused deposition modelling) 	<p>To include:</p> <ul style="list-style-type: none"> • Tools and equipment required • Steps carried out to manufacture a product • Safety measures
<p>1.2.5 Joining processes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Brazing <input type="checkbox"/> MIG/MAG welding <input type="checkbox"/> Riveting <ul style="list-style-type: none"> ▪ hammered rivets ▪ pop rivets <input type="checkbox"/> Mechanical fastening <ul style="list-style-type: none"> ▪ nuts and bolts ▪ self-tapping screws 	<p>To include:</p> <ul style="list-style-type: none"> • Tools and equipment required • Steps carried out to manufacture a product • Safety measures • The relative characteristics of different methods of joining
<p>1.2.6 Finishing processes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Painting <ul style="list-style-type: none"> ▪ brush ▪ spray <input type="checkbox"/> Powder coating 	<p>To include:</p> <ul style="list-style-type: none"> • Tools and equipment required • Steps carried out to manufacture a product • Safety measures

Topic Area 2: Engineering materials

Teaching content	Exemplification
<p>2.1 Mechanical properties of materials</p>	
<ul style="list-style-type: none"> <input type="checkbox"/> Strength <ul style="list-style-type: none"> ▪ yield/tensile ▪ compressive <input type="checkbox"/> Elasticity <input type="checkbox"/> Ductility <input type="checkbox"/> Hardness 	<p>To include:</p> <ul style="list-style-type: none"> • Definitions of the properties
<p>2.2 Other properties influencing manufacturing</p>	
<ul style="list-style-type: none"> <input type="checkbox"/> Malleability <input type="checkbox"/> Machinability <input type="checkbox"/> Cost <ul style="list-style-type: none"> ▪ material ▪ manufacturing <input type="checkbox"/> Sustainability 	<p>To include:</p> <ul style="list-style-type: none"> • Definitions of the properties

Unit R014: Principles of engineering manufacture

2.3 Types of engineering materials and how they are processed

2.3.1 Metals:

- Difference between pure metals and alloys
- Types of ferrous metal
 - cast iron
 - low carbon steel
 - high carbon steel
 - stainless steel
- Types of non-ferrous metal
 - aluminium and alloys
 - copper, brass and bronze

To include:

- The relative properties, typical forms of supply and common applications of the different materials

2.3.2 Polymers:

- Difference between thermoplastic and thermosetting polymers
- Types of thermoplastic polymer
 - Acrylonitrile-Butadiene-Styrene (ABS)
 - High Impact Polystyrene (HIPS)
 - Polymethylmethacrylate (PMMA/Acrylic)
 - Polycarbonate
 - Polylactic acid (PLA)
- Types of thermosetting polymer:
 - urea formaldehyde
 - melamine formaldehyde
 - epoxy resin
 - polyester resin

To include:

- The relative properties, typical forms of supply and common applications of the different materials

2.3.3 Engineering ceramics

- Types of engineering ceramic
 - silicon carbide
 - tungsten carbide
 - silicate glass

To include:

- The relative properties, typical forms of supply and common applications of the different materials

2.3.4 Composite materials

- Difference between metal alloys and composite materials
- Types of composite material
 - glass reinforced polymer (GRP/fibreglass)
 - carbon reinforced polymer (CRP)

To include:

- The relative properties, typical forms of supply and common applications of the different materials

2.3.5 Smart materials

- Definition of a smart material
- Types of smart material
 - shape memory alloy (SMA)
 - thermochromic pigment
 - photochromic pigment
 - Quantum Tunnelling Composite (QTC)

To include:

- The relative properties, typical forms of supply and common applications of the different materials

Unit R014: Principles of engineering manufacture

Topic Area 3: Manufacturing requirements

Teaching content

Exemplification

3.1 Interpreting orthographic third angle projection drawings

- Meaning of line types:
 - outlines
 - hidden detail
 - centreline
 - projection
 - dimension
 - leader line
- Standard conventions for dimensions
 - linear measurements
 - radius
 - diameter
 - tolerances
 - surface finish
- Abbreviations
 - across flats
 - centre line
 - diameter
 - drawing
 - material
 - square
- Representation of mechanical features
 - threads
 - holes
 - chamfers
 - countersinks
 - knurls

- To include:
- Standard conventions in BS 8888 and how these are applied
 - Calculation of maximum and minimum acceptable dimensions from a stated tolerance

3.2 Influence of the scale of manufacture on the production method

- Scales of manufacture
 - one-off
 - batch
 - mass
- Advantages and limitations of jigs, fixtures, templates and moulds
- Level of automation
 - manual control
 - CAM processes
 - fully automated robotic control
- Advantages and limitations of using CAM machines to manufacture parts

- To include:
- Typical products manufactured at different scales of manufacture
 - Typical products manufactured using different levels of automation
 - Advantages and limitations of using CAM including:
 - improved consistency of products
 - reduction in defects
 - ability to accurately manufacture complex parts
 - greater rate of production
 - ability of automated systems to work in environments that would be hazardous to operators
 - initial capital outlay
 - influence on employment opportunities

Unit R014: Principles of engineering manufacture

3.3 Quality

- Reasons for implementing a quality system in engineering
 - early intercept of problems in production
 - reducing waste and associated costs
 - consistency of finished products
 - conformity to industry standards and regulations
 - reduce issues at customer and returns
- Quality control as a reactive approach, measuring parts
- Quality assurance as a preventative approach putting in place systems to reduce occurrence of defects

To include:

- The difference between quality control and quality assurance

Topic Area 4: Developments in engineering manufacture

Teaching content

Exemplification

4.1 Inventory management

- Just in time (JIT) manufacturing
- Material requirements planning (MRP)

To include:

- Definitions
- The advantages and disadvantages

4.2 Lean manufacturing

- The seven categories of waste
 - transportation
 - inventory
 - movement
 - waiting
 - over-processing
 - over-production
 - defects
- How reducing each waste improves the performance of manufacturing

4.3 Globalisation

- Requirement for transportation
- International standards
- Influence on employment opportunities
- Differences in employment conditions
- Influence on product cost
- Implications for sustainability
- Consideration of economic, social, ethical and environmental implications

Assessment guidance

This unit is assessed by an exam. The exam is 1 hour 15 minutes. It has two Sections – Section A and Section B.

- Section A has 10 marks
- Section B has 60 marks
- The exam has 70 marks in total

This will be conducted under examination conditions. For more details refer to the [Administration](#) area.

The Engineering Manufacture '[Exploring our exams: a guide to our sample assessment material](#)' gives more information about the layout and expectations of the exam.

A range of question types will be used in the exam, but it will always require students to use the skills of analysis and evaluation.

Teaching content

1.1	<ul style="list-style-type: none">• Students will need to be able to describe how each type of process changes the form of materials and to recommend the process types that would be necessary to create an identified product.
1.2.1 – 1.2.6	<ul style="list-style-type: none">• Students will need to be able to identify the equipment and tools used to carry out the processes, describe the stages involved in carrying out each process using the equipment and explain the safety considerations when using the equipment.• Students are not expected to be able to use the processes in this unit, as this covers the principles of use
2.1 - 2.2	<ul style="list-style-type: none">• Students will need to know the definitions of the properties.
2.3	<ul style="list-style-type: none">• Students will need to know the materials, their relative properties, typical forms of supply, at least one common application for each material and the processes that can be used with each material. They are not expected to suggest materials for applications based on their properties
3.1	<ul style="list-style-type: none">• Students may be expected to identify each of the conventions or representations stated.• Students may also be expected to add dimensions using the conventions to provided drawings.• Students are not expected to create new drawings.
3.2	<ul style="list-style-type: none">• Students should know at least one example of a product produced at each scale of manufacture and at least one example of a product produced using each different level of automation.

Synoptic assessment

This unit allows students to gain underpinning knowledge and understanding relevant to the qualification and sector. The NEA units draw on and strengthen this learning with students applying their learning in a practical, skills-based way. The synoptic grids at the end of the NEA units show these synoptic links.

More information about synoptic assessment within this qualification can be found in [section 5.2 synoptic assessment](#).

4.3 Unit R015: Manufacturing a one-off product

Aims

There is often a need to manufacture one-off products in engineering. This might be for a unique application or product, or there may be a need to manufacture replacements for failed items. In addition, there will often be the need to produce a prototype in order to evaluate a design.

In this unit you will learn to identify the information required to make a product, plan the production of a product and carry out risk assessments for the processes, tools and equipment needed to produce

a product in small quantities. You will also learn how to select and safely use the equipment, processes and tools required to mark out, measure and manufacture a product in small quantities, using a range of hand-held equipment and conventional (non-Computer Numerical Control (CNC) machining methods.

Unit R015: Manufacturing a one-off product

Topic Area 1: Planning the production of a one-off product

Teaching content

Exemplification

1.1 Interpret an engineering drawing to identify information to facilitate manufacture

- Identify required form and mechanical features
 - threads
 - holes
 - chamfers
 - countersinks
 - knurls
- Identify required dimensions and characteristics:
 - linear measurements
 - radius
 - diameter
 - tolerances
- Surface finish

To include:

- Engineering drawings in third angle orthographic projection using standard conventions to BS 8888
- Three-dimensional components where there are dimension changes, tapers or steps along the form
- Mechanical features

1.2 Prepare a production plan to manufacture a one-off product

- Materials required
- Processes, tools and equipment required
- Sequence of operations
- Health and safety considerations
- Quality control requirements

1.3 Carry out a risk assessment

- Identify hazards (potential sources of harm)
- Identify risks (the probability of a hazard occurring)
- Identify control measures

Unit R015: Manufacturing a one-off product

Topic Area 2: Measuring and marking out

Teaching content

Exemplification

2.1 Select and safely use equipment for marking out

2.1.1 Equipment

- Rules
- Dividers
- Scribes
- Scribing blocks
- Surface plates
- Punches
- Squares
- Protractors
- Angle plates

To include:

- Which features each tool uses to mark out

2.1.2 Marking out techniques

- Datum
- Centre lines
- Profiles:
 - square/rectangular
 - angular
 - radial
- Circles
- Hole positions

2.2 Select and use measuring instruments

- Rules
- Digital Vernier callipers
 - external
 - internal
 - depth
- Micrometres
 - external
 - internal
 - depth
- Squares
- Protractors
- Height gauge
- Dial Test Indicator (DTI)

To include:

- Which types of dimensions are measured using each instrument

Unit R015: Manufacturing a one-off product

Topic Area 3: Safely use processes, tools and equipment to make a product

Teaching content

Exemplification

3.1 Manually controlled machining operations

- Drilling
- Turning using a centre lathe
- Milling

To include:

- Setting and operation of the stated machines
- For the lathe, end facing, parallel turning, centre drilling, grooves, knurling and parting off
- For the mill, facing and slotting

3.2 Tools and equipment

- Saws
 - hacksaw
 - junior hacksaw
- Guillotine
- Files
- Tap and die
- Press (sheet bending)

3.3 Joining techniques

- Brazing
- Pop-rivets
- Mechanical fastenings
 - nuts and bolts
 - self-tapping screws

Marking criteria

[Section 6.4](#) provides full information on how to mark the NEA units and apply the marking criteria. The marking criteria command words are further explained in [Appendix B Command words](#).

The tables below contain the marking criteria for the tasks for this unit. If a student's work does not meet the Mark Band 1 (MB1) criteria for any task, you must award zero marks for that task.

Unit R015 – Topic Area 1.1, 1.2: Interpret an engineering drawing and prepare a production plan		
MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–14 marks
<p>A basic plan that includes information that could be used when making the product, however additional content would be required to facilitate manufacture.</p> <p>A few of the materials needed are identified.</p> <p>Few suitable processes, tools and equipment are identified.</p> <p>Few health and safety issues have been considered.</p> <p>At least one quality control measure has been identified.</p>	<p>An adequate plan that includes information that could be used when making the product to facilitate manufacture.</p> <p>Some of the materials needed are identified.</p> <p>Some of the processes, tools and equipment are suitable and presented in a workable sequence.</p> <p>Some health and safety issues have been considered.</p> <p>Some quality control measures identified.</p>	<p>A comprehensive plan that includes all the information required to facilitate manufacture of the product.</p> <p>All materials needed are accurately identified.</p> <p>All processes, tools and equipment are appropriate and presented in a logical sequence.</p> <p>All health and safety issues have been considered.</p> <p>Appropriate quality control measures identified to support the manufacture of an effective outcome.</p>

Unit R015 – Topic Area 1.3: Risk assessment		
MB1: 1–2 marks	MB2: 3–4 marks	MB3: 5–6 marks
<p>At least one potential hazard is identified and the risk of occurrence estimated.</p> <p>At least one control measure has been identified.</p>	<p>Some potential hazards are identified and the risk of occurrence for each is estimated.</p> <p>Appropriate control measures identified for some of the hazards.</p>	<p>All of the potential hazards of the process are identified and the risk of occurrence for each is estimated.</p> <p>Appropriate control measures identified for all of the hazards.</p>

Unit R015 – Topic Areas 2.1 and 2.2: Measuring and marking out

MB1: 1–4 marks	MB2: 5–8 marks	MB3: 9–12 marks
Use at least one item of measuring equipment.	Select and use some appropriate items of measuring equipment.	All measuring equipment is selected and used appropriately.
Safely use a few items of marking out equipment.	Select and safely use marking out equipment for some of the features.	Select and safely use appropriate marking out equipment for all of the features.
Dependent upon assistance or help from other sources to measure and mark out.	Measuring and marking out is carried out with some assistance or help from other sources.	Able to measure and mark out independently .

Unit R015 – Topic Area 3.1: Manually controlled machining processes

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–14 marks
Dependent upon reminders of safety requirements in order to work safely.	Worked safely with some reminders of safety requirements.	Worked safely at all times without additional instruction.
Basic application of understanding and skills to partly achieve the intended result, but it would not be useable without further input/work.	Adequate application of understanding and skills to produce the intended result in a way that would be useable for its purpose.	Effectively applies understanding and skills to successfully produce the intended result in a way that would be fit-for-purpose.
Dependent upon assistance or help from other sources to use machinery.	Machinery is used with some assistance or help from other sources.	Able to use machinery independently .

Unit R015 – Topic Area 3.2 and 3.3: Tools and equipment and joining techniques

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–14 marks
<p>Dependent upon reminders of safety requirements in order to work safely.</p> <p>Basic application of understanding and skills to partly achieve the intended result, but it would not be useable without further input/work.</p> <p>Dependent upon assistance or help from other sources to use tools and equipment.</p>	<p>Worked safely with some reminders of safety requirements.</p> <p>Adequate application of understanding and skills to produce the intended result in a way that would be useable for its purpose.</p> <p>Tools and equipment are used with some assistance or help from other sources.</p>	<p>Worked safely at all times without additional instruction.</p> <p>Effectively applies understanding and skills to successfully produce the intended result in a way that would be fit-for-purpose.</p> <p>Able to use tools and equipment independently.</p>

Assessment guidance

Task	Assessment guidance
Task 1	<ul style="list-style-type: none"> You should ensure that students have the opportunity to carry out relevant supporting research, which might be achieved by access to the internet. Please remind students about the requirement to reference all sources. Any appropriate format can be used for the production plan, so long as the information required to facilitate manufacture is presented. Students are not expected to produce working drawings of the part to be manufactured.
Task 2	<ul style="list-style-type: none"> The assessment of risk can be either qualitative (e.g. high, low, medium) or quantitative. Students can use any appropriate formats for the risk assessment, but we do provide a template that students can use.
Task 3	<ul style="list-style-type: none"> Students should be able to identify, select and use appropriate equipment to mark out and measure the features of the product. No tolerances are specified as these will be dependent upon the resources available in individual centres. Students may wish to collate annotated images in the form of a practical diary as part of their evidence. This should be completed individually, so it would be highly unusual to see the same output from all students in a cohort.
Task 4	<ul style="list-style-type: none"> No tolerances are specified as these will be dependent upon the resources available in individual centres. Students may wish to collate annotated images in the form of a practical diary as part of their evidence. This should be completed individually, so it would be highly unusual to see the same output from all students in a cohort. Students must follow safe working practices at all times. You should complete a Teacher Observation Record for this task.

Task	Assessment guidance
Task 5	<ul style="list-style-type: none"> No tolerances are specified as these will be dependent upon the resources available in individual centres. Students may wish to collate annotated images in the form of a practical diary as part of their evidence. This should be completed individually, so it would be highly unusual to see the same output from all students in a cohort. Students must follow safe working practices at all times. You should complete a Teacher Observation Record for this task.

Synoptic assessment

Some of the knowledge, understanding and skills required when completing this unit will draw on the learning developed in Unit R014. The following table details where these synoptic links can be found:

R015: Manufacturing a one-off product		R014: Principles of engineering design	
Topic area		Topic area	
1	Planning the production of a one-off product	1	Manufacturing processes
		2	Engineering materials
		3	Manufacturing requirements
3	Safely use processes, tools and equipment to make a product	1	Manufacturing processes

More information about synoptic assessment within this qualification can be found in [section 5.2 Synoptic assessment](#).

4.4 Unit R016: Manufacturing in Quantity

Aims

Most products are produced for a commercial environment. This often means that they will need to be produced in large quantities to a consistent standard. To help achieve this, manufacturing in quantity will make use of Computer Aided Design/Computer Aided Manufacture (CAD/CAM) facilities.

In this unit you will learn how to manufacture and use simple jigs and templates to support manufacturing

in volume. By using CAD software you will learn about the information needed to facilitate manufacture, and apply this in order to program Computer Numerical Control (CNC) equipment. In addition, you will learn how to set up and operate the CNC equipment and monitor the quality of the manufactured products.

Unit R016: Manufacturing in Quantity

Topic Area 1: Preparing for manufacture

Teaching content

Exemplification

1.1 Manufacture and use production aids

- Manufacture and use:
 - jigs
 - templates
 - Go-No Go gauges

To include:

- The typical uses of these items, such as work holding and quality control
- The use of card to make templates

1.2 Sequence of operations

- Determine the sequence of operations required for a manufactured part

To include:

- Parts that can be manufactured using at least one Computer Numerical Control (CNC) process

1.3 Operating parameters

- Determine appropriate operating parameters for Computer Numerical Control (CNC) equipment

To include:

- Use of manufacturers manuals or other published sources
- Outputs of CAD software and simulation

1.4 Standard operating procedures (SOPs)

- Produce standard operating procedures (SOPs) for the use of manufacturing processes

Unit R016: Manufacturing in Quantity

Topic Area 2: Develop programmes to operate CNC equipment

Teaching content

Exemplification

2.1 Use Computer Aided Design (CAD) software

- Use provided CAD drawings to create working drawings suitable for the CNC manufacture of parts
- Carry out on-screen simulation of CNC operations

To include:

- Use of third angle orthographic projection drawings to create CAD drawings to manufacture 2D shapes using CNC equipment
- Use 3D CAD models to create instructions to manufacture parts by turning or 3D printing

2.2 Programme CNC machine operations

- Setting datum points
- Use of co-ordinates
- Sequence of operations
- Tool change-over
- Setting tool offsets
- Export information from CAD software to CNC machines

To include:

- Recognition that some programming requirements are specific to certain CNC processes
- The difference between absolute and incremental co-ordinates

Topic Area 3: Safely use processes and equipment to make products in quantity

Teaching content

Exemplification

3.1 Setting up of CNC equipment

- Tooling
- Work holding
- Setting datum points
- Safety procedures

To include:

- The types of processes used could include:
 - laser cutters
 - CNC lathes
 - CNC mills and routers
 - 3D printers

3.2 Operating CNC equipment

- Operate CNC equipment safely

3.3 Apply quality control methods for volume manufacture

- Use Go-No Go Gauges
- Comparison of dimensional characteristics against engineering drawings
- Use of statistical process control

To include:

- Measurement of linear and angular dimensions using appropriate devices
- Use of control charts with action limits and control limits

Marking criteria

[Section 6.4](#) provides full information on how to mark the NEA units and apply the marking criteria. The marking criteria command words are further explained in [Appendix B Command words](#).

The tables below contain the marking criteria for the tasks for this unit. If a student's work does not meet the Mark Band 1 (MB1) criteria for any task, you must award zero marks for that task.

Unit R016 – Topic Area 1.1: Manufacture and use templates

MB1: 1–2 marks	MB2: 3–4 marks	MB3: 5–6 marks [PO4]
<p>Basic application of understanding and skills to partly achieve the intended result, but it would not be useable without further input/work.</p> <p>Dependent upon assistance or help from other sources to measure, mark out and cut out templates for the parts.</p>	<p>Adequate application of understanding and skills to produce the intended result in a way that would be useable for its purpose.</p> <p>Templates are measured, marked out and cut out with some assistance or help from other sources.</p>	<p>Effectively applies understanding and skills to successfully produce the intended result in a way that would be fit-for-purpose.</p> <p>Able to measure, mark out and cut out templates for the parts independently.</p>

Unit R016 – Topic Areas 1.2, 1.3 and 1.4: Determine the sequence of operations, appropriate operating parameters for CNC equipment and produce standard operating procedures

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–14 marks
<p>The SOP includes basic information, however additional content would be required.</p> <p>Few of the operations required are identified but additions may be needed and the sequence may need adjustment to be workable.</p> <p>Few of the operating parameters for the CNC equipment are identified, however would not provide a satisfactory outcome without further input/work.</p>	<p>The SOP includes adequate information to make the product.</p> <p>Some of the operations required are identified. The sequence of operations may need minor adjustment to be a workable sequence.</p> <p>Some of the operating parameters for the CNC equipment are identified and should provide a satisfactory outcome with minimal adjustment.</p>	<p>The SOP produced includes all the information required to manufacture the product.</p> <p>All of the operations required are identified in a logical and workable sequence.</p> <p>All of the operating parameters for the CNC equipment are identified and appropriate and should provide a satisfactory outcome without adjustment.</p>

Unit R016 – Topic Areas 2.1 and 2.2: Use CAD software and program CNC machine operations

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–14 marks [PO2, PO4]
<p>Produces basic CAD drawings that include some relevant information however some additional features would be required to create instructions for the CNC operation.</p> <p>Carries out on-screen simulation of few aspects of the CNC operation.</p> <p>Limited application of understanding and skills to partly achieve the intended result, but information is not exported from the CAD software to the CNC equipment.</p> <p>Dependent upon assistance or help from other sources to use CAD software and program CNC machine operations.</p>	<p>Produces adequate CAD drawings that include most of the information required to create instructions for the CNC operation.</p> <p>Carries out on-screen simulation of most aspects of the CNC operation.</p> <p>Understanding and skills are used to partially export the information from CAD software to CNC equipment that does not fully meet the requirements.</p> <p>Some assistance or help from other sources is required to use CAD software and program CNC machine operations.</p>	<p>Produces comprehensive CAD drawings that are accurate and include all of the information required to create instructions for the CNC operation.</p> <p>Carries out an effective on-screen simulation of the CNC operation, making adjustments if required.</p> <p>Understanding and skills are used to fully export the information from CAD software to CNC equipment in a way that would be fit-for-purpose.</p> <p>Able to use CAD software and program CNC machine operations independently.</p>

Unit R016 – Topic Areas 3.1 and 3.2: Setting up and operating CNC equipment

MB1: 1–5 marks	MB2: 6–10 marks	MB3: 11–14 marks [PO4]
<p>Dependent upon reminders of safety requirements in order to work safely.</p> <p>Basic application of understanding and skills to partly achieve the intended result, but it would not be useable without further input/work.</p> <p>Dependent upon assistance or help from other sources to set up and operate CNC equipment.</p>	<p>Worked safely with some reminders of safety requirements.</p> <p>Adequate application of understanding and skills to produce the intended result in a way that would be useable.</p> <p>Some assistance or help from other sources is required to set up and operate CNC equipment.</p>	<p>Worked safely at all times without additional instruction.</p> <p>Effectively applies understanding and skills to successfully produce the intended result in a way that would be fully fit-for-purpose.</p> <p>Able to set up and operate CNC equipment independently.</p>

Unit R016 – Topic Area 3.3: Apply quality control methods

MB1: 1–4 marks	MB2: 5–8 marks	MB3: 9–12 marks
<p>Measured few of the features on the drawing although some methods may have not been the most appropriate.</p> <p>Basic application of understanding and skills to partly achieve the intended result, but it would not be useable without further input/work.</p> <p>Dependent upon assistance or help from other sources to apply quality control methods.</p>	<p>Measured some of the features on the drawing using appropriate methods.</p> <p>Adequate application of understanding and skills to produce the intended result in a way that would be useable.</p> <p>Some assistance or help from other sources is required to apply quality control methods.</p>	<p>Provided accurate and repeatable measurements of all of the features on the drawing using appropriate methods.</p> <p>Effectively applies understanding and skills to successfully produce the intended result in a way that would be fully fit-for-purpose.</p> <p>Able to apply quality control methods independently.</p>

Assessment guidance

Task	Assessment guidance
Task 1	<ul style="list-style-type: none"> Students are expected to manufacture at least one basic production aid. Any appropriate material can be used for to manufacture this items, including card or a thin sheet of polymer. The process used could be manual, such as scissors, craft knives or similar and the processes used can be either CNC or manually controlled.
Task 2	<ul style="list-style-type: none"> You should ensure that students have the opportunity to carry out relevant supporting research for the operating parameters of the equipment – this might be achieved by access to manufacturers manuals or the internet. Please remind students about the requirement to reference all sources. Any appropriate formats can be used for the standard operating procedure.
Task 3	<ul style="list-style-type: none"> Students should be able to use a provided drawing to create a working drawing with sufficient information for the CNC manufacturing operation. Evidence must include copies of the CAD drawings, the instructions or program created by the CAD software for the CNC machine, and screenshots of the on-screen simulation and data transfer. The on-screen simulation can be carried out using a separate CAD software package.
Task 4	<ul style="list-style-type: none"> Students are required to set up and operate CNC equipment. Evidence could be collated in the form of a practical diary, that contains annotated photographs. This should be completed individually, so it would be highly unusual to see the same output from all students in a cohort. You should complete a Teacher Observation Record for this task.

Task	Assessment guidance
Task 5	<ul style="list-style-type: none"> Students must be able to enter data onto a control chart and identify when intervention is required. Students are not required to create control charts or calculate process capabilities, action limits or control limits. Evidence must include images of the parts compared to the templates and the assembled product. The comparison of the dimensions of the parts to the engineering drawing could be carried out on a test record sheet or by annotating the drawings.

Synoptic assessment

Some of the knowledge, understanding and skills required when completing this unit will draw on the learning developed in Unit R014. The following table details where these synoptic links can be found:

R016: Manufacturing in quantity		R014: Principles of engineering design	
Topic area		Topic area	
1	Preparing for manufacture	1	Manufacturing processes
		3	Manufacturing requirements
2	Develop programmes to operate CNC equipment	3	Manufacturing requirements
3	Safely use processes and equipment to make products in quantity	1	Manufacturing processes
		3	Manufacturing requirements

More information about synoptic assessment within this qualification can be found in [section 5.2 Synoptic assessment](#).

5 Assessment and grading

5.1 Overview of the assessment

Entry code	Qualification title	GLH	Reference
J823	OCR Level 1/Level 2 Cambridge National in Engineering Manufacture	120	603/7087/7
Made up of three mandatory units: <ul style="list-style-type: none">Units R014, R015 and R016.			

Individual unit details below:

Unit R014: Principles of engineering manufacture	
48 GLH 1 hour 15 minute written examination 70 marks (80 UMS) OCR-set and marked Calculators are allowed in this exam	This question paper has two parts: <ul style="list-style-type: none">Part A – includes 10 multiple choice questions (MCQs)Part B – includes short answer questions and extended response questions. One extended response question will be assessed using a levels of response mark scheme.
Unit R015: Manufacturing a one-off product	
36 GLH OCR-set assignment 60 marks (60 UMS) Centre-assessed and OCR moderated	This set assignment contains 5 practical tasks.
Unit R016: Manufacturing in quantity	
36 GLH OCR-set assignment 60 marks (60 UMS) Centre-assessed and OCR moderated	This set assignment contains 5 practical tasks.

OCR-set assignments for units R015 and R016 are available free of charge from our secure portal.

5.2 Synoptic assessment

Synoptic assessment is a built-in feature of this qualification. It means that students need to use an appropriate selection of their knowledge, understanding and skills developed across the qualification in an integrated way and apply them to a key task or tasks.

This also helps students to build a holistic understanding of the subject and the connections between different elements of learning, so they can go on to apply what they learn from this qualification to new and different situations and contexts.

The externally assessed unit R014 allows students to gain underpinning knowledge and understanding

relevant to engineering, manufacturing, process and control, and the non examined assessment (NEA) units R015 and R016 draw on and strengthen this learning by letting students apply their learning in a practical, skills-based way, through the scaling up of manufacture.

It is important to be aware of the synoptic links between the units so that teaching, learning and assessment can be planned accordingly. Then students can apply their learning in ways which show they are able to make connections across the qualification when they are assessed.

5.3 Transferable skills

This qualification also allows students the opportunity to gain broad, transferable skills and experiences that can be applied as they progress into their next stages of study and life and to enhance their preparation for future employment.

Students will have the opportunity to develop and demonstrate the following skills that are transferable to different real-life contexts, roles or employment:

- Solving problems by exploring different engineering manufacture processes, tools and equipment
- Planning a sequence of processes. This will involve managing your time and identifying the resources

you will need, as well as reviewing your plans if necessary.

Planning as part of a project is an important skill for any engineering workplace. It helps businesses to prioritise and improve productivity and efficiencies. Good planning can also help develop time management skills.

Through the requirement to prepare a production plan students will also have the opportunity to identify what is needed, and the resources that will be required.

5.4 Grading and awarding grades

All results are awarded on the following scale:

- Distinction* at Level 2 (*2)
- Distinction at Level 2 (D2)
- Merit at Level 2 (M2)
- Pass at Level 2 (P2)
- Distinction at Level 1 (D1)
- Merit at Level 1 (M1)
- Pass at Level 1 (P1).

The shortened format of the grade will show on our online portal and some of our administrative documents. However, the full format of the grade will be on the certificates issued to students.

The boundaries for Distinction at Level 2, Pass at Level 2, and Pass at Level 1 are set judgementally. Other grade boundaries are set arithmetically.

The Merit (Level 2) is set at half the distance between the Pass (Level 2) grade and the Distinction (Level 2) grade. Where the gap does not divide equally, the Merit (Level 2) boundary is set at the lower mark (For example, 45.5 would be rounded down to 45).

For the examined unit, the Distinction* (Level 2) grade is normally set at about 0.75 of the D2-M2 distance above the D2 boundary mark.

To set the Distinction (Level 1) and Merit (Level 1) boundaries, the gap between the Pass (Level 1) grade and the Pass (Level 2) grade is divided by 3, and the boundaries set equidistantly. Where this division leaves a remainder of 1, this extra mark will be added to the Distinction (Level 1) to Pass (Level 2) interval, meaning

the Distinction (Level 1) boundary will be lowered by 1 mark. Where this division leaves a remainder of 2, the extra marks will be added to the Distinction (Level 1) to Pass (Level 2) interval, and the Merit (Level 1) to Distinction (Level 1) interval, meaning the Distinction (Level 1) boundary will be lowered by 1 mark, and the Merit (Level 1) boundary will be lowered by 1 mark.

For example, if Pass (Level 2) is set judgementally at 59, and Pass (Level 1) is set judgementally at 30, then Distinction (Level 1) is set at 49, and Merit (Level 1) is set at 39.

Grades are indicated on qualification certificates. However, results for students who fail to achieve the minimum grade (Pass at Level 1) will be recorded as unclassified (U or u) and this is not certificated.

This qualification is unitised. Students can take units across different series and can resit units (see [section 7.7 Unit and qualification resits](#)). Grade boundaries are

set per unit, per series, so may be set in different places for a unit in different series. When working out students' overall grades, OCR needs to be able to compare performance on the same unit in different series when different grade boundaries may have been set, and between different units. We use a Uniform Mark Scale (UMS) so this can be done.

A student's uniform mark for each unit is calculated from the student's raw mark on that unit. The raw mark boundary marks are converted to the equivalent uniform mark boundary. Marks between grade boundaries are converted on a pro rata basis.

When unit results are issued, the student's unit grade and uniform mark are given. The uniform mark is shown out of the maximum uniform mark for the unit (For example, 42/60).

The table below shows the Raw marks and UMS marks for each unit:

Marks	Exam	NEA1	NEA2
Raw marks	70	60	60
UMS	80	60	60

The uniform mark boundaries for each of the assessments are shown below:

Unit GLH	Max Unit Uniform Mark	Unit Grade							
		Distinction* at L2	Distinction at L2	Merit at L2	Pass at L2	Distinction at L1	Merit at L1	Pass at L1	U
36	60	54	48	42	36	30	24	18	0
48	80	72	64	56	48	40	32	24	0

The student's uniform mark for Unit R014 will be combined with the uniform mark for the NEA units to give a total uniform mark for the qualification. The student's overall grade will be determined by the total uniform mark. The following table shows the minimum total mark for each overall grade:

Max Uniform Mark	Qualification Grade							
	Distinction* at L2	Distinction at L2	Merit at L2	Pass at L2	Distinction at L1	Merit at L1	Pass at L1	U
200	180	160	140	120	100	80	60	0

A marks calculator is available on the qualification page of the [OCR website](#) to help you convert raw marks into uniform marks.

5.5 Performance descriptors

Performance descriptors give a general indication of likely levels of attainment by representative students performing at boundaries: Distinction at Level 2, Pass at Level 2 and Pass at Level 1.

Performance descriptor – Distinction at Level 2

Students will be able to:

- recall, select and apply **detailed** knowledge and understanding of engineering
- present information **clearly** and **accurately**, using a **wide range** of technical language and engineering terminology
- apply **relevant** knowledge, understanding and skills in a **range** of situations to plan and carry out investigations and tasks **effectively**, testing their solutions, and working safely and with a **high degree of precision**
- analyse and evaluate the evidence available, reviewing and adapting their methods **where appropriate**
- make **reasoned** judgements and **substantiated** conclusions
- work **confidently and independently** to create material which reflects **effective** planning, **skilled** development and **perceptive** evaluation as well as **demonstrating** practical skills at a **high level**.

Performance descriptor – Pass at Level 2

Students will be able to:

- recall, select and apply **sound** knowledge and understanding of engineering
- present information with **some accuracy**, using a **range of** technical language and engineering terminology
- apply knowledge, understanding and skills in a **range** of situations to plan and carry out investigations and tasks, testing their solutions, and working safely and with **precision**
- review evidence available, analysing and evaluating **some** information and making **adequate** adaptations to their methods
- make **judgements** and draw **appropriate** conclusions
- work with some **independence** to create material which reflects **adequate** planning, development and evaluation and an ability to demonstrate **sound** practical skills.

Performance descriptor – Pass at Level 1

Students will be able to:

- recall, select and apply knowledge and understanding of **basic** aspects of engineering
- present **basic** information, using **limited** engineering terminology
- apply **limited** knowledge, understanding and skills to plan and carry out **simple** investigations and tasks, with an awareness of the need for safety and precision
- review evidence and draw **basic** conclusions
- work, with **regular** assistance, to create material which demonstrates a degree of planning, development and evaluation and **limited** practical skills.

6 Non examined assessment (NEA) units (R015 and R016)

This section provides guidance on the completion of the NEA units (R015 and R016). The NEA units are designed so that students can build a portfolio of evidence to meet the topic areas for the unit.

Assessment for this qualification must adhere to JCQ's [Instructions for Conducting Coursework](#). Please **do not** use JCQ's *Instructions for Conducting Non-examination Assessments* – these are only relevant to GCE and GCSE specifications.

Units R015 and R016 are centre assessed and externally moderated by us.

You **must** make sure that you have read and understood all of the rules and guidance provided in this section **before** your students complete and you assess the set-assignments.

If you have any queries please [contact us](#) for help and support.

6.1 Preparing for NEA unit delivery and assessment

6.1.1 Centre and teacher/assessor responsibilities

For the NEA units of this qualification we assume the teacher is the assessor.

Before you plan to get [approval](#) from us to offer this qualification you must be confident your centre can fulfil all the responsibilities described below.

The quality of the delivery of teaching and the integrity of assessments and quality assurance is paramount. Systems must be in place so that assessments are fair, valid, reliable and authentic. One of the key factors behind valid, fair and reliable assessment is the expertise of those doing the assessment and internal quality assurance.

With this in mind, here's a summary of the responsibilities that your centre and teachers must be able to fulfil. It is the responsibility of the head of centre¹ to make sure our requirements are met:

- there are enough trained or qualified people to teach and assess the expected number of students you have in your cohorts
- teaching staff have the relevant level of subject knowledge and skills to deliver and assess this qualification
- teaching staff will fully cover the knowledge, understanding and skills requirements in teaching and learning activities
- necessary resources are available for teaching staff and students during teaching and assessment activities, to give students every opportunity to

meet the requirements of the qualification and reach the highest grade possible

- there's a system of standardisation in place so that all assessment decisions for teacher-marked (centre assessed) assignments are consistent, fair, valid and reliable (see [internal standardisation](#) in section 6.4.3)
- there's enough time for effective teaching and learning, assessment and internal standardisation
- processes are in place to make sure that students' work is individual and confirmed as being authentic (see [Ways to authenticate work](#) in section 6.2.1)
- you must use the OCR-set assignments for students' summative assessments
- the OCR-set assignments must not be used for practice (see section 6.2, [Requirements and guidance for delivering and marking the OCR-set assignments](#))
- students understand what they need to do to get the highest marks possible
- students understand what it means when we say work must be authentic and individual and they (and you) must follow any requirements we set out to make sure their work is their own

¹ This is the most senior officer in the organisation, directly responsible for the delivery of OCR qualifications, For example, the headteacher or principal of a school/college. The head of centre accepts full responsibility for the correct administration and conduct of OCR exams.

- students know they must not reference another individual's personal details in any evidence produced for summative assessment in accordance with the General Data Protection Regulations (UK GDPR). It is the student's responsibility to make sure evidence that includes another individual's personal details is anonymised
- marks submitted to us are correctly recorded in all centre and OCR records and forms
- assessment of set assignments must adhere to JCQ [Instructions for Conducting Coursework](#).
- a declaration is made at the point you're submitting any work to us for assessment that confirms:
 - all assessment is conducted according to the specified regulations identified in the [Administration area of our website](#),
 - students' work is authentic
 - marks have been transcribed accurately
- centre records and students' work are kept according to the requirements below:
 - students' work must be kept until after their qualifications have been awarded and any review of results or appeals processed. We will not consider any review if the centre does not keep the work
 - internal standardisation and assessment records must be kept securely for a minimum of three years after the date we've issued a certificate for a qualification
- the head of centre must report all cases of suspected malpractice involving teachers or students (see '[Reporting suspected malpractice](#)' in section 6.3.1).

6.2 Requirements and guidance for delivering and marking the OCR-set assignments

The assignments are set by us, taken under supervised conditions, marked by the teacher and moderated by us. Assignments are available on our secure portal.

The set assignments give an approximate time that it will take to complete all tasks. These timings are for guidance only, but should be used by you, the teacher, to give students an indication of how long to spend on each task. You can decide how the time should be allocated between each part or individual task. You are also permitted to spread the tasks across several sessions, and therefore it is permissible for evidence to be produced over several sessions.

We will review the set assignments annually which may result in an assignment being withdrawn and replaced. It is up to you to check our secure portal to see which set assignments are available to be used. We will give approximately 12 months' notice if a set assignment is to be withdrawn and replaced so that we do not disadvantage any students who have already started working on an assignment that is to be replaced.

Assessment of the set assignments must adhere to JCQ [Instructions for Conducting Coursework](#).

Appendix A of this specification gives guidance for creating electronic evidence for the NEA units. Please read Appendix A along with the unit content and marking criteria grids as it might help you plan your delivery of the units.

The rest of this section deals with how we expect you to manage the delivery and marking of the set assignments, so that assessment is valid and reliable. Please note that failing to meet these requirements may be deemed to be malpractice.

Here is a summary of what we need you to do.

You **must**:

- have covered the knowledge, understanding and skills with your students and be sure they are ready for assessment before you start the summative assessment
- give students the Student Guidance document before they start the assessment
- make sure students are clear about the tasks they must complete and the criteria they are expected to meet. You can:
 - explain the task
 - provide a copy of the marking criteria to students
- allow students a reasonable amount of time to complete the assignments and be fair and consistent to all students. The time you allow should be in line with the estimated time we think it should take which is stated in the OCR-set assignments. Within that time students can work on

the tasks any time until the date the centre collects the work for centre assessment

- tell the students the resources and sources of assets that they can use in the assignment before undertaking the assessment tasks
- only give students OCR-provided templates. If they opt to use a template from a book, a website or course notes when, for example, creating a plan for the production of a prototype, they must make sure the source is referenced
- monitor students' progress to make sure work is capable of being assessed against the marking criteria, on track for being completed in good time and is the **student's own work**:
 - work must be carried out with enough supervision to make sure that the work submitted can be confidently authenticated as the student's own work
 - NEA work **must** be completed during normal curriculum time and supervised and marked by the teacher/assessor
 - if you provide any material to prepare students for the set assignment, you must adhere to the rules on using referencing and on acceptable levels of guidance to students set out within the Plagiarism and Feedback sections (see 6.2.2 [Plagiarism](#) and 6.3 [Feedback](#))
 - students must produce their work independently (see 6.2.1 and 6.3 on [Ways to authenticate work](#) and [Feedback](#))
 - you must make sure students are aware of the requirement to keep their work secure, not share with other students and keep their passwords secure
- allow students to take the initiative to improve any element of their work as they work through the assignment
- use the marking criteria to mark students' work
- before submitting marks to us, allow students to repeat any element of the assignment and rework their original evidence. But, any feedback given to students on the original (marked) evidence, must only be generic and must be recorded and available to the moderator (see section 6.3 on [Feedback](#) and section 6.4.4 on [resubmitting work](#)).

You **must not**:

- make any changes to the OCR-set assignments outside of those allowed (see [Scope of Assessment Modification](#) below)
- accept multiple resubmissions of work where small changes have been made in response to feedback
- allow teachers or students to add, amend or remove any work after students have submitted work for final assessment. This will constitute malpractice
- practice the OCR-set assignment tasks with the students
- create practice assignments and practice data which are similar in nature to those set by us
- give detailed advice and suggestions to individuals or the whole class on how work may be improved to meet the marking criteria.

Scope of assessment modification

The set assignments for each unit have been designed to address the unit content and marking criteria. To make sure that the assessments remain fair and reliable, only limited modification is allowed.

The set assignment for Units R015 and R016 can be modified in the areas given below. If you make the modifications allowed, you must make sure that students can still cover all topic areas and access the full range of marks.

Modifications to the following are allowed:

- the scenario: this can be contextualised or amended to suit local needs or resources available in your centre, for example if the specified materials are not available in sufficient quantities in your centre
- the tasks: in order to match any contextual changes made to the scenario. No other changes should be made to the tasks.

Any changes made to the scenario must be set within a real-life and meaningful context and must have a clear purpose.

You **must** make sure that:

- the changes you make to the scenario mean the requirements are of the same complexity and demand to those in the OCR-set assignment. For example, if a different product will be designed

or prototyped, it must be of the same level of complexity or demand as the product we provide.

- there is **no change** to the:
 - unit content assessed – this means that additional assessment requirements must not be added in or removed when modifying
 - level of demand assessed – the requirements of the marking criteria must not be changed
 - total allocated time for the assignment
 - the level of guidance given.

If you make changes to the set assignment in line with these rules, you do not have to send your modified assignment to us for checking before you give it to your students.

However, the modified assignment **must** be sent to the OCR moderator when you submit your sample for moderation. This allows the moderator to:

- make moderation decisions based on the assignment completed by the students
- know that the assignment has been amended and that they don't need to report group approaches that are different to the OCR-set assignment as malpractice.

Any changes made to assignments outside of those allowed will be treated as malpractice.

6.2.1 Ways to authenticate work

You must be confident that the work you mark is the student's own. Every student must produce their own work independently. You must use enough supervision, or complete sufficient checks, to be able to judge the authenticity of the student's work.

Wherever possible, the teacher should discuss work-in-progress with students. This will make sure that work is being completed in a planned and timely way and provide opportunities for you to check authenticity of the work.

You must:

- make sure students and other teachers understand what constitutes plagiarism and not accept plagiarised work as evidence (you might find the JCQ document [Plagiarism in Assessments](#) helpful)
- use supervision and questioning as appropriate to confirm authenticity
- make sure students and teachers fill in declaration statements.

6.2.2 Plagiarism

When producing final 'written' pieces of work for the set assignments, students must use their own words to show they have genuinely applied their knowledge and understanding. When students use their own words, ideas and opinions, it reduces the possibility of their work being identified as plagiarised. Plagiarism is the submission of someone else's work as your own and/or failure to acknowledge a source correctly. Plagiarism makes up a large percentage of cases of suspected malpractice reported to us by moderators. Teachers must make sure they do not accept plagiarised work as evidence.

Plagiarism often occurs innocently when students do not know that they must reference or acknowledge their sources or aren't sure how to do so. It's important to make sure your students understand:

- the meaning of plagiarism and what penalties may be applied
- that they can refer to research, quotations or evidence produced by somebody else but they must list and reference their sources and clearly mark quotations
- quoting someone else's work, even when it's properly sourced and referenced, doesn't evidence understanding. The student must 'do' something with that information to show they understand it. For example, if a student has to analyse data from an experiment, quoting data doesn't show that they understand what it means. The student

must interpret the data and, by relating it to their assignment, say what they think it means. The work must clearly show how the student is using the material they have referenced **to inform their** thoughts, ideas or conclusions.

We have a guide to referencing on our website [The OCR Guide to Referencing](#) and we have also produced a [poster](#) on referencing and plagiarism which may be useful to share with students.

Some useful tips are:

- Best practice is to always reference material copied from the internet or other sources. This applies to infographics (graphical information providing data or knowledge) as well
- Teach your students how to reference and explain why it's important to do it. At Key Stage 4 it is sufficient if they:
 - use quote marks to show the beginning and end of the copied work
 - for website text, list the html address and ideally the date they accessed the website
 - for other publications, list the name of the resource/book/printed article and ideally the year in which it was published.
- Students must also identify information they have copied from teaching handouts and presentations for the unit, using quote marks and stating the text is from class handouts.

Identifying copied/plagiarised work

Inconsistencies throughout a student's response are often indicators of plagiarism. For example:

- different tones of voice, sentence structure and formality across pieces of work
- use of American expressions, spellings and contexts (such as American laws and guidelines)

- dated expressions and references to past events as being current
- sections of text in a document where the font or format is inconsistent with other sections.

What to do if you think a student has plagiarised

If you identify plagiarised work at the point of marking or moderation:

- this must be taken into account when applying the mark scheme.
 - the work should be included with any work that is sent to the moderator if it is part of the moderation sample, with a note on the Unit Recording Sheet to state that there is plagiarism in the work and that marks have been adjusted accordingly

- the student(s) must be reported for plagiarism in line with the JCQ document [Suspected Malpractice Policies and Procedures](#)
 - Fill in the [JCQ form M1](#)

In line with the policy and procedures of JCQ on suspected malpractice, the penalties applied for plagiarism would usually result in the work not being allowed or the mark being significantly reduced.

6.3 Feedback

Feedback to students on work in progress towards summative assessment

You can discuss work-in-progress towards summative assessment with students to make sure it's being done in a planned and timely way. It also provides an opportunity to check the authenticity of the work. You must intervene if there's a health and safety risk.

Generic guidance to the whole class is also allowed. This could include reminding students to check they have provided evidence to cover every aspect of the task. Individual students can be prompted to double check for gaps in evidence providing that specific gaps are not pointed out to them.

You can give general feedback and support if one or more students are struggling to get started on an aspect of the assignment or following a break between sessions working on the assignment. For example, if a student is seeking more guidance that suggests they are not able to apply knowledge, skills and understanding to complete their evidence you can remind them that they had a lesson which covered the relevant topic. The student would then need to review their own notes to find this information and apply it as needed.

Feedback must not provide specific advice and guidance that would be construed as coaching. This would compromise the student's ability to independently perform the task(s) they are doing and constitutes malpractice. Our moderators use a number of measures to assure themselves the work is the student's own.

Once work has been marked, feedback must be provided to students on the work they submitted for assessment.

Feedback **must**:

- be supportive, encouraging and positive
- tell the student what has been noticed, not what the teacher thinks (for example if you have observed the student completing a task you can describe what happened, what was produced and what was demonstrated)

Feedback **can**:

- identify what task and part of the task could be improved, but not detail how to improve it. You could show the student work from a **different** unit that demonstrates higher achievement, but you must not detail to the student how they could achieve that in their work. If you are using

another student's work as a model answer, please anonymise this work. You could remind students that they had a lesson on a specific topic and that they could review their notes, but you must not tell them how they could apply the teaching to improve their work.

- comment on what has been achieved, for example *'the evidence shows an **adequate** understanding for MB2'*
- identify that the student hasn't met a command verb or mark band requirement. For example, *'This is a description, not an evaluation'*
- use text from the specification, assignment or marking criteria in general guidance to clarify what is needed in the work. For example *'you need to consider all points relating to the creation of standard operating procedures. You have included **all** the information required to manufacture the product in your standard operating procedures, but only identified **some** of the operations required, and the sequence of operations may need minor adjustment to be a workable sequence'*
- point out where the work sits within the mark bands but students must make their own decisions as to what to improve and how. For example, the feedback can say *'this shows a **sound** understanding'* (for mark band 2) but not precisely what should be added to make it show a **comprehensive** understanding (for mark band 3).

Feedback **must not**:

- point out specific gaps, for example you must not prompt the student to include specific detail in their work, such as *'You need to improve this by giving more detail'*
- be so detailed that it
 - leads students to the answer, for example you must not give headings or templates that include examples which give all or part of what students have to write about or produce.
 - provides a step-by-step guide on what to do to complete or improve work
- talk the student through how to achieve or complete the task

- give model answers on the same unit being taken or explain specifically what amendments should be made. If work from another student on a different unit is being used to model answers, please ensure it is anonymised.
- give detail on where to find information/evidence.

In other words, feedback must help the student to take the initiative in making changes. It must not direct or tell the student what to do to complete or improve their

What over-direction might look like

When we see anything that suggests the teacher has led students to the answer, we become concerned because it suggests students have not worked independently to produce their assignment work. The following are examples of what may indicate over-direction by the teacher:

- prompts that instruct students to include specific detail in their work, such as, 'You need to define the difference between sketching techniques. How are they used? Which techniques are most appropriate?'

6.3.1 Reporting suspected malpractice

It is the responsibility of the head of centre to report all cases of suspected malpractice involving teachers or students.

A JCQ Report of Suspected Malpractice form (JCQ/M1 for student suspected malpractice or JCQ/M2 for staff suspected malpractice) is available to download from the [JCQ website](#) and must be completed as soon as possible and emailed to us at malpractice@ocr.org.uk.

6.3.2 Supervision

NEA work must be completed in normal curriculum time and supervised and marked by the teacher. You must use enough checks so you're confident the student's work is authentic.

6.3.3 Student and centre declarations

Both students and teachers must declare that the work is the student's own:

- **each student** must sign a declaration before submitting their work to their teacher. A candidate authentication statement that can be used is available to download from the OCR website. These statements should be kept within the centre until all enquiries about results, malpractice and appeal

work in a way that means they do not need to think how to apply their learning. Students need to recall or apply their learning. You must not do the work for the student(s).

Neither you nor the student can add, amend or remove any work after the final mark has been submitted for moderation.

Please see additional guidance for students who wish to resubmit their work in [Section 6.4.4](#).

- headings or templates that include examples which give all or part of what students have to write about or produce, such as planning the manufacture of a prototype.

Moderators will report suspected malpractice when they cannot see differences in content between students' work in the sample they are moderating. An exception is when students have only used and referenced technical facts and definitions. If the moderator is in any doubt, they will report suspected malpractice. The decision on whether or not to investigate is made by us not the moderator.

When we ask centres to investigate instances of malpractice, heads of centres must act promptly and report the outcomes to us.

More information about reporting and investigating suspected malpractice, and the possible sanctions and penalties which could be imposed, is in the JCQ publication: [Suspected Malpractice Policies and Procedures](#). You can also find out more on our [website](#).

For example, you can use questioning to confirm the depth and breadth of their understanding of the topic they've covered in a specific piece of work.

issues have been resolved. **A mark of zero must be recorded if a student cannot confirm the authenticity of their work**

- **teachers** must declare the work submitted for centre assessment is the student's own work by completing a centre authentication form (CCS160) for each unit. Centre authentication forms should be kept within the centre until all post-results issues have been resolved.

6.3.4 Group working

We do not assess the skills associated with group work in this qualification and the OCR-set assignment will not include it. If it is necessary to use group work to make the delivery of the assignment more manageable, you

must make sure that all practical tasks and evidence submitted for assessment that shows the student has met the marking criteria is entirely the individual's own work.

6.3.5 Methods of assessment

It is your responsibility to choose the best method of assessing a student in relation to their individual circumstances. The methods chosen must be:

- valid
- reliable
- safe and manageable
- suitable to the needs of the student.

Valid

Validity can be compromised if a student does not understand what is being asked of them. For example, one valid method of assessing a student's knowledge and understanding is to question them. If the questions posed are difficult for the student to understand (not in terms of the content but the way they are phrased, for example) the validity of the assessment method is questionable.

As well as assessment methods being valid, the evidence presented must also be valid. For example, it would not be appropriate to present an organisation's equal opportunities policy as evidence towards a student's understanding of how the equal opportunities policy operates within the organisation. It would be more appropriate for the student to incorporate the policy within a report describing different approaches to equal opportunities.

Reliable

A reliable method of assessment will produce consistent results for different assessors on each assessment occasion. Internal moderators must make sure that all assessors' decisions are consistent.

Safe and manageable

Assessors and internal moderators must make sure that the assessment methods are safe and manageable and do not put unnecessary demands on the student.

Suitable to the needs of the student

We are committed to ensuring that achievement of these qualifications is free from unnecessary barriers. You must follow this commitment through when

amending tasks and/or considering assessment. If you are amending tasks and are not sure what is acceptable, [contact us](#).

Observation and questioning

The primary evidence for assessment is the work submitted by the student, however we consider the following assessment methods suitable for teachers/assessors to use for these qualifications:

- **observation** of a student doing something
- **questioning** of the student or witness.

Observation

The teacher/assessor and student should plan observations together but it is the teacher's/assessor's responsibility to record the observation properly (for example observing a student undertaking a practical task). Find more information in the [Teacher Observation Records](#) section below.

Questioning

Questioning the student is normally an ongoing part of the formative assessment process and may, in some circumstances, provide evidence to support achievement of the criteria.

Questioning is often used to:

- test a student's understanding of work which has been completed outside of the classroom
- check if a student understands the work they have completed
- collect information on the type and purpose of the processes a student has gone through.

If questioning is to be used as evidence towards achievement of specific topic areas, it is important that teachers/assessors record enough information about what they asked and how the student replied, to allow the assessment decision to be moderated.

6.3.6 Teacher Observation Records

It is a requirement that a teacher completes the Teacher Observation Record form **in the OCR set-assignment for unit R015 and R016** for each student as evidence of their machining and setting up and operating CNC equipment. The Teacher Observation Record form should support evidence of a student using tools and equipment and a manually controlled machining process (R015), and the setting up and use of CNC equipment to manufacture parts (R016), alongside evidence such as annotated photographic evidence.

Teacher observation **cannot** be used as evidence of achievement for a whole unit. Most evidence should be produced directly by the student. Teacher observation should only be used where specified as an evidence requirement (For example, for using tools and equipment and machining in R015 and the setting up and operating of CNC equipment in R016.).

Teacher Observation Records must be suitably detailed for each student, to help assessors to determine if the grading criteria have been met. You must follow the guidance provided in the 'guidance notes' section of the form so that the evidence captured and submitted is appropriate. Both the student and the teacher must sign and date the form to show that you agree its contents.

Where the guidance has not been followed, the reliability of the form as evidence may be called into question. If doubt about the validity of the Teacher Observation Record form exists, it cannot be used as assessment evidence and marks based on it cannot be awarded. Moderators will be instructed to adjust centre marks accordingly.

6.3.7 Presentation of the final piece of work

Students must observe the following procedures when producing their final piece of work for the NEA tasks:

- work can be word processed or hand-written
 - tables and graphs (if relevant) may be produced using appropriate ICT
 - any copied material must be suitably acknowledged
 - quotations must be clearly marked and a reference provided
 - a completed Unit Recording Sheet must be attached to work submitted for moderation. The Unit Recording Sheet can be downloaded from the [qualification page](#)
- Centres **must** provide guidance on the Unit Recording Sheet (URS) to show where specific evidence can be found. This may be through the use of the 'page number' column and/or by referencing file names and locations
 - Work submitted digitally for moderation should be on electronic media (for example, on our portal, CD or USB Drive), and be in a suitable file format and structure, as detailed in Appendix A at the end of this specification. Students must submit their completed product(s) in an electronic format that is suitable for the client in the set assignment.

6.4 Marking NEA units

All NEA units are internally marked by teachers using the OCR marking criteria and guidance and externally moderated by the OCR-appointed moderator. Assessment of the set assignments must adhere to JCQ [Instructions for Conducting Coursework](#).

The centre is responsible for appointing someone to act as the assessor. This could be the teacher who has delivered the programme or another person from the centre.

6.4.1 Use of a 'best fit' approach to marking criteria

The assessment tasks should be marked by teachers/assessors according to the OCR marking criteria using a 'best fit' approach. For each of the marking criteria, teachers/assessors select the band descriptor provided in the marking grid that most closely describes the quality of the work being marked.

Marking should be positive, rewarding achievement rather than penalising failure or omissions. The award of marks **must be** directly related to the marking criteria.

- Each band descriptor covers all the relevant content for the topic areas.
- The descriptors should be read and applied as a whole.
- Make a best fit match between the answer and the band descriptors.
- An answer does not have to meet all of the requirements of a band descriptor before being placed in that band. It will be placed in a particular band when it meets more of the requirements of that band than it meets the requirements of other bands.
- Where there is more than one strand within the band descriptors for a topic area and a strand has not been addressed at all, it is still possible for the answer to be credited within that mark band depending upon the evidence provided for the remaining strands. The answer should be placed in the mark band most closely reflecting the standard achieved across all strands within the band descriptors for topic areas; however in this scenario, the mark awarded for that band should reflect that a strand has not been addressed.

The marking criteria must be used to mark the student's work. These specify the levels of skills, knowledge and understanding that the student is required to demonstrate.

When deciding the mark within a band, the criteria below should be applied:

- the extent to which the statements within the band have been achieved. For example:
 - an answer that convincingly meets nearly all of the requirements of a band descriptor should be placed at or near the top of that band. Where the student's work convincingly meets the statements, the highest mark should be awarded
 - an answer that meets many of the requirements of the band descriptor should be placed in the middle of the band. Where the student's work adequately meets the statements, the most appropriate mark in the middle range should be awarded
 - if an answer is on the borderline between two bands but it is decided that it better fits the descriptors for:
 - the lower of these two bands - it should be placed near the top of the lower band
 - the higher of these two bands - the lowest mark for the higher band should be awarded.
- if a student's work does not meet Mark Band 1 (MB1) criteria for any task, you must award zero marks for that task.

Teachers/assessors should use the full range of marks available to them and award full marks in any band for work that fully meets that descriptor. This is work that is 'the best one could expect from students working at that level'.

6.4.2 Annotating students work

Each piece of NEA work should show how the marks have been awarded in relation to the marking criteria.

Writing comments on students' work and Unit Recording Sheet (URS) provides a means of

communication between teachers during the internal standardisation, and with the moderator if the work is part of the moderation sample.

6.4.3 Internal standardisation

It is important that all teachers/assessors work to common standards. Centres must make sure that, within each unit, the internal standardisation of marks across teachers/assessors and teaching groups takes place using an appropriate procedure.

This can be done in a number of ways. In the first year, reference material and OCR training meetings will provide a basis for centres' own standardisation. In following years, this, or centres' own archive material, may be used. We advise centres to hold preliminary meetings of staff involved to compare standards through cross-marking a small sample of work. After most marking has been completed, a further meeting at which work is exchanged and discussed will help final adjustments to be made.

If you're the only assessor in your centre for this qualification, then it's still advisable to make sure your assessment decisions are internally standardised by someone else in your centre, ideally someone who has experience of the nature of this qualification (For example, is delivering a similar qualification in another subject) or relevant subject knowledge and asking them to review a sample of the assessments.

You must keep evidence of internal standardisation in the centre for the moderator to see.

We have a [guide](#) to how internal standardisation may be approached on our website.

6.4.4 Resubmitting moderated work for (summative) assessment to improve the grade

If following moderation you and the student feel they have not performed at their best during the assessment, the student can, at the centre's discretion, improve their work and resubmit it to you for assessment. You must be sure it is in the student's interests to re-attempt the assessment.

You must record the reasons why a student has been allowed to resubmit in the centre's assessment decision records. You must also follow our guidelines on giving feedback and record the feedback given to the student on the original work. We monitor the assessment decisions you make. You must follow the same guidelines as outlined in [Section 6](#) where a student improves their work for resubmission. All feedback that has been given to the student for the purposes of

resubmitting work must be recorded. We reserve the right to request the written feedback and the work in its original state. If you do not meet the requirements this will be treated as malpractice.

There is one re-submission opportunity. Resubmission before submitting a final mark to us is intended to allow the student to reflect on feedback (which must be recorded) and improve their work. It is not an iterative process where they make small modifications through ongoing feedback to eventually achieve the desired level.

Neither you nor the student can add, amend or remove any work after the final mark has been submitted for moderation.

See [Section 7.2](#) for terminal assessment rules.

6.4.5 Submitting marks

All work for NEA units is marked by the teacher and internally standardised by the centre. Marks are then submitted to us. You can find the key dates and timetables on our [website](#).

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

submits no work for a NEA unit, the student should be identified as being absent from that unit.

If a student completes any work at all for a NEA unit, then the work should be assessed according to the marking criteria and the appropriate mark awarded. This may be zero.

6.5 Moderating NEA units

The purpose of external moderation is to make sure that the standard of marking is the same for each centre and that internal standardisation has taken place.

The [administration](#) pages of our website provide full details about how to submit work for moderation.

This includes the deadline dates for entries and submission of marks. For moderation to happen, centres must submit their marks.

6.5.1 Sample requests

Once you have submitted your marks, we will tell you which work will be sampled as part of the moderation. Samples will include work from across the range of attainment of students' work. Copies of students' work must be kept until after their qualifications have been awarded and any review of results or appeals processed.

Centres will receive the final outcomes of moderation when the provisional results are issued. Results reports will be available for you to access. More information about the reports that are available is on our [administration](#) pages.

As it is essential for us to have sample work available at awarding meetings, we may ask some centres to release work for awarding and archive purposes. We will let you know as early as possible if we need this from you and always appreciate your co-operation.

7 Administration

The information in this section gives an overview of the processes involved in administering this qualification. All of the following processes require you to submit something to OCR by a specific deadline. More information about the processes and deadlines involved at each stage of the assessment cycle can be found in the Administration area of the [OCR website](#).

7.1 Assessment availability

There are two assessment series available each year in January and June to all students. Students can be entered for different units in different assessment series.

All students must take the exam at a set time on the same day in a series. Certification is available each January and June.

Series	Unit availability	
	Unit R014	Units R015 and R016
January	✓	✓
June	✓	✓

7.2 Terminal Assessment

The externally assessed unit must be taken as terminal assessment. This means that the exam for unit R014 must be taken at the end of the students' course of study. This exam contributes 40% of the total marks available for the qualification.

NEA units can be submitted in any series but must be submitted either before or in the same series as the externally assessed unit.

Certification entries

- For a student to achieve the qualification, you need to make a qualification certification entry (aggregation)
- You can make certification entries:
 - at the same time as unit entries for the exam
 - after you have received results for the exam as a late certification request for that series
 - after you have received results for the exam as a certification entry in a later series
- You can make certification entries in the January or June series – this is the series that will appear on the qualification certificate
- Certification entries and late certification requests are free of charge

Resitting units before certification

- Students **can** take the exam before all the NEA units are completed. This is classed as a 'practice attempt'

- 'Practice attempts' do not count towards the student's overall grade or in performance tables. The student will be issued with a unit result only
- When the student has completed all the NEA units, if you do not make a certification entry when you enter for the exam, the exam will be classed as a practice attempt unless you make a late certification entry or a certification entry in a subsequent series
- If a student takes the exam again after a practice attempt, the result of the latest attempt will count towards the qualification result, even if the practice attempt result was higher
- An NEA unit can be resubmitted once before the overall qualification is awarded. We will use the best result of both attempts towards the qualification result.

Retaking the qualification

- After a student has achieved a qualification result, they can resit the externally assessed unit and submit the NEA units again in a later series to improve their qualification result:
 - Students can retake the exam without resubmitting the NEA units
 - Students cannot resubmit the NEA units only to improve results. In order to meet terminal assessment requirements, they must also retake the exam if they are resubmitting NEA units
- The result from the first overall qualification result is used towards the performance tables

7.3 Equality Act information relating to Cambridge Nationals

The Cambridge Nationals require assessment of a broad range of skills and, as such, prepare students for further study and higher-level courses.

The Cambridge Nationals qualifications were reviewed to check if any of the competences required presented

a potential barrier to disabled students. If this was the case, the situation was reviewed again to make sure that such competences were included only where essential to the subject.

7.4 Accessibility

There can be adjustments to standard assessment arrangements on the basis of the individual needs of students. It's important that you identify as early as possible whether students have disabilities or particular difficulties that will put them at a disadvantage in the assessment situation and choose a qualification or adjustment that allows them to demonstrate attainment.

If a student requires access arrangements in assessments that need approval from us, this must be gained in Access Arrangements Online. You must select the appropriate qualification type(s) at time of application. Approval from GCSE or GCE applications alone no longer extends to other qualification types, but more than one qualification type can be selected when making an application. For guidance or support please contact the [OCR Special Requirements Team](#).

The responsibility for providing adjustments to assessment is shared between your centre and us. Please read the JCQ booklet *Access Arrangements and Reasonable Adjustments* at www.jcq.org.uk.

If you have students who need a post-examination adjustment to reflect temporary illness, indisposition or injury when they took the assessment, please read the JCQ document *A guide to the special consideration process*, available at www.jcq.org.uk.

If you think any aspect of this qualification unfairly restricts access and progression, please email or call our Customer Support Centre.

The access arrangements permissible for use in this specification are as follows:

Access arrangement	Yes/No	Type of assessment
Reader/Computer reader	Yes	All assessments
Scribes/Speech recognition technology	Yes	All assessments
Practical assistants	Yes	All assessments
Word processors	Yes	All assessments
Communication professional	Yes	All assessments
Language modifier	Yes	All assessments
Modified question paper	Yes	Timetabled examinations
Extra time	Yes	All assessments with time limits

7.5 Requirements for making an entry

We provide information on key dates, timetables and how to submit marks on our [website](#).

Centres must be registered with OCR in order to make any entries. We recommend that centres apply to become a registered centre with us, well in advance

of making their first entries. Details on how to register with OCR can be found on our [website](#).

It is essential that unit entry codes are quoted in all correspondence with OCR.

7.5.1 Making estimated unit entries

Estimated entries are not required for Cambridge Nationals in Engineering Manufacture.

7.5.2 Making final unit entries

When making an entry, centres must quote unit entry codes and component codes. Students submitting work must be entered for the appropriate unit entry code from the table below.

The short title for these Cambridge National qualifications is CAMNAT and will display as such on our secure portal and some of our administrative documents.

You do not need to register your students first.

Individual unit entries should be made for the series in which you intend to submit an NEA unit or sit the externally assessed examination.

Only make a certification entry using the overall qualification code (see [section 7.6](#)) in the final series.

Unit entry code	Component code	Assessment method	Unit titles
R014	01	Written paper	Principles of engineering manufacture
R015 A	01	Moderated	Manufacturing a one-off product
R016 A	01	Moderated	Manufacturing in quantity

7.6 Certification rules

Students must be entered for qualification certification separately from unit assessment(s). If a certification entry is **not** made, no overall grade can be awarded. Students may be entered for:

- OCR Level 1/Level 2 Cambridge National in Engineering Manufacture - certification code J823.

7.7 Unit and qualification resits

Students may resit each unit and the best unit result from the NEA units will be used to calculate the certification result.

Students may resit the externally assessed unit R014.

Please see [section 7.2](#) for information relating to our terminal assessment approach.

You must make sure that when arranging resit opportunities they are fair to all students and do not give students an unfair advantage over other students. For example, the student must not have direct guidance and support from the teacher in producing further evidence for NEA units. When resitting a NEA

unit, students must submit new, amended or enhanced work, as detailed in the [JCQ Instructions for conducting coursework](#).

Centres must make sure that when arranging resit opportunities they do not adversely affect other assessments being taken.

Arranging a resit opportunity is at the centre's discretion. Summative assessment series must not be used as a diagnostic tool and resits should only be planned if it is clear that the student has taken full advantage of the first assessment opportunity and formative assessment process.

7.8 Post-results services

A number of post-results services are available:

- Enquiries about results – If you think there might be something wrong with a student's results, you may submit an enquiry about results
- Missing and incomplete results – This service should be used if an individual subject result for a student is missing, or the student has been omitted entirely from the results supplied
- Access to scripts – you can ask for access to marked scripts.

Please refer to the [JCQ Post-Results Services booklet](#) and the [OCR Administration](#) page for further guidance about action on the release of results.

For internally assessed units the review of results process cannot be carried out for one individual student; the outcome of a review of moderation must apply to a centre's entire cohort.

Appendix A: Guidance for the production of electronic evidence

Structure for evidence

The centre-assessed (NEA) units in this qualification are units R015 and R016. For each student, all the tasks together will form a portfolio of evidence, stored electronically. Evidence for each unit must be stored separately.

An internal assessment portfolio is a collection of folders and files containing the student's evidence. Folders should be organised in a structured way so that the evidence can be accessed easily by a teacher or moderator. This structure is commonly known as a folder tree. It would be helpful if the location of particular evidence is made clear by naming each file

and folder appropriately and by use of an index called 'Home Page'.

There should be a top-level folder detailing the student's centre number, OCR candidate number, surname and forename, together with the unit code (R015 and R016), so that the portfolio is clearly identified as the work of one student.

Each student's internal assessment portfolio should be stored in a secure area on the centre's network. Before submitting the portfolio to OCR, the centre should add a folder to the folder tree containing the internal assessment and summary forms.

Data formats for evidence

In order to minimise software and hardware compatibility issues it will be necessary to save students' work using an appropriate file format.

Students must use formats appropriate to the evidence that they are providing and appropriate to viewing for assessment and moderation. Open file formats or proprietary formats for which a downloadable reader or player is available are acceptable. **Where this is not available, the file format is not acceptable.**

Evidence submitted is likely to be in the form of word processed documents, presentation documents, digital photos and digital video.

To make sure files are compatible, all files submitted electronically must be in the formats listed below. Where new formats become available that might be acceptable, we will provide further guidance. We advise against changing the file format that the document was originally created in. Files should be exported in a generic format that can be opened on a PC computer system without any specialist software applications. It is the centre's responsibility to make sure that the electronic portfolios submitted for moderation are accessible to the moderator and fully represent the evidence available for each student.

Standard file formats acceptable as evidence for the Cambridge Nationals are listed here.

File type	File format	Max file size*
Audio	.3g2 .3ga .aac .aiff .amr .m4a .m4b .m4p .mp3 .wav	25GB
Compression	.zip .zipx .rar .tar .tar .gz .tgz .7z .zipx .zz	25GB
Data	.xls .xlsx .mdb .accdb .xlsb	25GB
Document	.odt .pdf .rtf .txt .doc .docx .dotx .pages	25GB
Image	.jpg .png .jpeg .tif .jfif .gif .psd .dox .pcx .bmp .wmf	25GB
Presentation	.ppt .pptx .pdf .gslides .pptm .odp .ink .potx .pub	25GB
Video	.3g2 .3gp .avi .flv .m4v .mkv .mov .mp4 .mp4v .wmp .wmv	25GB
Web	.wlmf .mts .mov-1 .mp4-1 .xspf .mod .mpg	25GB

*max file size is only applicable if using eSubmission system.

eSubmission is our browser-based file repository, to upload students' work. You can run eSubmission on any laptop or desktop computer running Windows or macOS. It supports the upload of files in the formats listed in the table above as long as they do not exceed the maximum file size. Other file formats and folder

structures can be uploaded within a compressed file format.

When you view some types of files in eSubmission, they will be streamed in your browser. It would help your moderator or examiner if you could upload files in the format shown in the table below:

File type	File format	Chrome	Firefox
Audio	.mp3	Yes	Yes
Audio	.m4a	Yes	Yes
Audio	.aac	No	Yes
Document	.txt	Yes	Yes
Image	.png	Yes	Yes
Image	.jpg	Yes	Yes
Image	.jpeg	Yes	Yes
Image	.gif	Yes	Yes
Presentation	.pdf	Yes	Yes
Video	.mp4	Yes	Yes
Video	.mov	No	Yes
Video	.3gp	Yes	No
Video	.m4v	Yes	Yes
Web	.html	Yes	Yes
Web	.htm	Yes	Yes

Appendix B: Command words

External assessment

The table below shows the command words that will be used in exam questions. They show what we mean by the command word and how students should approach the question and understand its demand. Remember that the rest of the wording in the question is also important.

Word(s)	Students will....
Analyse	<ul style="list-style-type: none">• Separate or break down information into parts and identify their characteristics or elements• Explain the pros and cons of a topic or argument and make reasoned comments• Explain the impacts of actions using a logical chain of reasoning
Annotate	<ul style="list-style-type: none">• Add information, for example, to a table, diagram or graph until it is final• Add all the needed or appropriate parts
Calculate	<ul style="list-style-type: none">• Get a numerical answer showing how it has been worked out
Choose	<ul style="list-style-type: none">• Select an answer from options given
Circle	<ul style="list-style-type: none">• Select an answer from options given
Compare and contrast	<ul style="list-style-type: none">• Give an account of the similarities and differences between two or more items or situations
Complete	<ul style="list-style-type: none">• Add all the needed or appropriate parts• Add information, for example, to a table, diagram or graph until it is final
Create	<ul style="list-style-type: none">• Produce a visual solution to a problem (for example: a mind map, flowchart or visualisation)
Describe	<ul style="list-style-type: none">• Give an account including all the relevant characteristics, qualities or events• Give a detailed account of
Discuss	<ul style="list-style-type: none">• Present, analyse and evaluate relevant points (for example, for/against an argument)
Draw	<ul style="list-style-type: none">• Produce a picture or diagram
Evaluate	<ul style="list-style-type: none">• Make a reasoned qualitative judgement considering different factors and using available knowledge/experience
Explain	<ul style="list-style-type: none">• Give reasons for and/or causes of• Use the words or phrases such as 'because', 'therefore' or 'this means that' in answers.
Fill in	<ul style="list-style-type: none">• Add all the needed or appropriate parts• Add information, for example, to a table, diagram or graph until it is final
Identify	<ul style="list-style-type: none">• Select an answer from options given• Recognise, name or provide factors or features
Justify	<ul style="list-style-type: none">• Give good reasons for offering an opinion or reaching a conclusion
Label	<ul style="list-style-type: none">• Add information, for example, to a table, diagram or graph until it is final• Add all the necessary or appropriate parts
Outline	<ul style="list-style-type: none">• Give a short account, summary or description
State	<ul style="list-style-type: none">• Give factors or features• Give short, factual answers

Non examined assessment (NEA)

The tables below show the command words that will be used in the NEA Marking Criteria grids. They explain the type of evidence that you should expect to see to meet each command word.

Mark Band (MB1) Words:

Command word	Meaning
Basic	<ul style="list-style-type: none">• Work includes the minimum required. It is a starting point but is simplistic and not developed.• Understanding and skills are applied in a way that partly achieves the wanted or intended result, but it would not be useable without further input or work.
Brief/Briefly	<ul style="list-style-type: none">• Work includes a small number of relevant facts or concepts but lacks detail, contextualisation or examples.
Dependent	<ul style="list-style-type: none">• The student can perform a task when given regular assistance or help
Few	<ul style="list-style-type: none">• Work produced is restricted or narrow. It includes less than half of the information or examples expected for a full response.
Inefficient	<ul style="list-style-type: none">• Outputs are produced but with great expense or effort because of poor organisation or design and not making the best use of available resources.
Limited	<ul style="list-style-type: none">• Work produced is restricted in range or scope and includes only some of the information required. It evidences partial rather than full understanding.• Work produced is a starting point rather than a developed process, concept or output.
Minimal	<ul style="list-style-type: none">• Includes very little in amount or quantity required.
Simple	<ul style="list-style-type: none">• Includes a small number of relevant parts, which are not related to each other.
Superficial	<ul style="list-style-type: none">• Work completed lacks depth and detail.

Mark Band (MB2) Words:

Command word	Meaning
Adequate(ly)	<ul style="list-style-type: none">• Work includes the appropriate number of relevant facts or concepts but does not include the full detail, contextualisation or examples.
Assisted	<ul style="list-style-type: none">• The student can perform a task with occasional assistance or help.
Part(ly)/Partial	<ul style="list-style-type: none">• To some extent but not completely.• Work produced is inclusive in range and scope. It evidences a mainly developed application of understanding, performance or output needed.• Work produced results in a process, concept or output that would be useable for its purpose.
Some	<ul style="list-style-type: none">• Work produced is inclusive but not fully comprehensive. It includes over half the information or examples expected for a full response.
Sound	<ul style="list-style-type: none">• Valid, logical, shows the student has secured most of the relevant understanding, but points or performance are not fully developed.• Applies understanding and skills to produce the wanted or intended result in a way that would be useable.

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Mark Band (MB3) Words:

Command word	Meaning
Accurate(ly)	<ul style="list-style-type: none">• Acting or performing with care and precision.• Correct in all details.
All	<ul style="list-style-type: none">• Work produced is fully comprehensive and wide-ranging. It includes almost all, or all the information or examples expected for a full response.
Clear(ly)	<ul style="list-style-type: none">• Focused and accurately expressed, without ambiguity.
Complex	<ul style="list-style-type: none">• Includes many relevant parts, all of which relate to each other logically.
Comprehensive(ly)	<ul style="list-style-type: none">• The work produced is complete and includes everything required to show depth and breadth of understanding.• Applies the understanding and skills needed to successfully produce the wanted or intended result in a way that would be fully fit-for-purpose.
Consistent(ly)	<ul style="list-style-type: none">• A level of performance which does not vary in quality over time.
Critical	<ul style="list-style-type: none">• Objective analysis and evaluation in order to form: a judgement, evaluation of the evidence or effective trouble shooting/fault finding.
Detailed	<ul style="list-style-type: none">• Gives point by point consideration of all the key information.
Effective	<ul style="list-style-type: none">• Applies the skills required to the task and is successful in producing the desired or intended result.• The work produced is effective in relation to a brief.
Efficient	<ul style="list-style-type: none">• Able to produce results or outputs with the minimum expense or effort, because of good organisation or design and making the best use of available resources.
Full(y)	<ul style="list-style-type: none">• Work produced is comprehensive in range and scope. It evidences a fully developed application of understanding, performance or output needed.• Work produced results in a process, concept or output that would be fully fit-for-purpose.
Independent(ly)	<ul style="list-style-type: none">• The student can perform a task without assistance or reliance on others
Justify/Justified	<ul style="list-style-type: none">• The reasons for doing something are explained in full.
Most(ly)	<ul style="list-style-type: none">• Includes nearly all of what is expected to be included.
Wide (ranging)	<ul style="list-style-type: none">• Includes many relevant details, examples or contexts; all of which are fully detailed, contextualised or exemplified.

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