Qualification specification

NCFE Level 1/2 Technical Award in Engineering
QN: 603/7006/3

Qualification summary

Qualification title	NCFE Level 1/2 Technical Award in Engineering (603/7006/3)		
Ofqual qualification number (QN)	603/7006/3	**Aim reference**	60370063
Guided learning hours (GLH)	140	**Total qualification time (TQT)**	154
Minimum age	14		
Qualification purpose	This qualification is part of a suite of technical award qualifications that have been developed to meet the Department for Education's (DfE's) requirements for high-quality, rigorous qualifications that: • have appropriate content for the learner to acquire core knowledge and practical skills • allow the qualification to be graded • provide synoptic assessment • enable progression to a range of study and employment opportunities		
Grading	Level 1 pass/merit/distinction Level 2 pass/merit/distinction/distinction*		
Assessment method	Externally-set: non-exam assessment (NEA) and an examined assessment (EA)		
Performance points	Please check with the DfE for the most up-to-date information, should there be any changes		

Contents

Section 1: introduction

Please note this is a draft version of the qualification specification and is likely to be subject to change before the final version is produced for the launch of the qualification.

If you are using this qualification specification for planning purposes, please make sure that you are using the most recent version.

Aims and objectives

This qualification aims to:

- focus on the study of the engineering sector
- offer breadth and depth of study, incorporating a key core of knowledge
- provide opportunities to acquire a number of practical and technical skills

The objectives of this qualification are to:

- understand the different engineering disciplines
- apply science and mathematics in engineering
- understand how to read engineering drawings
- understand the properties, characteristics and selection of engineering materials
- understand engineering tools, equipment and machines
- produce hand-drawn engineering drawings
- produce computer-aided design (CAD) engineering drawings
- understand production planning techniques
- apply processing skills and techniques

Support handbook

This qualification specification must be used alongside the mandatory support handbook on the qualifications page on the NCFE website, which contains additional supporting information to help with the planning, delivery and assessment.

This qualification specification contains all of the qualification-specific information you will need that is not covered in the support handbook.

Entry guidance

This qualification is designed for learners aged 14 to 16 in schools and colleges, but is also accessible for post-16 learners.

It is a vocational qualification equivalent to GCSE grades 8.5 to 1.

There are no specific prior skills/knowledge a learner must have for this qualification.

Entry is at the discretion of the centre.

Centres are responsible for ensuring that all learners are capable of achieving the learning outcomes and complying with the relevant literacy, numeracy and health and safety requirements.

Learners registered on this qualification should not undertake another qualification at the same level, or with the same/a similar title, as duplication of learning may affect funding eligibility.

Achieving this qualification

To be awarded this qualification, learners are required to successfully achieve all learning outcomes from the single graded mandatory unit.

Qualification title		NCFE Level 1/2 Technical Award in Engineering
Qualification number (QN)		603/7006/3
Level		Combined level 1/2
Guided learning hours (GLH) (Total GLH has been rounded up to the nearest hour)		139
GLH breakdown		• 120 hours delivery • 1 hour 30 minutes examined assessment • 18 hours non-exam assessment
Non-exam assessment (NEA)	Weighting (60%)	Externally-set, internally marked and externally moderated: • synoptic project
Examined assessment (EA)	Weighting (40%)	Externally-set and externally marked: • written exam
Total	100%	Overall qualification grades: L1P, L1M, L1D, L2P, L2M, L2D, L2D*

Please refer to the content area summaries in section 2 for further information.

To achieve this qualification, learners must successfully demonstrate their achievement of all learning outcomes of the units as detailed in this qualification specification.

Progression

Depending on the grade the learner achieves in this qualification, they could progress to level 2 and level 3 qualifications and/or GCSE/A Levels.

Learners who achieve at level 1 might consider progression to level 2 qualifications post-16, such as:

- GCSE Engineering
- study at level 2 in a range of technical routes that have been designed for progression to employment, apprenticeships and further study; examples might include a Level 2 Technical Certificate in Engineering Studies

Technical certificate qualifications provide post-16 learners with the knowledge and skills they need for skilled employment or for further technical study.

Learners who achieve at level 2 might consider progression to level 3 qualifications post-16, such as:

- A Level Engineering (this will support progression to higher education)
- Level 3 Applied General Certificate in Engineering

- study at level 2 in a range of technical routes that have been designed for progression to employment, apprenticeships, and further study
- Level 3 Technical Level in Engineering, Manufacturing, Processing and Control (this will support progression to higher education)

Learners could also progress into employment or onto an apprenticeship. The understanding and skills gained through this qualification could be useful to progress onto an apprenticeship in the engineering industry through a variety of occupations that are available within the industry, such as technical writing, technical sales, or as an engineer in one of the many different sectors across the industry, such as pharmaceuticals, aerospace or construction.

Staffing requirements

There are no additional staffing requirements for this qualification. See the staffing requirements section in the support handbook.

Resource requirements

There are no mandatory resource requirements for this qualification, but centres must ensure learners have access to suitable resources to enable them to cover all the appropriate learning outcomes.

Real work environment requirement/recommendation

This is a knowledge-only qualification. Experience in the real work environment is not required.

Work/industry placement experience

This is a knowledge-only qualification. Work/industry placement experience is not required.

Purpose statement

Who is this qualification for?

The Level 1/2 Technical Award in Engineering is designed for learners who want an introduction to engineering that includes a vocational and project-based element. The qualification will appeal to learners who wish to pursue a career in the engineering industry or progress onto further study.

The NCFE Level 1/2 Technical Award in Engineering (603/7006/3) complements GCSE qualifications. It is aimed at 14 to 16 year olds studying key stage 4 (KS4) curriculum who are interested in the engineering industry. This qualification is designed to match the rigour and challenge of GCSE study. The qualification is graded at level 1 pass, merit, distinction and level 2 pass, merit, distinction and distinction* (equivalent to GCSE grades 8.5 to 1). More information on grading can be found in section 2 of this qualification specification.

This qualification focuses on an applied study of engineering and learners will gain a broad knowledge and understanding of working in the sector.

This qualification has been designed to sit alongside the requirements of core GCSE subjects and is appropriate for learners who are motivated and challenged by learning through hands-on experiences and through content that is concrete and directly related to those experiences.

It is distinct from GCSE Engineering, as it encourages the learner to use knowledge and practical tools to focus on developing transferrable skills in practical engineering, accompanied by the theoretical knowledge to help with progression into employment and onto further education.

The study of engineering is the application of maths and science to solve real-world problems. This involves an understanding of the different disciplines of engineering and how they have shaped the products and projects of the modern world. Learners will be able to read technical drawings, select appropriate materials, along with tools and machinery, and know how to carry out a practical task, working in a safe manner in line with current health and safety legislation.

This level 1/2 qualification is appropriate for learners who are looking to develop a significant core of knowledge and understanding in engineering and apply that knowledge through a project.

What will the learner study as part of this qualification?

This qualification will promote the learner's understanding of:

- the different engineering disciplines
- applied science and maths in engineering
- how to read engineering drawings
- the properties, characteristics and selection of engineering materials
- engineering tools, equipment and machines
- hand-drawn engineering drawings
- computer-aided design (CAD) engineering drawings
- production planning techniques
- applied processing skills and techniques

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

Learners will develop the following knowledge and skills:

- adapting their own ideas and responding to feedback
- evaluating their own work
- analysing data and making decisions
- practical application of tools and machinery, whilst adhering to health and safety legislation and guidance
- an appreciation of materials, technology and applications
- skills that are essential for the engineering sector, such as understanding how to read drawings, responding to data, independent working, working to deadlines, and efficient use of resources
- an ability to reflect upon their preferred learning style and identify relevant study skills

Successful completion of this qualification will enable learners to progress to level 2 or 3 qualifications in related subjects.

The knowledge and skills gained will provide a secure foundation for careers in the engineering industry.

Learners will develop the following skills that will inform future training and work in the engineering industry:

- decision making
- observation
- resourcefulness
- problem solving
- planning
- evaluation
- reflection
- interpersonal skills
- professional behaviours
- respect and appreciation of others
- an ability to reflect upon their preferred learning style and identify relevant study skills

Successful completion of this qualification will enable learners to progress to level 2 or 3 qualifications in related subjects.

The knowledge and skills gained will provide a secure foundation for learners to progress into career opportunities in the engineering industry and provide a valuable platform for further study.

Which subjects will complement this course?

The following subject areas will complement this course:

- design and technology
- manufacturing
- maths
- English
- science

This list is not exhaustive, and a range of other subject areas may also be appropriate.

How the qualification is assessed

Assessment is the process of measuring a learner's skill, knowledge and understanding against the standards set in a qualification.

The qualification has **2** assessments externally-set by NCFE: **one** non-exam assessment and **one** written examined assessment.

Non-exam assessment	
Assessment method	**Description**
Non-exam assessment Externally-set Internally marked and externally moderated	60% of the technical award 120 marks The completion time for the non-exam assessment is 18 hours. The non-exam assessment will assess the learner's ability to effectively draw together their knowledge, understanding and skills from across the whole vocational area. The non-exam assessment will target assessment objectives (AOs) AO1, AO2, AO3, AO4 and AO5.
Non-exam assessment availability	The learner should not undertake the non-exam assessment until all content areas have been delivered. This is to ensure learners are in a position to complete the non-exam assessment successfully. A different non-exam assessment brief will be released every December.

Non-exam assessment

Non-exam assessment encourages the learner to combine elements of their learning and to show accumulated knowledge and understanding across the content areas.

Non-exam assessment enables the learner to show their ability to integrate and apply knowledge, understanding and skills with breadth and depth. It also requires them to demonstrate their capability to apply knowledge, understanding and skills across a range of units and learning outcomes that are being assessed.

The non-exam assessment is internally assessed work and should be completed by the learner in accordance with the qualification specification. Information on delivery guidance and assessment hours for the internal assessment will be available in the non-exam assessment brief. To support with this, we have also created a sample non-exam assessment brief, which is available on the qualification page under support materials. A representative number of assessment hours should be timetabled into the scheme of work. Internal assessment hours must be administered outside of scheduled teaching and learning hours and should be supervised and assessed by the teacher.

Any work submitted for internal assessment must be completed during scheduled assessment hours in accordance with the scheme of work and must be authenticated and attributable to the learner. The teacher must be satisfied that the work produced is the learner's own and the learner must declare that the work is their own.

In practice, this means that all of the non-exam assessment will be completed in normal class time within scheduled assessment hours and kept separate from any teaching and learning hours.

The internally assessed non-exam assessment component is based on coverage of the qualification content areas, which are assessed holistically against descriptors to achieve a grade.

Each learner must create a portfolio of evidence generated from appropriate assessment tasks that demonstrates achievement of all the learning outcomes associated with each unit. The assessment tasks should allow the learner to respond to a real-life situation that they may face when in employment. On completion of each unit, learners must declare that the work produced is their own and the assessor must countersign this. Examples of suitable evidence for the portfolio for each unit are provided in section 2.

Examined assessment	
Assessment method	**Description**
Examined assessment Externally-set Written examination Externally marked	40% of technical award Written examination: • 80 marks • 1 hour 30 minutes • a mixture of multiple-choice, short-answer, and extended response questions The written examined assessment is a terminal assessment and will assess the learner's knowledge and understanding of all content areas and target assessment objectives AO1, AO2 and AO3.
Examined assessment availability	The examination date is expected to take place in May/June every year. Please refer to the external assessment timetable available on the NCFE website.

Examined assessment

Examined assessments are set and marked by NCFE. The assessment assesses learners' knowledge and understanding of the content areas of this qualification. Centres must not assess, internally quality assure, or otherwise access or review any examined assessment materials or learner responses at any time and must adhere to the required exam regulations at all times.

The examined assessment is on a set date and time (invigilated). NCFE specifies the date and time that the examined assessment must be administered in the centre and also publishes in advance the dates on which external assessment results will be released.

A variety of assessment questions will be used, including multiple-choice, short-answer and extended response questions. This will enable learners to demonstrate their breadth of knowledge and understanding of the subject and ensure achievement at the appropriate level, including stretch and challenge. Questions will be written in plain English and in a way that is supportive and accessible to learners of all abilities.

As far as possible, real-world case studies and contexts that are relevant to the sector will be used. This is to engage and stimulate learners under examination conditions and to facilitate the drawing out of a wide range of knowledge and skills developed throughout their learning.

All questions will have available marks clearly identified. The examined assessment will be carefully constructed following a rigorous quality control process to ensure that the assessment is valid.

For further information, including instructions for conducting an external assessment, centres must ensure they have read/are familiar with the regulations for the conduct of external assessment, and qualification specific instructions for delivery documents available on the policies & documents page on the NCFE website.

The examined assessment material will be sent out in time for the start of the assessment. Assessment materials must be kept secure at all times in line with the requirement of the regulations for the conduct of external assessment.

You must return all examined assessment materials and partially or fully completed learner work to NCFE within one working day of the examined assessment taking place or the final timetabled supervised/invigilated session.

Rationale for synoptic assessment

Synoptic assessment encourages the learner to combine elements of their learning and to show accumulated knowledge and understanding across units and/or learning outcomes.

Synoptic assessment enables the learner to show their ability to integrate and apply knowledge, understanding and skills with breadth and depth. It also requires them to demonstrate their capability to apply knowledge, understanding and skills across a range of units and learning outcomes that are being assessed.

Enquiries about results

All enquiries relating to learners' results must be submitted in line with our enquiries and appeals about results and assessment decisions policy, which is available on the policies & documents page on the NCFE website.

External assessment conditions

For more information on external assessment conditions, please see the regulations for the conduct of external assessments and qualification specific instructions for delivery on the policies & documents page on the NCFE website.

There is one assessment window during the year. Please refer to the external assessment timetable on the NCFE website for the specific date.

For instructions on conducting external assessments, please refer to our regulations for the conduct of external assessments and qualification specific instructions for delivery documents, available on the policies & documents page on the NCFE website.

Assessment windows

For assessments sat in windows, the centre must enter learners to the specified window. This will be either a set date and time assessment or a window in which the assessment will be completed.

For qualifications with 'entry on registration', the centre will choose the assessment window at the point of registering the learner. The last date that we will accept learner work for a specified assessment window is by that assessment window's cut-off date.

Please note: the 'cut-off date' is the last day that returned scripts will be accepted for the specified assessment window.

On completing their work at the end of the assessment window, learners must sign the assessment declaration to authenticate the work produced as their own. Centres must ensure that all assessments are submitted for marking in accordance with the assessment windows.

Scheme of assessment

The Level 1/2 Technical Award in Engineering qualification is made up of 2 component parts: an examined assessment (EA) and a non-exam assessment (NEA).

Assessments	Assessment time	% weighting	Raw marks	Scaling factor	Scaled marks*	Assessment conditions	Marking
Non-exam assessment (NEA)	18 hours	60%	120	1.000	120	Supervised	Internal, with external moderation
Examined assessment (EA)	1 hour 30 minutes	40%	80	1.000	80	Invigilated	External
Assessment total	**19 hours 30 minutes**	**100%**			200		

Assessment objectives

The assessment of our technical awards is mapped against assessment objectives (AOs). These AOs provide a consistent framework for learners and are applied synoptically, allowing learners to show their knowledge, understanding and skills from across the full breadth and depth of the qualification.

The AOs that will be assessed against the content in our technical awards are:

AO1	**Recall knowledge and show understanding** The emphasis here is for learners to recall and communicate the fundamental elements of knowledge and understanding.
AO2	**Apply knowledge and understanding** The emphasis here is for learners to apply their knowledge and understanding to real-world contexts and novel situations.
AO3	**Analyse and evaluate knowledge and understanding** The emphasis here is for learners to develop analytical thinking skills to make reasoned judgements and reach conclusions.
AO4	**Demonstrate and apply relevant technical skills, techniques and processes** The emphasis here is for learners to demonstrate the essential technical skills relevant to the vocational sector by applying the appropriate processes, tools and techniques.
AO5	**Analyse and evaluate the demonstration of relevant technical skills, techniques and processes** The emphasis here is for learners to analyse and evaluate the essential technical skills, processes, tools and techniques relevant to the vocational sector.

Assessment objective weightings

The table below shows the approximate weightings for each of the AOs in the technical award assessments.

AOs	Non-exam assessment (%)	Examined assessment (%)	Overall weighting (%)
AO1	16.7%	40–45%	26–28%
AO2	13.3%	35–40%	22–24%
AO3	13.3%	20–25%	16–18%
AO4	50%	N/A	30%
AO5	6.7%	N/A	4%
Overall weighting of assessments	**60%**	**40%**	**100%**

The purpose of the qualification means that it is necessary to assess understanding through 2 means of assessment, an internal non-exam assessment (NEA) and an external examined assessment (EA). The variance in assessment methods used allows for a range of knowledge, understanding and skills to be assessed using the most fit for purpose method.

Non-exam assessment

Refer to the mark scheme for the current non-exam assessment where you will find the information required to mark the non-exam assessment tasks and their descriptors.

Centres will mark the non-exam assessment, and this will then be submitted to NCFE for moderation.

Examined assessment

The examined assessment will be submitted to NCFE for marking to calculate the overall grades for learners.

Overall grading descriptors

To achieve a level 2 distinction, learners will be able to:

- recall and apply highly relevant knowledge and understanding, in an excellent and highly comprehensive manner, of engineering disciplines, science and mathematics in engineering drawings, properties and characteristics of engineering materials, tools and machinery, hand-drawn and CAD-drawn engineering drawings, product planning techniques and applied skills and techniques
- critically analyse and evaluate to make excellent, reasoned judgements and reach well-supported conclusions on engineering disciplines, science and mathematics in engineering drawings, properties and characteristics of engineering materials, tools and machinery, hand-drawn and CAD-drawn engineering drawings, product planning techniques and applied skills and techniques
- safely and effectively demonstrate essential and excellent skills, techniques and processes relevant to engineering when using a wide range of tools and equipment to implement a production plan, applying skills and techniques to a complex engineering piece in an excellent and highly comprehensive manner
- critically analyse and evaluate their own demonstration of relevant skills, techniques and processes relevant to the sector when planning and preparing complex, completed engineering pieces in an excellent and highly comprehensive manner

To achieve a level 2 pass, learners will be able to:

- recall and apply mostly relevant knowledge and understanding, in a good and mostly detailed manner, of engineering disciplines, science and mathematics in engineering drawings, properties and characteristics of engineering materials, tools and machinery, hand-drawn and CAD-drawn engineering drawings, product planning techniques and applied skills and techniques
- analyse and evaluate to make good, mostly reasoned judgements and reach coherent conclusions on engineering disciplines, science and mathematics in engineering drawings, properties and characteristics of engineering materials, tools and machinery, hand-drawn and CAD-drawn engineering drawings, product planning techniques and applied skills and techniques
- safely and effectively demonstrate good and mostly relevant skills, techniques and processes relevant to engineering when using a wide range of tools and equipment to implement a production plan, applying skills and techniques to a complex engineering piece
- analyse and evaluate their own demonstration of relevant skills, techniques and processes relevant to the sector when planning and preparing completed engineering pieces in a good and mostly detailed manner

To achieve a level 1 pass, learners will be able to:

- recall and apply some knowledge and understanding, in a reasonable manner, that has some relevance and some detail of engineering disciplines, science and mathematics in engineering drawings, properties and characteristics of engineering materials, tools and machinery, hand-drawn and CAD-drawn engineering drawings, product planning techniques and applied skills and techniques

- analyse and evaluate, in a reasonable manner, to make some judgements and reach straightforward conclusions on engineering disciplines, science and mathematics in engineering drawings, properties and characteristics of engineering materials, tools and machinery, hand-drawn and CAD-drawn engineering drawings, product planning techniques and applied skills and techniques
- safely and effectively demonstrate some skills, techniques and processes relevant to engineering when using a wide range of tools and equipment to implement a production plan, applying skills and techniques to a complex engineering piece
- analyse and evaluate their own demonstration of relevant skills, techniques and processes relevant to the sector when planning and preparing completed engineering pieces in a reasonable, straightforward manner, with some detail

Grading information

The following grades are available for the qualification: level 2 distinction*, level 2 distinction, level 2 merit, level 2 pass, level 1 distinction, level 1 merit and level 1 pass.

The qualification is linear, meaning both assessments must be taken in the same assessment series and cannot be combined across different assessment series. After all assessment is complete, the marks for each assessment are combined to give a final mark for each learner. Where raw marks do not reflect the required weighting of the assessment, a scaling factor is applied to the raw mark prior to aggregation.

Scaling factors can be found in the table below.

Assessment	Maximum raw mark	Weighting	Scaling factor	Maximum scaled mark
Non-exam assessment	120 marks	60%	1.000	120
Examined assessment	80 marks	40%	1.000	80
			Total	200

For each series, grade boundaries are set by NCFE using a variety of statistical and judgemental evidence. Each learner's overall grade is determined by comparing their combined final mark with the grade boundaries for that series.

Where a learner achieves insufficient marks across the 2 assessments in the series to achieve a level 1 pass, they will be awarded an unclassified (U) result.

Section 2: unit content and assessment guidance

This section provides details of the structure and content of this qualification.

Information in the teaching content section must be covered by the teacher during the delivery of the content areas and should be considered as mandatory teaching content.

The verb 'understand' encompasses both 'knowledge' and 'understanding' within the content areas of this qualification. Each content area will read 'The learner will understand'.

To make cross-referencing assessment and quality assurance easier, we have used a sequential numbering system in this document for each content area. The numbering system used refers to a content area, subject topic, and teaching content (for example, 1.1.1 refers to the content area (first number 1), the subject topic within that learning content (second number 1.1) and the teaching content within the subject topic (third number 1.1.1)). This will support signposting feedback and tracking.

Anything within the teaching guidance is advisory and optional and is intended to provide useful advice and guidance to support delivery of the teaching content.

The types of evidence listed are for guidance purposes only. Within learners' portfolios, other types of evidence are acceptable if all content areas are covered.

Whilst studying the qualification, learners should reflect on the importance of knowing and developing their preferred learning style. They should also be able to identify a range of individual study skills they can use in order to study effectively.

For further information or guidance about this qualification, please contact our customer support team.

Content areas

This qualification consists of one unit with multiple content areas.

The regulated unit title is ‘Understanding engineering’.

The regulated unit number for the qualification content is Y/618/6058.

Content area number	Content area title	Suggested GLH
Content area 1	Engineering disciplines	15
Content area 2	Applied science and mathematics in engineering	15
Content area 3	Reading engineering drawings	10
Content area 4	Properties, characteristics and selection of engineering materials	15
Content area 5	Engineering tools, equipment and machines	15
Content area 6	Hand-drawn engineering drawings	12
Content area 7	Computer-aided design (CAD) engineering drawings	12
Content area 8	Production planning techniques	10
Content area 9	Applied processing skills and techniques	16

Content areas

Content areas
1. Engineering disciplines 1.1 Engineering disciplines through projects and products 1.1.1 Engineering discipline skills 1.2 The health and safety legislation governing engineering 1.2.1 Health and safety legislation
2. Applied science and mathematics in engineering 2.1 Application of SI units of measurement 2.1.1 SI units of measurement 2.1.2 Application of base SI units 2.2 Equations used to calculate energy, force, motion, electrical and geometric shapes 2.2.1 Equations for properties 2.2.2 Application of equations
3. Reading engineering drawings 3.1 Reading engineering drawings 3.1.1 Drawing conventions 3.1.2 British Standards
4. Properties, characteristics and selection of engineering materials 4.1 Properties and characteristics of materials 4.1.1 Properties 4.1.2 Characteristics 4.1.3 Materials
5. Engineering tools, equipment and machines 5.1 Tools, equipment and machines 5.1.1 Marking out 5.1.2 Modification 5.1.3 Joining 5.1.4 Finishing 5.2 Safe and correct use 5.2.1 Control measures
6. Hand-drawn engineering drawings 6.1 Hand-drawn engineering drawings 6.1.1 A freehand sketch 6.1.2 A hand-drafted isometric drawing sheet 6.1.3 A hand-drafted orthographic drawing sheet
7. Computer-aided design (CAD) engineering drawings 7.1 CAD engineering drawings 7.1.1 A CAD isometric drawing sheet 7.1.2 A CAD orthographic drawing sheet 7.1.3 The uses of CAD
8. Production planning techniques 8.1 Production planning 8.1.1 Risk assessment 8.1.2 Production plan
9. Applied processing skills and techniques 9.1 Skills and techniques 9.1.1 Prepare materials 9.1.2 Modify shape and size of materials 9.1.3 Join materials

9.1.4 Finish materials 9.2 Safe and correct use of tools, equipment and machines 9.2.1 Preparation and use of tools, equipment and machines 9.2.2 Control measures

Teaching content

Information in this section must be covered by the teacher during the delivery of this qualification.

1. Engineering disciplines

1.1	**Engineering disciplines through projects and products**
	The learner will understand different engineering disciplines and how their application has solved problems and shaped the modern world through projects and products:
1.1.1	**Engineering discipline skills**

	• mechanical:
	  ○ hydraulics
	  ○ gears
	  ○ pulleys
	• electrical:
	  ○ power station:
	  ▪ DC
	  ▪ AC
	  ○ household appliances
	• electronic:
	  ○ integrated circuits:
	  ▪ PCB
	  ○ input/output receivers, transmitters
	• aerospace:
	  ○ aircraft
	  ○ space vehicles
	  ○ missiles
	• telecommunications:
	  ○ mobile:
	  ▪ 3G
	  ▪ 4G
	  ▪ 5G
	  ○ satellite
	  ○ telephone
	  ○ radio
	  ○ fibre-optic
	• chemical:
	  ○ pharmaceuticals:
	  ▪ medicines
	  ○ fossil fuels
	  ○ food and drinks
	  ○ cosmetics
	• civil:
	  ○ buildings
	  ○ roads
	  ○ bridges
	  ○ railways
	• automotive:
	  ○ cars
	  ○ trucks
	  ○ motorcycles

	○ trains • biomedical: ○ prosthetics ○ medical devices ○ radiotherapy • software: ○ applications ○ systems ○ computer programming
1.2	**The health and safety legislation governing engineering**
1.2.1	**Health and safety legislation**
	The learner will understand the health and safety legislation governing the engineering industry and its purpose. The learner will understand the requirements of each piece of legislation, their own and an employer's responsibilities:
	• health and safety at work legislation: ○ the purpose – understand the general legislation for health and safety: ▪ general responsibilities of employers ▪ general responsibilities of employers and self-employed ▪ general responsibilities of employees within the workplace • personal protective equipment (PPE) at work legislation: ○ the purpose – how and when PPE might be used in the workplace: ▪ eyes: • goggles • safety glasses • visors • face screens ▪ ears: • ear plugs • ear defenders ▪ head and neck: • hard hats • helmets • bump caps ▪ respiratory system: • face mask • full face respirators • breathing apparatus (forced air) ▪ hands and arms: • gloves • gauntlets • armlets ▪ feet and legs: • safety boots (with, for example, protective toe caps, gaiters and spats) • penetration-resistant wellington boots • foot and leg protection • safety shoes (heat resistant, impact resistant, electrical insulation) • leggings • shin guards ▪ whole body: • disposable overalls

	• high visibility vests • apron • boiler suits • chemical suits • manual handling operations legislation: o the purpose – understand the safe movement of any load: ▪ manual handling risk assessment ▪ overview of moving different loads safely, including: • an individual • a pair • as part of a team • using mechanical aids • Control of Substances Hazardous to Health (COSHH): o the purpose – understand the dangers of different substances hazardous to health: ▪ products containing chemicals or biological agents ▪ fumes ▪ dusts: • vapours • gases • Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR): o the purpose – understand what RIDDOR covers and the procedure if applicable: ▪ what RIDDOR covers ▪ reporting process ▪ record keeping ▪ timescales for reporting and recording incidents

2. Applied science and mathematics in engineering

2.1	**Application of SI units of measurement**
	The learner will understand how SI units of measurement are used in engineering products and projects:
2.1.1	**SI units of measurement**

	• current – ampere:
	  ○ microamp
	  ○ milliamp
	  ○ amp
	  ○ kiloamp
	• luminous intensity – candela:
	  ○ microcandela
	  ○ millicandela
	  ○ candela
	• thermodynamic temperature – kelvin:
	  ○ kelvin
	  ○ degrees Celsius (accepted for use within the SI)
	• mass – kilogram:
	  ○ milligram
	  ○ gram
	  ○ kilogram
	• length – metre:
	  ○ micrometre
	  ○ millimetre
	  ○ centimetre
	  ○ metre
	  ○ kilometre
	• amount of substance – mole:
	  ○ nanomole
	  ○ micromole
	  ○ millimole
	  ○ mole
	• time – second:
	  ○ microsecond
	  ○ millisecond
	  ○ second
	  ○ minute (accepted for use within the SI)
	  ○ hour (accepted for use within the SI)

2.1.2	**Application of base SI units**
	The learner will understand how equations of SI units are derived from base units and how the unknown factor can be found:
	• hydraulics gears and pulleys • power stations, household appliances and integrated circuits • aircraft, space vehicles and missiles • telephone, radio and fibre-optic communications • pharmaceuticals, fossil fuels, food and drinks, and cosmetics • buildings, roads, bridges and railways • cars, trucks, motorcycles and trains • prosthetics, medical devices and radiotherapy

	• applications, systems and computer programming
2.2	**Equations used to calculate energy, force, motion, electrical and geometric shapes**
	The learner will understand how mathematical and scientific equations are used in engineering disciplines to calculate energy, force, motion, electrical and geometric shapes:
2.2.1	**Equations for properties**
	• energy: ○ efficiency efficiency (%) = (useful energy out ÷ total energy in) x 100 ○ power P = E ÷ t power = energy ÷ time ○ work done W = F x d work done = force x distance • force and motion: ○ speed s = d ÷ t speed = distance ÷ time ○ acceleration a = (v - u) ÷ t acceleration = change in velocity ÷ time ○ force F = m x a force = mass x acceleration ○ moment of force m = F x d moment = force x perpendicular distance from pivot ○ momentum p = m x v momentum = mass x velocity ○ pressure p = F ÷ A pressure = force ÷ area • mass: ○ weight w = m x g weight = mass x gravity ○ density d = m ÷ v density = mass ÷ volume • electrical: ○ power P = V x I power = voltage x current ○ voltage V = I x R voltage = current x resistance ○ current I = P ÷ V current = power ÷ voltage ○ resistance R = V ÷ I resistance = voltage ÷ current • geometric: ○ area – square length of side^2 ○ area – rectangle length of side 1 x length of side 2 ○ area – triangle (length of base x height of triangle) ÷ 2 ○ area – circle π x radius^2 ○ volume – cube length of side^3 ○ volume – pyramid (1/3) x (base area) x height of pyramid ○ volume – cylinder π x radius^2 x height of cylinder
2.2.2	**Application of equations**
	The learner will understand how equations for properties can be used to evaluate the unknown factor:
	• hydraulics, gears and pulleys • power stations, household appliances and integrated circuits • aircraft, space vehicles and missiles • telephone, radio and fibre-optic communications • pharmaceuticals, fossil fuels, food and drinks, and cosmetics • buildings, roads, bridges and railways • car, trucks, motorcycles and trains • prosthetics, medical devices and radiotherapy • applications, systems and computer programming

3. Reading engineering drawings

3.1	**Reading engineering drawings**
3.1.1	**Drawing conventions**
	The learner will understand the British Standard 8888 for 2 and 3-dimensional engineering drawings. The learner will understand the elements which are included in an engineering drawing:

	• lines:
	  ○ visible
	  ○ hidden
	  ○ centre
	  ○ construction
	  ○ dimension
	• tolerance:
	  ○ + or –
	  ○ limits of size in relevant context
	• content of title block:
	  ○ drawing reference number in drawing as per sequence along with reference to others, signatures and approval stamps and dates to revisions
	  ○ author
	  ○ drawing number
	  ○ date
	  ○ title
	  ○ materials
	  ○ scale
	  ○ sheet number
	  ○ system of measurement
	  ○ projection
	• scale:
	  ○ ratio
	• system of measurement:
	  ○ imperial and metric conversion
	• 2-dimensional projection:
	  ○ first angle projection and symbol
	  ○ third angle projection and symbol
	• 3-dimensional projection:
	  ○ isometric
	  ○ oblique

3.1.2	**British Standards**

	• British Standard (BS) 8888 (education version):
	  ○ purpose of the standard
	  ○ how BS 8888 fits with the ISO standards
	  ○ how BS 8888 is applied to engineering drawings

4. Properties, characteristics and selection of engineering materials

4.1	**Properties and characteristics of materials**
4.1.1	**Properties**
	The learner will understand how materials exhibit properties and characteristics in engineering products and projects:

	• chemical:
	  ○ heat of combustion
	  ○ toxicity
	  ○ oxidation state
	• electrical and magnetic:
	  ○ conductivity
	  ○ resistance
	  ○ magnetism
	• mechanical (Young's modulus):
	  ○ strength
	  ○ hardness
	  ○ toughness
	  ○ elasticity
	  ○ plasticity
	  ○ ductility
	  ○ durability
	  ○ malleability
	• optical:
	  ○ reflectivity
	  ○ photosensitivity
	• thermal:
	  ○ flammability
	  ○ thermal conductivity
	  ○ melting point

4.1.2	**Characteristics**

	• aesthetics:
	  ○ colour
	  ○ surface texture
	  ○ finish effect
	• environmental impact:
	  ○ extraction of raw material
	  ○ fossil fuels
	  ○ sustainability
	  ○ renewables
	  ○ carbon footprint
	  ○ recycling

4.1.3	**Materials**

	• metals:
	  ○ ferrous alloys:
	  ▪ mild steel
	  ▪ cast iron
	  ▪ stainless steel
	  ○ pure non-ferrous:
	  ▪ aluminium
	  ▪ copper

	▪ lead ○ non-ferrous alloys: ▪ brass ▪ bronze/phosphor bronze ▪ solder ▪ silver solder • polymers: ○ thermoset: ▪ epoxy resin ▪ urea formaldehyde ▪ polyester resin ○ thermoplastic: ▪ acrylic ▪ polypropylene ▪ high-impact polystyrene ○ elastomers: ▪ rubber ▪ neoprene ▪ silicone • wood: ○ hardwood: ▪ oak ▪ ash ▪ beech ▪ sycamore ▪ balsa ○ softwood: ▪ pine ▪ cedar ▪ spruce ○ manufactured board: ▪ plywood ▪ MDF ▪ chipboard • ceramics: ○ glass ○ cement ○ brick ○ diamond ○ pottery • composite: ○ concrete: ▪ reinforced concrete ▪ glass fibre reinforced concrete ○ glass reinforced plastic (GRP) ○ carbon fibre reinforced polymer (CFRP) ○ natural fibre composite (NFC)

5. Engineering tools, equipment and machines

5.1	**Tools, equipment and machines**
	The learner will understand health and safety, control measures, and safe and correct use of common tools, equipment and machines used in the engineering industry for manufacturing, including those used for marking out, cutting, modifying, joining and finishing:
5.1.1	**Marking out**
	• engineer's scriber • steel rule • engineer's square • marking gauge • centre/dot punch • calipers
5.1.2	**Modification**

	• saw:
	  ○ hacksaw/mechanical hacksaw
	  ○ junior hacksaw
	  ○ crosscut hand saw
	  ○ tenon
	  ○ coping
	  ○ circular saw (trained technician or member of staff only)
	  ○ reciprocating saw (trained technician or member of staff only)
	  ○ band saw (trained technician or member of staff only)
	• tin snips
	• jigsaw
	• scroll saw
	• computer-aided manufacture laser cutter
	• pliers:
	  ○ side cut
	  ○ long nose
	• hammer:
	  ○ ball pein
	  ○ claw
	• cordless drill
	• angle grinder (trained technician or member of staff only)
	• router (trained technician or member of staff only)
	• lathe:
	  ○ wood lathe
	  ○ centre lathe (metal)
	• pillar drill
	• computer numerically controlled (CNC) milling machine
	• computer numerically controlled (CNC) lathe
	• file

5.1.3	**Joining**

	• riveting gun
	• screwdriver:
	  ○ Phillips
	  ○ Torx
	  ○ Slotted
	  ○ Pozidriv

	• spanner:
	  ○ open ended
	  ○ combination
	  ○ ratchet
	• adhesives:
	  ○ polyvinyl acetate (PVA)
	  ○ contact adhesive
	  ○ epoxy resin
	  ○ hot glue gun (trained technician or member of staff only)
	  ○ wood glue
	  ○ super glue (cyanoacrylate)
	  ○ spray adhesive
	• soldering iron (training or supervision may be required)
	• welding:
	  ○ metal inert gas (MIG)
	  ○ tungsten inert gas (TIG)
	  ○ arc welding
	• components:
	  ○ nails
	  ○ wood screw
	  ○ wood dowel
	  ○ rivets
	  ○ engineering bolt and nut
	  ○ engineering screw and nut

5.1.4	**Finishing**

	• hand sander:
	  ○ palm sander
	  ○ portable belt sander
	• fixed disc sander
	• fixed belt sander
	• buffing wheel

5.2	**Safe and correct use**
	The learner will understand the safe and correct use of common tools, equipment and machines used in the engineering industry:
5.2.1	**Control measures**

	• training requirements of specific tools, equipment and machines commonly found in an engineering environment:
	  ○ bandsaws
	  ○ planer/thicknesser machines
	  ○ dust collectors
	  ○ circular saws
	  ○ scroll saws
	  ○ sanding machines
	  ○ jigsaws
	  ○ routers (trained technician or member of staff only)
	  ○ woodworking tools
	  ○ bench drilling machines
	  ○ pillar drilling machines
	  ○ lathe/milling machines
	  ○ shaping and forming machines
	  ○ hacksaws

	○ tenon saws ○ coping saws ○ hand tools • use of guards and safety zones • isolation and emergency power cut-off points • personal protective equipment (PPE): ○ eyes ○ ears ○ head and neck ○ respiratory system ○ hands and arms ○ whole body ○ feet and legs • extraction and ventilation for each piece of equipment

6. Hand-drawn engineering drawings

6.1	**Hand-drawn engineering drawings**
	The learner will understand how to produce hand-drawn engineering drawings, apply specific drawing conventions and use layouts recognised within the engineering industry, following British Standard 8888 (education version):
6.1.1	**A freehand sketch**

	• rendering:
	  ○ colour and shading
	  ○ direction of light
	• annotation:
	  ○ materials
	  ○ manufacturing details
	• dimensions:
	  ○ angles
	  ○ lengths
	  ○ diameters

6.1.2	**A hand-drafted isometric drawing sheet**

	• 3-dimensional:
	  ○ 30° angle applied to the sides
	• scale
	• dimension:
	  ○ angles
	  ○ lengths
	  ○ diameters
	• unit of measurement:
	  ○ imperial
	  ○ metric
	• lines:
	  ○ visible
	  ○ hidden
	  ○ centre
	  ○ construction
	• tolerance (+ or -)
	• title block

6.1.3	**A hand-drafted orthographic drawing sheet**

	• 2-dimensional:
	  ○ first or third angle projection
	  ○ projection symbol
	• scale
	• dimension:
	  ○ angles
	  ○ lengths
	  ○ diameters
	• unit of measurement:
	  ○ imperial
	  ○ metric
	• lines:
	  ○ visible
	  ○ hidden

	○ centre ○ construction • tolerance (+ or -) • title block

7. Computer-aided design (CAD) engineering drawings

7.1	**CAD engineering drawings**
	The learner will understand CAD software to produce engineering drawings. The learner will understand the specific drawing conventions and layouts recognised within the engineering industry, following British Standard 8888 (education version):
7.1.1	**A CAD isometric drawing sheet**

	• 3-dimensional:
	  ○ 30° angle applied to the sides
	• scale
	• dimension:
	  ○ angles
	  ○ lengths
	  ○ diameters
	• unit of measurement:
	  ○ imperial
	  ○ metric
	• lines:
	  ○ visible
	  ○ hidden
	  ○ centre
	  ○ construction
	• tolerance (+ or -)
	• title block

7.1.2	**A CAD orthographic drawing sheet**

	• 2-dimensional:
	  ○ first or third angle projection
	  ○ projection symbol
	• scale
	• dimension:
	  ○ angles
	  ○ lengths
	  ○ diameters
	• unit of measurement:
	  ○ imperial
	  ○ metric
	• lines:
	  ○ visible
	  ○ hidden
	  ○ centre
	  ○ construction
	• tolerance (+ or -)
	• title block

7.1.3	**The uses of CAD**
	• finite element modelling (FEM) • finite element analysis (FEA): ○ fluid dynamics • computer-aided manufacturing (CAM) • 3D printing • computer numerically controlled (CNC) laser cutting

	• computer numerically controlled (CNC) routing • computer numerically controlled (CNC) turning

8. Production planning techniques

8.1	**Production planning**
	The learner will understand how to plan a manufacturing task safely and on time:
8.1.1	**Risk assessment**

	• hazards
	• risks
	• control measures:
	  ○ actions
	  ○ activities
	  ○ equipment that is used to prevent, eliminate or reduce the risk of a hazard occurring

8.1.2	**Production plan**

	• tools and equipment requirements
	• health and safety measures
	• quality control measures
	• production plan (use of one of the following):
	  ○ flow chart
	  ○ Gantt chart
	  ○ spreadsheet
	• time plan, including timescales and deadlines for completion of tasks

9. Applied processing skills and techniques

9.1	**Skills and techniques**
	The learner will understand a range of processing skills and manufacturing techniques: preparing, modifying, joining and finishing techniques applied to materials for a manufacturing task. The learner will understand the safe and correct use of tools, equipment and machines:
9.1.1	**Prepare materials**
	• cleaning • marking out
9.1.2	**Modify shape and size of materials**
	• cutting • drilling • bending • casting • computer-aided manufacture (CAM)
9.1.3	**Join materials**
	• riveting • gluing • bolting • soldering
9.1.4	**Finish materials**
	• filing • sanding • polishing • applying a surface finish
9.2	**Safe and correct use of tools, equipment and machines**
	The learner will understand how to maintain safe and correct use of common tools, equipment and machines used in the engineering industry for manufacturing techniques:
9.2.1	**Preparation and use of tools, equipment and machines**
	• handheld tools • power tools • fixed machines • computer numerical control/computer-aided manufacture machines
9.2.2	**Control measures**

	• guards and safety zones
	• isolation and emergency power cut-off
	• extraction and ventilation
	• personal protective equipment (PPE):
	  ○ eyes
	  ○ ears
	  ○ head and neck
	  ○ respiratory system
	  ○ hands and arms
	  ○ feet and legs
	  ○ whole body

Teaching guidance

In this section, we provide some useful advice and suggested guidance to support the delivery of the teaching content.

Website links are provided as sources of potentially useful information for delivery/learning of this subject area. NCFE does not explicitly endorse any learning resources available on these websites. For official NCFE endorsed learning resources, please see the additional and teaching materials sections on the qualification page on the NCFE website.

1. Teaching guidance – engineering disciplines
Delivery could take place through the study of different engineering disciplines with reference made to the development of products, projects and services which have had a positive influence in the way in which we interact with the modern world around us. Suitable examples of products and projects should be selected to explore how engineering has developed over time, and teachers should lead discussions on how engineering has developed to encompass a wide range of disciplines and how projects may require a team of engineers from different engineering disciplines to work in collaboration. Discussion must include how engineered products and projects have shaped the modern world. Reference could be made to local, national and international products and projects. This could be delivered through site visits, guest speakers, paper-based or digital presentations and teacher-led class discussion. Delivery must explore how and why health and safety legislation has developed and how it is applied within different engineering disciplines. The learner should understand how and why legislation has been developed to ensure the safety of employees, employers, visitors to the workplace and the general public. Learners should be able to recall key acronyms and relate these to relevant contextual situations. The learner should be able to carry out and produce a basic risk assessment based on practical tasks and equipment they have been taught. **External visits/guest speakers:** It would be useful for the learner to review a commercial engineering environment, to understand health and safety in a practical setting. This could be undertaken with external site visits or through guest speakers. **Resources:** Classroom teaching pack: • PowerPoint • lesson plans • scheme of work • worksheets • revision workbook **Useful websites:** • www.hse.gov.uk/index.htm • www.hse.gov.uk/pubns/indg174.pdf • www.hse.gov.uk/pubns/books/l23.htm

1. Teaching guidance – engineering disciplines
• www.hse.gov.uk/coshh/index.htm • www.hse.gov.uk/riddor • www.technologystudent.com • www.bbc.co.uk/education/subjects/zvg4d2p • www.raeng.org.uk • www.theiet.org • www.howstuffworks.com • www.eng-tips.com

2. Teaching guidance – applied science and mathematics in engineering

Delivery must take place through the study of basic SI units (metric units) of measurement and equations, using examples of engineered products and projects to understand how mathematics and science are applied by engineers to develop engineered products and services.

The teacher should talk the learner through each equation in context (for example, how to consider the acceleration that could be achieved when designing a car, force in the building of a bridge, area of a site for a building's foundations, or theoretical available power from a wind turbine). The teacher should provide practical scenarios which the learner can relate and apply equations to. The learner should then consider situations and apply equations to formulate answers. This could be done through a site visit to a bridge, where the learner is given the facts about the bridge: length, height, average traffic volumes, typical weather conditions and speed limits. The learner could then discuss which equations may have been considered in the design and, using the information provided, produce an analysis of the bridge. The same process could be applied to engineered products such as a household kettle. The learner could be given facts on electrical power sources and usage. The learner could then discuss which equations may have to be considered in the design and, using the information provided, produce an analysis and produce some calculations.

When the teacher demonstrates an equation and the SI factors involved, these should use the same methods as the learner receives elsewhere, such as in science or maths. Equally, when teaching the learners about 'transposition of formula', they should be consistently using the same methodology. It is recommended that some engagement and collaboration with other centre teachers is conducted to standardise the delivery to ensure greater understanding and success for the learner.

External visits/guest speakers:

It would be useful for the learner to visit engineered project sites to be able to review products and projects to ascertain which equations may have been applied in the development stages, and also the practical application of these in real-world outcomes.

Resources:

Classroom teaching pack:

- PowerPoint
- lesson plans
- scheme of work
- worksheets
- revision workbook

3. Teaching guidance – reading engineering drawings

Delivery of this learning outcome must be supported by the use of example drawings of engineering products and projects from a range of engineering disciplines. Delivery must relate to the purpose of BS 8888 for engineering drawings, and the accurate requirements the drawing needs to meet this drawing standard.

The learner should consider how the quality of drawings could have an impact on the manufacturing process of an engineered product. The learner should be encouraged to consider how an engineering drawing is used to communicate information from design to realisation in the most efficient way, and the possible effects inaccuracies or missing information can have on the manufacturing process and the quality of a finished outcome.

The learner should be able to read and understand all elements which are included in an engineering drawing: types of lines, tolerance, content of a title block, scale, system of measurement, drawing, number, materials and projection. The learner should be able to understand the purpose of BS 8888 and the benefits of using a recognised standard for the communication of technical information in a worldwide manufacturing environment.

It would be beneficial for the learner to be given examples of engineering drawings alongside physical products to enable them to visualise and enhance understanding of 2 and 3-dimensional projection of differing styles. Learners could be given inaccurate drawings and prompted to identify what information is missing or required to ensure the manufacture of a high-quality product when engineers may not understand the same language. In preparation for practical tasks, learners could be encouraged to produce BS 8888 standard drawings for practical tasks that they could follow.

Resources:

Classroom teaching pack:

- PowerPoint
- lesson plans
- scheme of work
- worksheets
- revision workbook

Useful websites:

- www.technologystudent.com
- www.raeng.org.uk
- www.theiet.org
- www.howstuffworks.com
- www.eng-tips.com
- www.design-technology.info

4. Teaching guidance – properties, characteristics and selection of engineering materials

Delivery of this learning outcome must take place through the handling and physical testing of common engineering materials, to understand how materials perform when exposed to different demands.

Testing could be carried out by the teacher or an expert, by presentation of testing on video, or by the learner themselves. By handling samples of different engineering materials, the learner should be able to make judgements about their properties and characteristics and the suitability for use in real-world products and scenarios.

Observations and testing should enable the learner to draw conclusions as to why specific materials have been selected, because of how their properties and characteristics allow for different engineering functions.

The learner should research and test a range of engineered products and be able to explain what they are made from, and the properties and characteristics of the materials used in the manufacturing process. The learner should have an ability to draw conclusions about the suitability of the material to perform and why materials have been selected for the manufacture of a range of products. Products could include, for example, a non-stick saucepan, an electrical plug, safety gloves, a pair of spectacles, traditional wooden toy, or a ballpoint pen.

Resources:

Classroom teaching pack:

- PowerPoint
- lesson plans
- scheme of work
- worksheets
- revision workbook
- material testing

Useful websites:

- www.technologystudent.com
- www.bbc.co.uk/education/subjects/zvg4d2p
- www.raeng.org.uk
- www.theiet.org
- www.howstuffworks.com
- www.eng-tips.com
- www.design-technology.info/home.htm

5. Teaching guidance – engineering tools, equipment and machines

The learner should understand what each of the tools, equipment and machines are used for and which are the most appropriate for selection. This includes their performance for a series of techniques on various materials for marking out, modifying, joining and finishing.

The learner should understand the safe and correct use of tools, equipment and machines and be able to discuss the different training requirements and control measures that are required for using each piece of equipment to meet health and safety legislation.

Before any practical tasks are undertaken, the learner should demonstrate an ability to maintain a safe working environment. This should include ensuring their own personal safety, the safety of those around them in the workspace and the correct usage, maintenance and storage of tools and equipment, in line with appropriate health and safety legislation.

The learner must maintain a safe working environment while undertaking all practical tasks. This includes selecting the correct personal protective equipment for each task that is being undertaken. Full training must be provided for learners using any tools or equipment to allow the learner to work in a safe manner, adhering to safety rules of the workshop.

Resources:

Classroom teaching pack:

- PowerPoint
- lesson plans
- scheme of work
- worksheets
- revision workbook
- focussed practical task

Useful websites:

- www.technologystudent.com
- www.bbc.co.uk/education/subjects/zvg4d2p
- www.young-engineers.co.uk
- www.raeng.org.uk
- www.theiet.org
- www.howstuffworks.com
- www.eng-tips.com
- www.design-technology.info

6. Teaching guidance – hand-drawn engineering drawings

Delivery of this learning outcome must give the learner the appropriate skills to produce hand-drawn engineering drawings to a required standard. This learning outcome focuses on the ability to draw, not design, and does not assess the learner's creative ability.

The learner should have the ability to produce a range of freehand sketches without the need for drawing instruments other than pencils, eraser and sharpener. The drawing should make use of rendering techniques to show colour and direction of light. All information required to manufacture the item should be included in the drawing.

The learner should also have the ability to produce formal engineering hand-drafted isometric and orthographic drawing sheets with consideration for BS 8888. The drawing sheets should evidence, through application, the learner's understanding of scale, dimension (angles, lengths and diameters), units of measurement (imperial or metric), construction lines, tolerance and a border and title block containing relevant information.

The drawing in isometric must be drawn in 3 dimensions and with a 30° angle at each side.

The drawing in orthographic could be drawn in either first or third angle; however, it must show the corresponding projection symbol, or the angle of projection should be stated in the title block.

The learner may produce the hand-drafted isometric and/or orthographic drawing sheets by making use of drawing instruments such as a drawing board, T-square, ellipse stencil, flexi-curves, compasses, set square and protractor.

Resources:

Classroom teaching pack:

- PowerPoint
- lesson plans
- scheme of work
- worksheets
- revision workbook

Useful websites:

- www.technologystudent.com
- www.bbc.co.uk/education/subjects/zvg4d2p
- www.raeng.org.uk
- www.theiet.org
- www.howstuffworks.com
- www.eng-tips.com
- www.design-technology.info

7. Teaching guidance – computer-aided design (CAD) engineering drawings

Delivery of this learning outcome must give the learner the appropriate skills to produce computer-aided design (CAD) engineering drawings. This learning outcome focuses on the ability to draw and does not take into consideration the learner's design or creative abilities.

The learner should have the ability to produce CAD isometric and orthographic drawing sheets with consideration for BS 8888. The drawing sheets should demonstrate an understanding of scale, dimension (angles, lengths and diameters), units of measurement (imperial or metric), various lines (visible, hidden, centre or construction), tolerance and a completed title block.

The drawing in isometric should be drawn in 3 dimensions and with a 30° angle at each side.

The drawing in orthographic could be drawn in either first or third angle; however, it must show the corresponding projection symbol, or the angle of projection should be stated in the title block.

The learner may produce the CAD isometric and orthographic drawing sheets by making use of any CAD software available to them with the capability of producing both 2-dimensional and 3-dimensional drawings.

The learner should research the uses of CAD following learning about the appropriate skills to produce CAD engineering drawings.

Resources:

Classroom teaching pack:

- PowerPoint
- lesson plans
- scheme of work
- worksheets
- revision workbook
- engineered products that could be measured and drawn

Useful websites:

- www.autodesk.com/education/free-software/all
- www.onshape.com
- www.freecadweb.org
- www.technologystudent.com
- www.bbc.co.uk/education/subjects/zvg4d2p
- www.young-engineers.co.uk
- www.raeng.org.uk
- www.theiet.org
- www.howstuffworks.com
- www.eng-tips.com
- www.design-technology.info

8. Teaching guidance – production planning techniques

Throughout the delivery of this learning outcome, the learner must develop skills to plan the manufacture of a product.

Planning should begin with a risk assessment of the workshop environment and the selection of tools and equipment required to undertake the fulfilment of the manufacturing task.

The risk assessment should include the identification of hazards, the level of risk of each hazard occurring, and control measures which need to be considered to ensure a safe working environment.

Control measures that could be introduced to the learner through the delivery of the learning outcome are PPE, guards, safety zones, extraction and ventilation, isolation and emergency cut-off.

The learner should be able to demonstrate the ability to complete a thorough production plan which should provide information about all the stages to manufacture the outcome.

The production plan should:

- include details of the selected tools and equipment with explanation for why they have been selected
- break down the manufacture into separate stages which detail the tasks which must be undertaken, and these tasks should also include timings to incorporate a time plan and ensure the task can be completed within a given time frame
- include what quality control checks must be undertaken throughout the manufacture to check that a product meets the requirements set out in the given brief, and is completed to a high standard; this should be documented with a flow diagram using, as appropriate, flowcharts, Gantt charts or a spreadsheet

Resources:

Classroom teaching pack:

- PowerPoint
- lesson plans
- scheme of work
- worksheets
- revision workbook
- focused practical task

Useful websites:

- www.technologystudent.com
- www.bbc.co.uk/education/subjects/zvg4d2p
- www.raeng.org.uk
- www.theiet.org
- www.howstuffworks.com
- www.eng-tips.com
- www.design-technology.info

9. Teaching guidance – applied processing skills and techniques

The learner should be able to select appropriate tools and equipment and apply the correct skills and techniques. The selected tools and equipment should be used on different materials to prepare, mark out, modify shape to size, join and finish materials correctly, maintaining safety at all times.

Delivery should allow the learner to develop skills in using techniques within a workshop environment.

The learner should be able to apply techniques for preparation, marking out, modifying shape and size, joining and finishing for a variety of engineering materials to manufacture an item.

The processing of the different materials should not be manufactured entirely with the use of computer-aided manufacture (CAM); however, the learner should have the ability to apply CAM in some aspects of a manufacturing task. This is to ensure the learner can demonstrate their ability to undertake traditional manufacturing techniques alongside more modern practices. The selection of tools, equipment and machines should demonstrate the learner's knowledge of working properties to enable them to select the most appropriate technique for a given task.

The learner should demonstrate an ability to maintain a safe working environment before any practical tasks are undertaken. This should include ensuring their own personal safety, the safety of those in the same workspace and the correct usage and storage of tools and equipment, in line with appropriate health and safety legislation.

Resources:

Classroom teaching pack:

- PowerPoint
- lesson plans
- scheme of work
- worksheets
- revision workbook
- focused practical tasks

Useful websites:

- www.technologystudent.com
- www.bbc.co.uk/education/subjects/zvg4d2p
- www.raeng.org.uk
- www.theiet.org
- www.howstuffworks.com
- www.eng-tips.com
- www.design-technology.info

Synoptic connections

Synoptic assessment requires learners to combine elements of their learning and show accumulated knowledge and understanding across the qualification content. It enables learners to evidence their capability to integrate and apply knowledge, understanding and skills gained with breadth and depth in context.

It is therefore essential when planning for teaching and throughout delivery that the interdependencies and links build across the content of the qualification and are highlighted and reinforced.

The qualification comprises 9 content areas in a single unit model. All content is mandatory and must be taught.

The teaching content does not have to be delivered in a linear way; the unit contents are interdependent in knowledge, skills and concepts.

Teachers may take a synoptic approach across the qualification. This will enable learners to be able to apply theories and concepts from across the qualification specification in context to skills-based situations. Through combining content and developing holistic connections, learners will be able to demonstrate and evidence their full knowledge and understanding of the subject area and the engineering industry.

Learners will have the opportunity to identify relevant study skills and reflect upon their preferred learning style throughout the qualification.

Section 3: additional information

School accountability measures (performance points)

This V Cert qualification has been developed to meet the criteria set by the Department for Education (DfE) to be included in the key stage 4 performance tables. Each grade has been assigned a points value. Please check the Register of Regulated Qualifications website register.ofqual.gov.uk for further information.

Discounting

If a learner is taking a GCSE and V Cert in the same year with the same discount code, such as GCSE Physical Education and an NCFE V Cert in health and fitness, the first entry will count. However, because we do not upload V Cert data to the DfE until August, the exam entry for V Certs is classed as the date the centre claims certification.

- if the centre delivers the GCSE Physical Education exam first and then claims the V Cert afterwards, the GCSE will count
- if the centre delivers the V Cert first and claims the certificate before the GCSE Physical Education exam is sat, the V Cert will count
- if the centre delivers the GCSE and the exam is sat on the same day the V Cert certificate is claimed, then it is the best result that counts

Discount codes for V Cert qualifications can be found on the NCFE website. We advise centres to refer to the Discounting and Early Entry Guidance document provided by the DfE. For more information on discounting please contact the DfE directly.

Qualification dates

Regulated qualifications have operational end dates and certification end dates.

We review qualifications regularly, working with sector representatives, vocational experts and stakeholders to make any changes necessary to meet sector needs and to reflect recent developments.

If a decision is made to withdraw a qualification, we will set an operational end date and provide reasonable notice to our centres. We will also take all reasonable steps to protect the interest of learners.

An operational end date will only show on the Ofqual Register of Regulated Qualifications register.ofqual.gov.uk if a decision has been made to withdraw a qualification. After this date we can no longer accept learner registrations. However, certification is allowed until the certification end date so that learners have time to complete any programmes of study. The certification end date will only show on the Ofqual Register once an operational end date has been set. After this date we can no longer process certification claims.

Where a qualification has an external assessment, this can only be taken up to the last assessment date set by us. No external assessments will be permitted after this date so learners will need to be entered in sufficient time.

Support materials

The following support materials are available to assist with the delivery of this qualification and are available on the NCFE website:

- learning resources
- qualification factsheet

Other support materials

The resources and materials used in the delivery of this qualification must be age-appropriate and due consideration should be given to the wellbeing and safeguarding of learners in line with your centre's safeguarding policy when developing or selecting delivery materials.

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