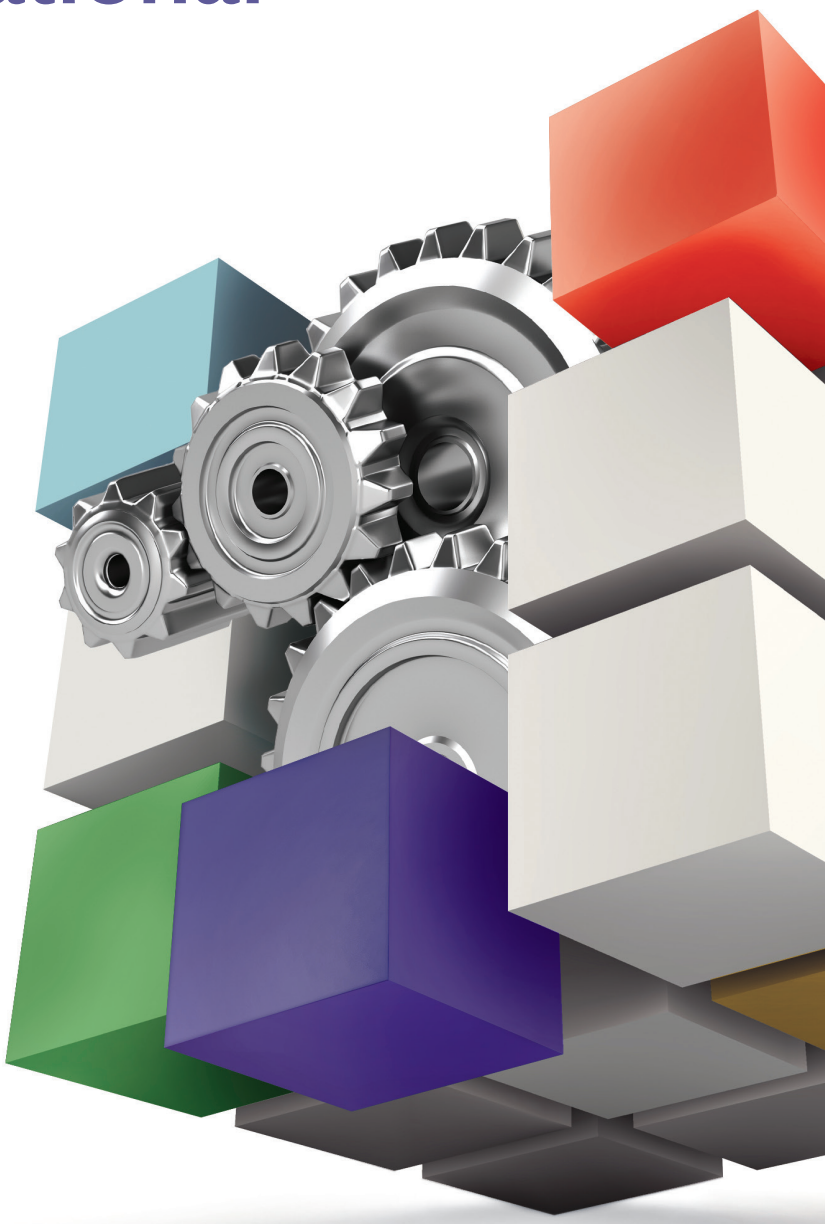
Pearson BTEC

Pearson BTEC Level 3 National Certificate in Engineering



Specification

First teaching from September 2018

First certification from 2019

Issue 6

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About Pearson

We are the world's learning company operating in 70 countries around the world with more than 22,500 employees. We provide content, assessment and digital services to schools, colleges and universities, as well as professional and vocational education to learners to help increase their skills and lifelong employability prospects. We believe that wherever learning flourishes so do people.

This specification is Issue 6. We will inform centres of any changes to this issue. The latest issue can be found on our website.

References to third-party material made in this specification are made in good faith. We do not endorse, approve or accept responsibility for the content of materials, which may be subject to change, or any opinions expressed therein. (Material may include textbooks, journals, magazines and other publications and websites.)

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Welcome

With a track record built over 30 years of learner success, BTEC Nationals are widely recognised by industry and higher education as the signature vocational qualification at Level 3. They provide progression to the workplace either directly or via study at a higher level. Proof comes from YouGov research, which shows that 62% of large companies have recruited employees with BTEC qualifications. What's more, well over 100,000 BTEC students apply to UK universities every year and their BTEC Nationals are accepted by over 150 UK universities and higher education institutes for relevant degree programmes either on their own or in combination with A Levels.

Why are BTECs so successful?

BTECs embody a fundamentally learner-centred approach to the curriculum, with a flexible, unit-based structure and knowledge applied in project-based assessments. They focus on the holistic development of the practical, interpersonal and thinking skills required to be able to succeed in employment and higher education.

When creating the BTEC Nationals in this suite, we worked with many employers, higher education providers, colleges and schools to ensure that their needs are met. Employers are looking for recruits with a thorough grounding in the latest industry requirements and work-ready skills such as teamwork. Higher education needs students who have experience of research, extended writing and meeting deadlines.

We have addressed these requirements with:

- a range of BTEC sizes, each with a clear purpose, so there is something to suit each learner's choice of study programme and progression plans
- refreshed content that is closely aligned with employers' and higher education needs for a skilled future workforce
- assessments and projects chosen to help learners progress to the next stage. This means some are set by you to meet local needs, while others are set and marked by Pearson so that there is a core of skills and understanding that is common to all learners. For example, a written test can be used to check that learners are confident in using technical knowledge to carry out a certain job.

We are providing a wealth of support, both resources and people, to ensure that learners and their teachers have the best possible experience during their course. See *Section 10* for details of the support we offer.

A word to learners

Today's BTEC Nationals are demanding, as you would expect of the most respected applied learning qualification in the UK. You will have to choose and complete a range of units, be organised, take some assessments that we will set and mark, and keep a portfolio of your assignments. But you can feel proud to achieve a BTEC because, whatever your plans in life – whether you decide to study further, go on to work or an apprenticeship, or set up your own business – your BTEC National will be your passport to success in the next stage of your life.

Good luck, and we hope you enjoy your course.

Collaborative development

Students completing their BTEC Nationals in Engineering will be aiming to go on to employment, often via the stepping stone of higher education. It was, therefore, essential that we developed these qualifications in close collaboration with experts from professional bodies, businesses and universities, and with the providers who will be delivering the qualifications. To ensure that the content meets providers' needs and provides high-quality preparation for progression, we engaged experts. We are very grateful to all the university and further education lecturers, teachers, employers, professional body representatives and other individuals who have generously shared their time and expertise to help us develop these new qualifications.

Employers, professional bodies and higher education providers that have worked with us include:

Cisco Systems

Engineering Council

Network Rail

Nottingham Trent University

Parafix

Royal Academy of Engineering

University of Exeter

University of Northampton.

These qualifications have been approved by the engineering professional bodies on behalf of the Engineering Council as contributing to the requirements for professional registration as an Engineering Technician (EngTech).

The professional bodies include the:

Institution of Engineering and Technology (IET)

Institution of Mechanical Engineers (IMechE)

Society of Operations Engineers (SOE).

In addition, universities, professional bodies and businesses have provided letters of support confirming that these qualifications meet their entry requirements. These letters can be viewed on our website.

Summary of Pearson BTEC Level 3 National Certificate in Engineering specification Issue 6 changes

Summary of changes made between the previous issue and this current issue	Page number
The *Structures of the qualifications at a glance* table has been updated to include units that have been added to the Extended Certificate, Diploma and Extended Diploma.	Pages 10 and 13
Removal of references to MyBTEC, as that service is retiring.	Pages 50, 54, 59, 72, 73

Summary of Pearson BTEC Level 3 National Certificate in Engineering specification Issue 5 changes

Summary of changes made between Issue 4 and Issue 5	Page number
The last paragraph of the *Qualification and unit content* section has been amended to allow centres delivering the qualification above to alter the content to reflect the context of the country where it is being delivered.	Page 14

If you need further information on these changes or what they mean, contact us via our website at: qualifications.pearson.com/en/support/contact-us.html.

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Introduction to BTEC National qualifications for the engineering sector

This specification contains the information you need to deliver the Pearson BTEC Level 3 National Certificate in Engineering. The specification signposts also you to additional handbooks and policies. It includes all the units for this qualification.

This qualification is part of the suite of engineering qualifications offered by Pearson. In the suite there are qualifications that focus on different progression routes, allowing learners to choose the one best suited to their aspirations.

All qualifications in the suite share some common units and assessments, allowing learners some flexibility in moving between sizes. The qualification titles are given below.

Some BTEC National qualifications provide a broad introduction that gives learners transferable knowledge and skills. These qualifications are for post-16 learners who want to continue their education through applied learning. The qualifications prepare learners for a range of higher education courses and job roles related to a particular sector. They provide progression either by meeting entry requirements in their own right or by being accepted alongside other qualifications at the same level and adding value to them.

In the engineering sector these qualifications are:

Pearson BTEC Level 3 National Certificate in Engineering (180 GLH) 603/1197/6

Pearson BTEC Level 3 National Extended Certificate in Engineering (360 GLH) 601/7584/9

Pearson BTEC Level 3 National Foundation Diploma in Engineering (540 GLH) 601/7591/6.

Some BTEC National qualifications are for post-16 learners wishing to specialise in a specific industry, occupation or occupational group. The qualifications give learners the specialist knowledge and skills, enabling entry to an apprenticeship or other employment, or progression to related higher education courses. Learners taking these qualifications must have a significant level of employer involvement in their programmes.

In the engineering sector these qualifications are:

Pearson BTEC Level 3 National Diploma in Engineering (720 GLH) 601/7580/1

Pearson BTEC Level 3 National Diploma in Electrical and Electronic Engineering (720 GLH) 601/7579/5

Pearson BTEC Level 3 National Diploma in Mechanical Engineering (720 GLH) 601/7583/7

Pearson BTEC Level 3 National Diploma in Computer Engineering (720 GLH) 601/7578/3

Pearson BTEC Level 3 National Diploma in Manufacturing Engineering (720 GLH) 601/7582/5

Pearson BTEC Level 3 National Diploma in Aeronautical Engineering (720 GLH) 601/7577/1

Pearson BTEC Level 3 National Extended Diploma in Engineering (1080 GLH) 601/7588/6

Pearson BTEC Level 3 National Extended Diploma in Electrical and Electronic Engineering (1080 GLH) 601/7587/4

Pearson BTEC Level 3 National Extended Diploma in Mechanical Engineering (1080 GLH) 601/7590/4

Pearson BTEC Level 3 National Extended Diploma in Computer Engineering (1080 GLH) 601/7586/2

Pearson BTEC Level 3 National Extended Diploma in Manufacturing Engineering (1080 GLH) 601/7589/8

Pearson BTEC Level 3 National Extended Diploma in Aeronautical Engineering (1080 GLH) 601/7585/0.

This specification signposts all the other essential documents and support that you need as a centre in order to deliver, assess and administer the qualification, including the staff development required. A summary of all essential documents is given in *Section 7*. Information on how we can support you with this qualification is given in *Section 10*.

The information in this specification is correct at the time of publication.

Total Qualification Time

For all regulated qualifications, Pearson specifies a total number of hours that it is estimated learners will require to complete and show achievement for the qualification: this is the Total Qualification Time (TQT). Within TQT, Pearson identifies the number of Guided Learning Hours (GLH) that we estimate a centre delivering the qualification might provide. Guided learning means activities, such as lessons, tutorials, online instruction, supervised study and giving feedback on performance, that directly involve teachers and assessors in teaching, supervising and invigilating learners. Guided learning includes the time required for learners to complete external assessment under examination or supervised conditions.

In addition to guided learning, other required learning directed by teachers or assessors will include private study, preparation for assessment and undertaking assessment when not under supervision, such as preparatory reading, revision and independent research.

BTEC Nationals have been designed around the number of hours of guided learning expected. Each unit in the qualification has a GLH value of 60, 90 or 120. There is then a total GLH value for the qualification.

Each qualification has a TQT value. This may vary within sectors and across the suite depending on the nature of the units in each qualification and the expected time for other required learning.

The following table shows all the qualifications in this sector and their GLH and TQT values.

Qualifications, sizes and purposes at a glance

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Certificate in Engineering	180 GLH (260 TQT) Equivalent in size to 0.5 of an A Level. 2 units of which both are mandatory and 1 is external. Mandatory content (100%). External assessment (67%).	This qualification is intended for post-16 learners who want to continue their education through applied learning and who aim to progress to higher education and ultimately employment. It aims to provide a coherent introduction to study of the engineering sector.
Pearson BTEC Level 3 National Extended Certificate in Engineering	360 GLH (465 TQT) Equivalent in size to one A Level. 4 units of which 3 are mandatory and 2 are external. Mandatory content (83%). External assessment (67%).	This qualification provides a broad basis of study for the engineering sector. It has been designed to support progression to higher education when taken as part of a programme of study that includes other appropriate BTEC Nationals or A Levels.
Pearson BTEC Level 3 National Foundation Diploma in Engineering	540 GLH (740 TQT) Equivalent in size to 1.5 A Levels. 7 units of which 4 are mandatory and 2 are external. Mandatory content (67%). External assessment (44%).	This qualification has been designed as a one-year, full-time course that supports progression to an apprenticeship in engineering or to a further year of study at Level 3. If taken as part of a programme of study that includes other BTEC Nationals or A Levels, it supports progression to higher education.
Pearson BTEC Level 3 National Diploma in Engineering	720 GLH (975 TQT) Equivalent in size to two A Levels. 10 units of which 5 are mandatory and 2 are external. Mandatory content (58%). External assessment (33%).	This qualification is aimed at learners preparing for roles in engineering, for example engineering technician or engineering operative. Learners gain relevant skills and knowledge from studying a range of content focused on electrical/electronic and mechanical disciplines, for example electrical machines and maintenance of mechanical systems. The qualification has been designed to be the substantive part of a 16–19 study programme for learners who want a strong core of sector study and a focus on the wider engineering industry. It may be complemented with other BTEC Nationals or A Levels or non-qualification elements to support progression to specific job roles or to higher education courses in engineering.

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Diploma in Electrical and Electronic Engineering	720 GLH (980 TQT) Equivalent in size to two A Levels. 10 units of which 5 are mandatory and 2 are external. Mandatory content (58%). External assessment (33%).	This qualification is aimed at learners preparing for roles in electrical and electronic engineering, for example electrical engineering technician or electronic engineering operative. Learners gain relevant skills and knowledge from studying a range of units, for example in electronic devices and circuits, power and energy systems and printed circuit board design and manufacture. The qualification is designed to be the substantive part of a 16–19 study programme for learners wanting a strong core of electrical and electronic engineering. It may be complemented with other BTEC Nationals or A Levels or non-qualification elements to support progression to specific job roles or to higher education courses in engineering.
Pearson BTEC Level 3 National Diploma in Mechanical Engineering	720 GLH (985 TQT) Equivalent in size to two A Levels. 10 units of which 5 are mandatory and 2 are external. Mandatory content (58%). External assessment (33%).	This qualification is aimed at learners preparing for roles in mechanical engineering, for example mechanical engineering technician or mechanical fitter. Learners gain relevant skills and knowledge from studying a range of units, for example in metallic and non-metallic materials, fluid mechanics and/or thermodynamic practices. The qualification is designed to be the substantive part of a 16–19 study programme for learners who want a strong core of mechanical engineering. The qualification may be complemented with other BTEC Nationals or A Levels or non-qualification elements to support progression to specific job roles or to higher education courses in engineering.

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Diploma in Computer Engineering	720 GLH (985 TQT) Equivalent in size to two A Levels. 10 units of which 6 are mandatory and 2 are external. Mandatory content (67%). External assessment (33%).	This qualification is aimed at learners preparing for roles in computer engineering, for example computer engineering technician or computer support analyst. Learners gain relevant skills and knowledge from studying a range of units, for example in computer programming, website design and/or cyber security. The qualification is designed to be the substantive part of a 16–19 study programme for learners who want a strong core of knowledge in computer engineering. It may be complemented with other BTEC Nationals or A Levels or non-qualification elements to support progression to specific job roles or to higher education courses in engineering.
Pearson BTEC Level 3 National Diploma in Manufacturing Engineering	720 GLH (980 TQT) Equivalent in size to two A Levels. 10 units of which 6 are mandatory and 2 are external. Mandatory content (67%). External assessment (33%).	This qualification is aimed at learners preparing for roles in manufacturing engineering, for example manufacturing engineering technician or welding operative. Learners gain relevant skills and knowledge from studying a range of units, for example in computer-aided manufacturing, modern manufacturing systems, additive manufacturing and machining. The qualification is designed to be the substantive part of a 16–19 study programme for learners who want a strong core of knowledge of manufacturing engineering. It may be complemented with other BTEC Nationals or A Levels or non-qualification elements to support progression to specific job roles or to higher education courses in engineering.

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Diploma in Aeronautical Engineering	720 GLH (990 TQT) Equivalent in size to two A Levels. 10 units of which 6 are mandatory and 2 are external. Mandatory content (67%). External assessment (33%).	This qualification is aimed at learners preparing for roles in aeronautical engineering, for example aeronautical engineering technician or aerospace fitter. Learners gain relevant skills and knowledge from studying a range of units, for example in aircraft workshop principles, gas turbine engines, airframe construction and first-line maintenance. The qualification is designed to be the substantive part of a 16–19 study programme for learners who want to focus on the specific aspects that relate to the aeronautical industry. It may be complemented with other BTEC Nationals or A Levels or non-qualification elements to support progression to specific job roles or to higher education courses in engineering.
Pearson BTEC Level 3 National Extended Diploma in Engineering	1080 GLH (1475 TQT) Equivalent in size to three A Levels. 15 units of which 7 are mandatory and 3 are external. Mandatory content (56%). External assessment (33%).	This qualification has been designed as a two-year, full-time course that meets entry requirements in its own right for learners wanting to progress to employment in engineering. Learners gain relevant skills and knowledge from studying a range of content focused on electrical/electronic and mechanical disciplines, for example electrical machines and maintenance of mechanical systems. Progression could be either directly to employment in Level 3 job roles, higher apprenticeship programmes or via higher education courses in engineering.

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Extended Diploma in Electrical and Electronic Engineering	1080 GLH (1485 TQT) Equivalent in size to three A Levels. 15 units of which 7 are mandatory and 3 are external. Mandatory content (56%). External assessment (33%).	This qualification has been designed as a two-year, full-time course that meets entry requirements in its own right for learners wanting to progress to employment in electrical and electronic engineering, such as a power engineering technician. Learners gain relevant skills and knowledge from studying a range of units, for example in electronic devices and circuits, power and energy systems, printed circuit board design and manufacture, microcontrollers and/or calculus. Progression could be either directly to employment in Level 3 job roles, higher apprenticeship programmes or via higher education courses in engineering.
Pearson BTEC Level 3 National Extended Diploma in Mechanical Engineering	1080 GLH (1485 TQT) Equivalent in size to three A Levels. 15 units of which 7 are mandatory and 3 are external. Mandatory content (56%). External assessment (33%).	This qualification has been designed as a two-year, full-time course that meets entry requirements in its own right for learners who want to progress to employment in mechanical engineering, such as a mechanical maintenance technician. Learners gain relevant skills and knowledge from studying a range of units, for example in metallic and non-metallic materials, fluid mechanics, thermodynamic practices, microcontrollers and/or calculus. Progression could be either directly to employment in Level 3 job roles, higher apprenticeship programmes or via higher education courses in engineering.

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Extended Diploma in Computer Engineering	1080 GLH (1485 TQT) Equivalent in size to three A Levels. 15 units of which 8 are mandatory and 3 are external. Mandatory content (61%). External assessment (33%).	This qualification has been designed as a two-year, full-time course that meets entry requirements in its own right for learners wanting to progress to employment in computer engineering, such as a computer support technician. Learners gain relevant skills and knowledge from studying a range of units, for example in computer programming, microcontrollers, website design, cyber security, microcontrollers and/or calculus. Progression could be either directly to employment in Level 3 job roles, higher apprenticeship programmes or via higher education courses in engineering.
Pearson BTEC Level 3 National Extended Diploma in Manufacturing Engineering	1080 GLH (1475 TQT) Equivalent in size to three A Levels. 15 units of which 8 are mandatory and 3 are external. Mandatory content (61%). External assessment (33%).	This qualification has been designed as a two-year, full-time course that meets entry requirements in its own right for learners wanting to progress to employment in manufacturing engineering, such as a quality control technician. Learners gain relevant skills and knowledge from studying a range of units, for example in computer-aided manufacturing, modern manufacturing systems, microcontrollers, additive manufacturing, and machining. Progression could be either directly to employment in Level 3 job roles, higher apprenticeship programmes or via higher education courses in engineering.

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Extended Diploma in Aeronautical Engineering	1080 GLH (1495 TQT) Equivalent in size to three A Levels. 15 units of which 8 are mandatory and 3 are external. Mandatory content (61%). External assessment (33%).	This qualification has been designed as a two-year, full-time course that meets entry requirements in its own right for learners wanting to progress to employment in aeronautical/ aerospace engineering, for example in aerospace manufacturing or as a systems fitter or aircraft maintenance operative. Learners gain relevant skills and knowledge from studying a range of units, for example in aircraft workshop principles, microcontrollers, calculus, gas turbine engines, airframe construction and first-line maintenance. Progression could be either directly to employment in Level 3 job roles, higher apprenticeship programmes or via higher education courses in engineering.

Structures of the qualifications at a glance

This table shows all the units and the qualifications to which they contribute. The full structure for this Pearson BTEC Level 3 National in Engineering is shown in *Section 2*. **You must refer to the full structure to select units and plan your programme.**

Key

	Unit assessed externally	**M**	**Mandatory units**	**O**	**Optional units**		
E	**Engineering**	**EE**	**Electrical/Electronic**	**ME**	**Mechanical**	**C**	**Computer**
MA	**Manufacturing**	**AE**	**Aeronautical**				

Unit (number and title)	Unit size (GLH)	Certificate (180 GLH)	Extended Certificate (360 GLH)	Foundation Diploma (540 GLH)	Diploma (720 GLH)						Extended Diploma (1080 GLH)					
					E	EE	ME	C	MA	AE	E	EE	ME	C	MA	AE
1 Engineering Principles	120	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
2 Delivery of Engineering Processes Safely as a Team	60	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
3 Engineering Product Design and Manufacture	120		M	M	M	M	M	M	M	M	M	M	M	M	M	M
4 Applied Commercial and Quality Principles in Engineering	60			M	M	M	M	M	M	M	M	M	M	M	M	M
5 A Specialist Engineering Project	60				M	M	M	M	M	M	M	M	M	M	M	M
6 Microcontroller Systems for Engineers	120										M	M	M	M	M	M
7 Calculus to Solve Engineering Problems	60		O	O	O	O	O	O	O	O	M	M	M	M	M	M
8 Further Engineering Mathematics	60				O	O	O	O	O	O	O	O	O	O	O	O
9 Work Experience in the Engineering Sector	60		O	O	O	O	O	O	O	O	O	O	O	O	O	O
10 Computer Aided Design in Engineering	60		O	O	O		O	O	O	O	O		O	O	O	O
11 Engineering Maintenance and Condition Monitoring Techniques	60		O	O	O		O	O	O	O	O		O	O	O	O
12 Pneumatic and Hydraulic Systems	60		O	O	O	O	O	O	O	O	O	O	O	O	O	O

continued overleaf

Unit (number and title)	Unit size (GLH)	Certificate (180 GLH)	Extended Certificate (360 GLH)	Foundation Diploma (540 GLH)	Diploma (720 GLH)						Extended Diploma (1080 GLH)					
					E	EE	ME	C	MA	AE	E	EE	ME	C	MA	AE
13 Welding Technology	60			O	O		O		O	O	O		O		O	O
14 Electrical Installation of Hardware and Cables	60				O	O		O			O	O		O	O	
15 Electrical Machines**	60			O	O	O	O	O		O	O	O	O	O		O
16 Three Phase Electrical Systems	60				O	O		O	O	O	O	O		O	O	O
17 Power and Energy Electronics	60				O	O					O	O				
18 Electrical Power Distribution and Transmission	60				O	O		O			O	O	O	O		
19 Electronic Devices and Circuits	60		O	O	O	O	O	O	O	O	O	O	O	O	O	O
20 Analogue Electronic Circuits	60				O	O	O	O			O	O	O	O		
21 Electronic Measurement and Testing of Circuits	60			O	O	O	O	O			O	O	O	O	O	O
22 Electronic Printed Circuit Board Design and Manufacture	60			O	O	O		O	O		O	O		O	O	
23 Digital and Analogue Electronic Systems	60				O	O					O	O				
24 Maintenance of Mechanical Systems	60			O	O	O	O	O	O		O	O	O	O	O	
25 Mechanical Behaviour of Metallic Materials	60		O	O	O	O	O	O	O	O	O	O	O	O	O	O
26 Mechanical Behaviour of Non-metallic Materials	60				O		O		O	O	O	O	O		O	O
27 Static Mechanical Principles in Practice	60			O	O	O	O	O	O		O	O	O	O	O	
28 Dynamic Mechanical Principles in Practice	60				O		O		O		O	O	O		O	O
29 Principles and Applications of Fluid Mechanics	60				O		O			O	O		O		O	O
30 Mechanical Measurement and Inspection Technology	60		O	O	O	O	O		O		O	O	O	O	O	

continued overleaf

Unit (number and title)	Unit size (GLH)	Certificate (180 GLH)	Extended Certificate (360 GLH)	Foundation Diploma (540 GLH)	Diploma (720 GLH)						Extended Diploma (1080 GLH)					
					E	EE	ME	C	MA	AE	E	EE	ME	C	MA	AE
31 Thermodynamic Principles and Practice	60				O		O			O	O		O			O
32 Computer System Principles and Practice	60				O			M			O			M		
33 Computer Systems Security	60				O	O		O			O	O	O	O		
34 Computer Systems Support and Performance	60				O	O	O	O	O		O	O	O	O	O	
35 Computer Programming	60		O	O	O	O	O	O	O	O	O	O	O	O	O	O
36 Programmable Logic Controllers	60			O	O	O	O	O	O	O	O	O	O	O	O	O
37 Computer Networks	60				O	O		O			O	O		O		
38 Website Production to Control Devices	60				O	O		O			O	O		O		
39 Modern Manufacturing Systems	60				O				M		O				M	
40 Computer Aided Manufacturing and Planning	60				O			O	O		O		O	O	O	
41 Manufacturing Secondary Machining Processes	60		O	O	O	O	O	O	O	O	O	O	O	O	O	O
42 Manufacturing Primary Forming Processes	60				O		O		O		O		O		O	
43 Manufacturing Computer Numerical Control Machining Processes	60			O	O	O	O	O	O	O	O	O	O	O	O	O
44 Fabrication Manufacturing Processes	60		O	O	O	O	O		O		O	O	O		O	O
45 Additive Manufacturing Processes	60		O	O	O	O	O	O	O	O	O	O	O	O	O	O
46 Manufacturing Joining, Finishing and Assembly Processes	60				O				O		O				O	
47 Composites Manufacture and Repair Processes	60				O				O	O	O				O	O

continued overleaf

Unit (number and title)	Unit size (GLH)	Certificate (180 GLH)	Extended Certificate (360 GLH)	Foundation Diploma (540 GLH)	Diploma (720 GLH)						Extended Diploma (1080 GLH)					
					E	EE	ME	C	MA	AE	E	EE	ME	C	MA	AE
48 Aircraft Flight Principles and Practice	60									M						M
49 Aircraft Workshop Methods and Practice	60									O						O
50 Aircraft Gas Turbine Engines	60									O						O
51 Aircraft Propulsion Systems	60									O						O
52 Airframe Construction and Repair	60									O						O
53 Airframe Mechanical Systems	60									O						O
54 Aircraft Electrical and Instrument Systems	60									O						O
55 Aircraft First Line Maintenance Operations	60									O						O
56 Industrial Robotics	60				O	O	O	O	O	O	O	O	O	O	O	O
57 Sustainable Transport	60			O	O						O					
58 Energy Management	60				O						O					
59 Principles of Electrical Machines**	60				O	O					O	O				
60 Autonomous Mobile Robotics	60				O	O	O				O	O	O			

** Learners may only take one unit from *Unit 15: Electrical Machines* or *Unit 59: Principles of Electrical Machines*, they cannot take both.

Qualification and unit content

Pearson has developed the content of the new BTEC Nationals in collaboration with employers and representatives from higher education and relevant professional bodies. In this way, we have ensured that content is up to date and that it includes the knowledge, understanding, skills and attributes required in the sector.

Each qualification in the suite has its own purpose. The mandatory and optional content provides a balance of breadth and depth, while retaining a degree of choice for individual learners to study content relevant to their own interests and progression choices. Also, the content may be applied during delivery in a way that is relevant to local employment needs.

The proportion of mandatory content ensures that all learners are following a coherent programme of study and acquiring the knowledge, understanding and skills that will be recognised and valued. Learners are expected to show achievement across mandatory units as detailed in *Section 2*.

BTEC Nationals have always required applied learning that brings together knowledge and understanding (the cognitive domain) with practical and technical skills (the psychomotor domain). This is achieved through learners performing vocational tasks that encourage the development of appropriate vocational behaviours (the affective domain) and transferable skills. Transferable skills are those such as communication, teamwork, research and analysis, which are valued in both higher education and the workplace.

Our approach provides rigour and balance, and promotes the ability to apply learning immediately in new contexts. Further details can be found in *Section 2*.

Centres should ensure that delivery of content is kept up to date. Some of the units within the specification may contain references to legislation, policies, regulations and organisations, which may not be applicable in the country you deliver this qualification in (if teaching outside of England), or which may have gone out-of-date during the lifespan of the specification. In these instances, it is possible to substitute such references with ones that are current and applicable in the country you deliver subject to confirmation by your Standards Verifier.

Assessment

Assessment is specifically designed to fit the purpose and objective of the qualification. It includes a range of assessment types and styles suited to vocational qualifications in the sector. There are three main forms of assessment that you need to be aware of: external, internal and synoptic.

Externally-assessed units

Each external assessment for a BTEC National is linked to a specific unit. All of the units developed for external assessment are of 90 or 120 GLH to allow learners to demonstrate breadth and depth of achievement. Each assessment is taken under specified conditions, then marked by Pearson and a grade awarded. Learners are permitted to resit external assessments during their programme. You should refer to our website for current policy information on permitted retakes.

The styles of external assessment used for qualifications in the Engineering suite are:

- examinations – all learners take the same assessment at the same time, normally with a written outcome
- set tasks – learners take the assessment during a defined window and demonstrate understanding through completion of a vocational task.

Some external assessments include a period of preparation using set information. External assessments are available once or twice a year. For detailed information on the external assessments please see the table in *Section 2*. For further information on preparing for external assessment see *Section 5*.

Internally-assessed units

Most units in the sector are internally assessed and subject to external standards verification. This means that you set and assess the assignments that provide the final summative assessment of each unit, using the examples and support that Pearson provides. Before you assess you will need to become an approved centre, if you are not one already. You will need to prepare to assess using the guidance in *Section 6*.

In line with the requirements and guidance for internal assessment, you select the most appropriate assessment styles according to the learning set out in the unit. This ensures that learners are assessed using a variety of styles to help them develop a broad range of transferable skills. Learners could be given opportunities to:

- write up the findings of their own research
- use case studies to explore complex or unfamiliar situations
- carry out projects for which they have choice over the direction and outcomes
- demonstrate practical and technical skills using appropriate processes, devices, components, equipment, materials, consumables.

You will make grading decisions based on the requirements and supporting guidance given in the units. Learners may not make repeated submissions of assignment evidence. For further information see *Section 6*.

Synoptic assessment

Synoptic assessment requires learners to demonstrate that they can identify and use effectively, in an integrated way, an appropriate selection of skills, techniques, concepts, theories and knowledge from across the whole sector as relevant to a key task. BTEC learning has always encouraged learners to apply their learning in realistic contexts using scenarios and realistic activities that will permit learners to draw on and apply their learning. For these qualifications we have formally identified units which contain a synoptic assessment task. Synoptic assessment must take place after the teaching and learning of other mandatory units in order for learners to be able to draw from the full range of content. The synoptic assessment gives learners an opportunity to independently select and apply learning from across their programmes in the completion of a vocational task. Synoptic tasks may be in internally or externally assessed units. The particular unit that contains the synoptic tasks for this qualification is shown in the structure in *Section 2*.

Language of assessment

Assessment of the internal and external units for these qualifications will be available in English. All learner work must be in English. A learner taking the qualifications may be assessed in British or Irish Sign Language where it is permitted for the purpose of reasonable adjustment. For information on reasonable adjustments see *Section 7*.

Grading for units and qualifications

Achievement in the qualification requires a demonstration of depth of study in each unit, assured acquisition of a range of practical skills required for employment or progression to higher education, and successful development of transferable skills. Learners achieving a qualification will have achieved across mandatory units, including external and synoptic assessment.

Units are assessed using a grading scale of Distinction (D), Merit (M), Pass (P), Near Pass (N) and Unclassified (U). The grade of Near Pass is used for externally-assessed units only. All mandatory and optional units contribute proportionately to the overall qualification grade, for example a unit of 120 GLH will contribute double that of a 60 GLH unit.

Qualifications in the suite are graded using a scale of P to D*, **or** PP to D*D*, **or** PPP to D*D*D*. Please see *Section 9* for more details. The relationship between qualification grading scales and unit grades will be subject to regular review as part of Pearson's standards monitoring processes on the basis of learner performance and in consultation with key users of the qualification.

UCAS Tariff points

The BTEC Nationals attract UCAS points. Please go to the UCAS website for full details of the points allocated.

1 Qualification purpose

Pearson BTEC Level 3 National Certificate in Engineering

In this section you will find information on the purpose of this qualification and how its design meets that purpose through the qualification objective and structure. We publish a full 'Statement of Purpose' for each qualification on our website. These statements are designed to guide you and potential learners to make the most appropriate choice about the size of qualification suitable at recruitment.

Who is this qualification for?

The Pearson BTEC Level 3 National Certificate in Engineering is intended to be an Applied General qualification for post-16 learners who want to continue their education through applied learning and who aim to progress to higher education and ultimately to employment, possibly in the engineering sector. The qualification is equivalent in size to half an A Level and aims to provide a coherent introduction to study of the engineering sector. Learners do not need to have studied engineering previously but will have successfully completed a Level 2 programme of learning with GCSEs or vocational qualifications.

What does this qualification cover?

The content of this qualification has been developed in consultation with academics to ensure that it supports progression to higher education. In addition, employers and professional bodies have been involved and consulted in order to confirm that the content is also appropriate and consistent with current practice for learners who may choose to enter employment directly in the engineering sector.

Everyone taking this qualification will study two mandatory units covering the following content areas:

- mathematics for engineering
- engineering principles
- mechanical principles
- engineering processes.

What could this qualification lead to?

This qualification is intended to carry UCAS points and is recognised by higher education providers as contributing to meeting admission requirements for many courses if taken alongside other qualifications as part of a two-year programme of learning. This combination combines well with a large number of subjects and supports entry to higher education courses in a wide range of disciplines, depending on the subjects taken alongside it. However, for learners wishing to study an aspect of engineering in higher education, opportunities include:

- BSc Hons in Electrical Engineering, if taken alongside A Levels in maths and a science subject (i.e. physics)
- BSc (Hons) in Architectural Engineering, if taken alongside a BTEC National in Construction and the Built Environment and A Levels in maths or art/design
- BSc (Hons) in Computer Science, if taken alongside A Levels in computing and maths
- BSc (Hons) in Maths or Physics if taken alongside A Levels in maths and physics.

Learners should always check the entry requirements for degree programmes with specific higher education providers.

How does the qualification provide employability skills?

In the BTEC National units there are opportunities during the teaching and learning phase to give learners practice in developing employability skills. Where employability skills are referred to in this specification, we are generally referring to skills in the following three main categories:

- **cognitive and problem-solving skills:** use critical thinking, approach non-routine problems applying expert and creative solutions, use systems and technology
- **intrapersonal skills:** communicating, working collaboratively, negotiating and influencing, self-presentation
- **interpersonal skills:** self-management, adaptability and resilience, self-monitoring and development.

There are also specific requirements in some units for assessment of these skills where relevant, for example, where learners are required to undertake real or simulated activities.

How does the qualification provide transferable knowledge and skills for higher education?

All BTEC Nationals provide transferable knowledge and skills that prepare learners for progression to university. The transferable skills that universities value include:

- the ability to learn independently
- the ability to research actively and methodically
- being able to give presentations and being active group members.

BTEC learners can also benefit from opportunities for deep learning where they are able to make connections among units and select areas of interest for detailed study. BTEC Nationals provide a vocational context in which learners can develop the knowledge and skills required for particular degree courses, including:

- analytical and problem-solving skills
- reading technical texts
- effective writing
- preparation for assessment methods used in degrees.

2 Structure

Qualification structure

Pearson BTEC Level 3 National Certificate in Engineering

Mandatory units

There are two mandatory units, one internal and one external. Learners must complete and achieve at Near Pass grade or above in all mandatory external units and achieve a Pass or above in all mandatory internal units.

Pearson BTEC Level 3 National Certificate in Engineering				
Unit number	**Unit title**	**GLH**	**Type**	**How assessed**
	Mandatory units – learners complete and achieve all units			
1	Engineering Principles	**120**	**Mandatory and Synoptic**	External
2	Delivery of Engineering Processes Safely as a Team	**60**	**Mandatory**	Internal

External assessment

This is a summary of the type and availability of external assessment, which is of units making up 67% of the total qualification GLH. See *Section 5* and the units and sample assessment materials for more information.

Unit	Type	Availability
Unit 1: Engineering Principles	• Written exam set and marked by Pearson. • Two hours. • 80 marks.	**Jan and May/June** **First assessment January 2019**

Synoptic assessment

The mandatory synoptic assessment requires learners to apply learning from across the qualification to the completion of a defined vocational task. Within the assessment for *Unit 1: Engineering Principles* learners apply mathematical and physical science principles to solve electrical-, electronic- and mechanical-based engineering problems. Learners are taught solutions to problems, drawing on electrical, electronic, mechanical and mathematical principles. Learners complete the exam using knowledge and understanding from their studies of the sector and apply both transferable and specialist knowledge and skills. In completing the exam, learners will select and apply learning from the other mandatory unit, *Unit 2: Delivery of Engineering Processes Safely as a Team*. Learners complete the task using knowledge and understanding from their studies of the sector and apply both transferable and specialist knowledge and skills.

In delivering the unit you need to encourage learners to draw on their broader learning so they will be prepared for the assessment.

Employer involvement in assessment and delivery

You are encouraged to give learners opportunities to be involved with employers.
See *Section 4* for more information.

3 Units

Understanding your units

The units in this specification set out our expectations of assessment in a way that helps you to prepare your learners for assessment. The units help you to undertake assessment and quality assurance effectively.

Each unit in the specification is set out in a similar way. There are two types of unit format:

- internal units
- external units.

This section explains how the units work. It is important that all teachers, assessors, internal verifiers and other staff responsible for the programme review this section.

Internal units

Section	Explanation
Unit number	The number is in a sequence in the sector. Numbers may not be sequential for an individual qualification.
Unit title	This is the formal title that we always use and it appears on certificates.
Level	All units are at Level 3 on the national framework.
Unit type	This shows if the unit is internal or external only. See structure information in *Section 2* for full details.
GLH	Units may have a GLH value of 120, 90 or 60 GLH. This indicates the numbers of hours of teaching, directed activity and assessment expected. It also shows the weighting of the unit in the final qualification grade.
Unit in brief	A brief formal statement on the content of the unit that is helpful in understanding its role in the qualification. You can use this in summary documents, brochures etc.
Unit introduction	This is designed with learners in mind. It indicates why the unit is important, how learning is structured, and how learning might be applied when progressing to employment or higher education.
Learning aims	These help to define the scope, style and depth of learning of the unit. You can see where learners should be learning standard requirements ('understand') or where they should be actively researching ('investigate'). You can find out more about the verbs we use in learning aims in *Appendix 2*.
Summary of unit	This new section helps teachers to see at a glance the main content areas against the learning aims and the structure of the assessment. The content areas and structure of assessment are required. The forms of evidence given are suitable to fulfil the requirements.
Content	This section sets out the required teaching content of the unit. Content is compulsory except when shown as 'e.g.'. Learners should be asked to complete summative assessment only after the teaching content for the unit or learning aim(s) has been covered.

Section	Explanation
Assessment criteria	Each learning aim has Pass and Merit criteria. Each assignment has at least one Distinction criterion. A full glossary of terms used is given in *Appendix 2*. All assessors need to understand our expectations of the terms used. Distinction criteria represent outstanding performance in the unit. Some criteria require learners to draw together learning from across the learning aims.
Essential information for assignments	This shows the maximum number of assignments that may be used for the unit to allow for effective summative assessment, and how the assessment criteria should be used to assess performance.
Further information for teachers and assessors	The section gives you information to support the implementation of assessment. It is important that this is used carefully alongside the assessment criteria.
Resource requirements	Any specific resources that you need to be able to teach and assess are listed in this section. For information on support resources see *Section 10*.
Essential information for assessment decisions	This information gives guidance for each learning aim or assignment of the expectations for Pass, Merit and Distinction standard. This section contains examples and essential clarification.
Links to other units	This section shows you the main relationship among units. This section can help you to structure your programme and make best use of materials and resources.
Employer involvement	This section gives you information on the units that can be used to give learners involvement with employers. It will help you to identify the kind of involvement that is likely to be successful.

External units

Section	Explanation
Unit number	The number is in a sequence in the sector. Numbers may not be sequential for an individual qualification.
Unit title	This is the formal title that we always use and it appears on certificates.
Level	All units are at Level 3 on the national framework.
Unit type	This shows if the unit is internal or external only. See structure information in *Section 2* for full details.
GLH	Units may have a GLH value of 120, 90 or 60 GLH. This indicates the numbers of hours of teaching, directed activity and assessment expected. It also shows the weighting of the unit in the final qualification grade.
Unit in brief	A brief formal statement on the content of the unit.
Unit introduction	This is designed with learners in mind. It indicates why the unit is important, how learning is structured, and how learning might be applied when progressing to employment or higher education.
Summary of assessment	This sets out the type of external assessment used and the way in which it is used to assess achievement.
Assessment outcomes	These show the hierarchy of knowledge, understanding, skills and behaviours that are assessed. Includes information on how this hierarchy relates to command terms in sample assessment materials (SAMs).
Essential content	For external units all the content is obligatory, the depth of content is indicated in the assessment outcomes and sample assessment materials (SAMs). The content will be sampled through the external assessment over time, using the variety of questions or tasks shown.
Grade descriptors	We use grading descriptors when making judgements on grade boundaries. You can use them to understand what we expect to see from learners at particular grades.
Key terms typically used in assessment	These definitions will help you analyse requirements and prepare learners for assessment.
Resources	Any specific resources that you need to be able to teach and assess are listed in this section. For information on support resources see *Section 10*.
Links to other units	This section shows the main relationship among units. This section can help you to structure your programme and make best use of materials and resources.
Employer involvement	This section gives you information on the units that can be used to give learners involvement with employers. It will help you to identify the kind of involvement that is likely to be successful.

Index of units

This section contains all the units developed for this qualification. Please refer to *pages 10–13* to check which units are available in all qualifications in the engineering sector.

Unit 1: Engineering Principles 27

Unit 2: Delivery of Engineering Processes Safely as a Team 37

Unit 1: Engineering Principles

Level: **3**

Unit type: **External**

Guided learning hours: **120**

Unit in brief

Learners apply mathematical and physical science principles to solve electrical-, electronic- and mechanical-based engineering problems.

Unit introduction

Modern life depends on engineers to develop, support and control the products and systems that are all around us. For example, cars, heart rate monitors and manufacturing and transport systems. To make a contribution as an engineer you must be able to draw on an important range of principles developed by early engineering scientists, such as Newton, Young, Faraday and Ohm. There is an increasing demand for 'multi-skilled' engineers who can apply principles from several engineering disciplines to develop solutions.

This unit will develop your mathematical and physical scientific knowledge and understanding to enable you to solve problems set in an engineering context. You will explore and apply the algebraic and trigonometric mathematical methods required to solve engineering problems. The mechanical problems you will encounter cover static, dynamic and fluid systems. The electrical and electronic problems you will encounter cover static and direct current (DC) electricity, DC circuit theory and networks, magnetism, and single-phase alternating current theory. You may apply these engineering principles to solve problems involving more than one of these topic areas.

This unit is externally assessed. It sits at the heart of the qualification and gives you a foundation to support you in any engineering technician role, an engineering apprenticeship or in higher education.

Summary of assessment

The unit will be assessed through one paper of 80 marks lasting two hours that will be set and marked by Pearson.

Learners will be assessed through a number of short- and long-answer problem-solving questions. Learners will need to explore and relate to the engineering contexts and data presented. Assessment will focus on learners' ability to solve problems that require individual and combined application of mathematical techniques, and electrical, electronic and mechanical principles to solve engineering problems.

The assessment availability is twice a year in January and May/June.

Sample assessment materials will be available to help centres prepare learners for assessment.

Assessment outcomes

AO1 Recall basic engineering principles and mathematical methods and formulae

Command words: calculate, describe, explain, identify, name

Marks: ranges from 1 to 5 marks

AO2 Perform mathematical procedures to solve engineering problems

Command words: calculate, convert, find, solve

Marks: ranges from 1 to 10 marks

AO3 Demonstrate an understanding of electrical, electronic and mechanical principles to solve engineering problems

Command words: find, calculate, describe, draw, explain

Marks: ranges from 1 to 5 marks

AO4 Analyse information and systems to solve engineering problems

Command words: calculate, draw

Marks: ranges from 1 to 5 marks

AO5 Integrate and apply electrical, electronic and mechanical principles to develop an engineering solution

Command words: calculate, draw, explain

Marks: ranges from 1 to 10 marks

Essential content

The essential content is set out under content areas. Learners must cover all specified content before the assessment.

A Algebraic and trigonometric mathematical methods

- Application of appropriate units

A1 Algebraic methods

- Solve, transpose and simplify equations.
- Indices and logarithms:
  - laws of indices: $a^m \times a^n = a^{m+n}$, $\frac{a^m}{a^n} = a^{m-n}$, $(a^m)^n = a^{mn}$
  - laws of logarithms: $\log A + \log B = \log AB$, $\log A^n = n\log A$, $\log A - \log B = \log \frac{A}{B}$
  - common logarithms (base 10), natural logarithms (base e).
- Application to problems involving exponential growth and decay.
- Linear equations and straight line graphs:
  - linear equations of the form $y = mx + c$
  - straight-line graph (coordinates on a pair of labelled Cartesian axes, positive or negative gradient, intercept, plot of a straight line)
  - pair of simultaneous linear equations in two unknowns.
- Factorisation and quadratics:
  - multiply expressions in brackets by a number, symbol or by another expression in a bracket
  - extraction of a common factor $ax + ay$, $a(x + 2) + b(x + 2)$
  - grouping $ax - ay + bx - by$
  - quadratic expressions $a^2 + 2ab + b^2$
  - roots of an equation, including quadratic equations with real roots by factorisation, and by the use of formula.

A2 Trigonometric methods

- Circular measure:
  - radian
  - conversion of degree measure to radian measure and vice versa
  - angular rotations (multiple number (n) of radians)
  - problems involving areas and angles measured in radians
  - length of arc of a circle $s = r\theta$
  - area of a sector $A = \frac{1}{2} r^2\theta$
- Triangular measurement:
  - functions (sine, cosine and tangent)
  - sine/cosine wave over one complete cycle
  - graph of $\tan A$ as A varies from 0° and 360° confirming $\tan A = \frac{\sin A}{\cos A}$
  - values of the trigonometric ratios for angles between 0° and 360°
  - periodic properties of the trigonometric functions
  - the sine and cosine rule
  - application of vectors:
    - calculation of the phasor sum of two alternating currents
    - diagrammatic representation of vectors
    - resolution of forces/velocities.

- Mensuration:
  - standard formulae to solve surface areas and volumes of regular solids
    - volume of a cylinder $V = \pi r^2 h$
    - total surface area of a cylinder $TSA = 2\pi rh + 2\pi r^2$
    - volume of sphere $V = \frac{4}{3}\pi r^3$
    - surface area of a sphere $SA = 4\pi r^2$
    - volume of a cone $V = \frac{1}{3}\pi r^2 h$
    - curved surface area of cone $CSA = \pi rl$

B Static engineering systems

- Application of appropriate units

B1 Static engineering systems

Recall, perform procedures, demonstrate an understanding of and analyse information and systems, involving:

- Non-concurrent coplanar forces:
  - representation of forces using space and free body diagrams
  - moments
  - resolution of forces in perpendicular directions $F_x = F\cos\theta$, $F_y = F\sin\theta$
  - vector addition of forces – resultant, equilibrant and line of action
  - conditions for static equilibrium $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma M = 0$
- Simply supported beams:
  - concentrated loads
  - uniformly distributed loads (UDL).
- Reactions:
  - support reactions
  - pin reaction forces
  - roller reaction forces.

B2 Loaded components

Recall, perform procedures, demonstrate an understanding of and analyse information and systems involving:

- direct stress and strain: direct stress $\sigma = \frac{F}{A}$, direct strain $\varepsilon = \frac{\Delta L}{L}$
- shear stress and strain: shear stress $\tau = \frac{F}{A}$, shear strain $\gamma = \frac{a}{b}$
- tensile and shear strength
- elastic constants: Young's Modulus (modulus of elasticity)

  $E = \frac{\sigma}{\varepsilon}$; Modulus of rigidity $G = \frac{\tau}{\gamma}$

C Dynamic engineering systems

- Application of appropriate units

C1 Dynamic engineering systems

Recall, perform procedures, demonstrate an understanding of and analyse information and systems involving:

- kinetic parameters and principles:
  - displacement (s)
  - velocity – initial velocity (u), final velocity (v)
  - acceleration (a)
  - equations for linear motion with uniform acceleration

    $v = u + at$, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$, $s = \frac{1}{2}(u + v)t$
- dynamic parameters and principles:
  - force
  - inertia
  - torque (T)
  - mechanical work $W = Fs$, mechanical power (average and instantaneous)
  - mechanical efficiency
  - energy: gravitational potential energy $PE = mgh$, kinetic energy $KE = \frac{1}{2}mv^2$
  - Newton's Laws of Motion
  - principles of conservation of momentum
  - principles of conservation of energy.
- angular parameters:
  - angular velocity (ω)
  - centripetal acceleration $a = \omega^2 r = \frac{v^2}{r}$
  - uniform circular motion power $P = T\omega$
  - rotational kinetic energy $KE = \frac{1}{2}I\omega^2$
- lifting machines, including inclined planes, scissor jacks, pulleys:
  - velocity ratio
  - mechanical advantage
  - effort and load motion
  - friction effects.

D Fluid engineering systems

- Application of appropriate units

D1 Fluid systems

Recall, perform procedures, demonstrate an understanding of and analyse information and systems involving:

- submerged surfaces in fluid systems:
  - hydrostatic pressure and hydrostatic thrust on an immersed plane surface $F = \rho gAx$
  - centre of pressure of a rectangular retaining surface with one edge in the free surface of a liquid
- immersed bodies:
  - Archimedes' principle
  - determination of density using floatation methods
  - relative density

- fluid flow in a gradually tapering pipe:
  - flow rate (volumetric and mass)
  - flow velocities (input and output)
  - input and output pipe diameters
  - incompressible fluid flow (continuity of volumetric flow $A_1v_1 = A_2v_2$ and mass flow $\rho A_1v_1 = \rho A_2v_2$)

E Static and direct current electricity and circuits

- Application of appropriate units

E1 Static and direct current electricity

Recall, perform procedures, demonstrate an understanding of and analyse information and systems, in the context of electrical circuits (networks) and devices, including:

- conductance
- conventional current flow
- charge/electron flow $I = \frac{q}{t}$
- voltage
- Coulomb's law $F = \frac{q_1 q_2}{4\pi\varepsilon_o r^2}$
- factors affecting resistance, including conductor length, cross sectional area, resistivity, and temperature coefficient of resistance $R = \frac{\rho l}{A}$, $\frac{\Delta R}{R_o} = \alpha\Delta T$
- resistors, including function, fixed, variable, values
- electric field strength, including uniform electric fields $E = \frac{F}{q}$, $E = \frac{v}{d}$
- factors affecting capacitance, including plate spacing, plate area, permittivity $C = \frac{\varepsilon A}{d}$
- capacitors – typical capacitance values and construction, including plates, dielectric materials and strength, flux density, permittivity.

E2 Direct current circuit theory

Recall, perform procedures, demonstrate an understanding of and analyse information and systems involving:

- Ohm's law $I = \frac{V}{R}$
- Power $P = IV$, $P = I^2R$, $P = \frac{V^2}{R}$
- Efficiency (η)= $\frac{P_{out}}{P_{in}}$
- Kirchhoff voltage and current laws $V = V_1 + V_2 + V_3$ or $\Sigma PD = \Sigma IR$, $I = I_1 + I_2 + I_3$
- Charge, voltage, capacitance and energy stored in capacitors

  $Q = CV$, $W = \frac{1}{2}CV^2$
- RC transients (capacitor/resistor), charge and discharge, including exponential growth and decay of voltage and current, and time constant $\tau = RC$
- Diodes, including forward and reverse bias characteristics:
  - forward mode applications, including rectification, clamping, circuit/component protection
  - reverse mode applications, including zener diode for voltage regulation

E3 Direct current networks

Recall, perform procedures, demonstrate an understanding of and analyse information and systems involving:

- DC power sources, including cells, batteries, stabilised power supply, photovoltaic cell/array and internal resistance
- at least five resistors in series and parallel combinations

  $R_T = R_1 + R_2 + R_3$

  $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
- DC circuits containing resistors and two power sources
- DC power source with at least two capacitors connected (series, parallel, combination).

F Magnetism and electromagnetic induction

- Application of appropriate units

F1 Magnetism

Recall, perform procedures, demonstrate an understanding of and analyse information and systems involving:

- magnetic field:
  - flux density $B = \frac{\phi}{A}$
  - magnetomotive force (mmf) and field strength (H), $F_m = NI$, $H = \frac{NI}{l}$
  - permeability $\frac{B}{H} = \mu_0 \mu_r$
  - B/H curves and loops
  - ferromagnetic materials
  - reluctance $S = \frac{F_m}{\phi}$
  - magnetic screening
  - hysteresis
- electromagnetic induction and applications:
  - induced electromotive force (emf)
  - relationship between induced emf, magnetic field strength, number of conductor turns and rate of change of flux
  - relationship between number of turns, magnetic length, permeability, and inductance
  - eddy currents
  - principle of operation of electric motors and generators including efficiency
  - self inductance, including inductance of a coil, energy stored in an inductor, induced emf

    $L = \frac{N\phi}{I}$, $W = \frac{1}{2} LI^2$, $E = Blv$, $E = -N\frac{d\phi}{dt} = -L\frac{dI}{dt}$
  - mutual inductance (principals of transformer operation – step up/down, primary and secondary current and voltage ratios, including efficiency.)

    $\frac{V_1}{V_2} = \frac{N_1}{N_2}$
  - application of Faraday's and Lenz's laws.

G Single-phase alternating current

- Application of appropriate units

G1 Single-phase alternating current theory

Recall, perform procedures, demonstrate an understanding of and analyse information and systems involving:

- waveform characteristics:
  - sinusoidal and non-sinusoidal waveforms
  - amplitude, time period, frequency
  - instantaneous values:
    - peak/peak-to-peak
    - root mean square (RMS):

      RMS voltage = $\frac{\text{peak voltage}}{\sqrt{2}}$
    - average values:

      average value = $\frac{2}{\pi}$ × maximum value
    - form factor:

      form factor = $\frac{\text{RMS value}}{\text{average value}}$
- AC principles:
  - determination of values using phasor and trigonometric representation of alternating quantities
  - graphical and phasor addition of two sinusoidal voltages
  - reactance and impedance of pure R, L and C components

    $X_C = \frac{1}{2\pi fC}$, $X_L = 2\pi fL$
  - total impedance of an inductor in series with a resistance $z = \sqrt{X_L{}^2 + R^2}$
  - total impedance of a capacitor in series with a resistance $z = \sqrt{X_C{}^2 + R^2}$
  - rectification, including half wave, full wave.

Grade descriptors

To achieve a grade a learner is expected to demonstrate these attributes across the essential content of the unit. The principle of best fit will apply in awarding grades.

Level 3 Pass

Learners are able to use and apply basic electrical, electronic, mechanical and mathematical principles to solve simple and familiar engineering and mathematical problems directly. They can provide responses showing understanding and analysis of basic and familiar engineering problems. They can interpret and analyse diagrams, graphical information and systems, using their knowledge and understanding to solve basic and familiar problems. They can select and implement appropriate basic procedures to provide solutions for given mathematical and engineering situations. They often use appropriate engineering and mathematical terminology and units.

Level 3 Distinction

Learners are able to use and apply advanced electrical, electronic, mechanical and mathematical principles to solve complex and unfamiliar engineering and mathematical problems directly, indirectly and synoptically. They can provide balanced responses showing developed understanding and evaluation of complex familiar and unfamiliar engineering problems. They can interpret and evaluate diagrams, graphical information and systems, using their knowledge and understanding to solve complex familiar and unfamiliar problems. They can select and implement appropriate advanced procedures to provide justified and optimised solutions for given engineering and mathematical situations. They use appropriate and technically accurate engineering and mathematical terminology consistently. Learners can propose solutions to problems, drawing on their knowledge and understanding of electrical, electronic, mechanical and mathematical principles.

Key terms typically used in assessment

The following table shows the key terms that will be used consistently by Pearson in our assessments to ensure students are rewarded for demonstrating the necessary skills.

Please note: the list below will not necessarily be used in every paper/session and is provided for guidance only.

Command or term	Definition
Calculate	Learners judge the number or amount of something by using the information they already have, and add, subtract, multiply, or divide numbers. For example, 'Calculate the reaction forces…'
Convert	Learners will change the form of a measurement to different units without a change of size or amount. For example, 'Convert degrees into radians…'
Draw	Learners make a graphic representation of data by hand (as in a diagram). For example, 'Draw a diagram to represent…'
Describe	Learners give a clear, objective account in their own words showing recall, and in some cases application, of the relevant features and information about a subject. For example, 'Describe mechanical advantage…'

Command or term	Definition
Explain	Learners make something clear or easy to understand by describing or giving information about it. For example, 'Explain one factor affecting…'
Find	Learners discover the facts or truth about something. For example, 'Find the coordinates where…'
Identify	Provide or select an answer from a number of alternatives. For example, 'Identify the unit of measure for the energy loss and identify the definition of…'
Label	Learners affix a label to; mark with a label. For example, 'Label the diagram to show…'
Name	Give the correct term for something.
Solve	Learners find the answer or explanation to a problem. For example, 'Solve the equation to…'
State	Learners declare definitely or specifically. For example, 'State all three conditions for…'

Links to other units

This unit would relate to the teaching of the following and other units:

- Unit 3: Engineering Product Design and Manufacture
- Unit 4: Applied Commercial and Quality Principles in Engineering.

Employer involvement

Centres may involve employers in the delivery of this unit if there are local opportunities. There is no specific guidance related to this unit.

Unit 2: Delivery of Engineering Processes Safely as a Team

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners explore how processes are undertaken by teams to create engineered products or to deliver engineering services safely.

Unit introduction

The use of engineering processes is integral to the manufacture of engineered products and the delivery of engineering services. Thousands of engineering processes are used in the manufacture and service of a complex product, such as an aeroplane. To ensure that these engineering processes can be planned and carried out safely and effectively, engineers must be able to work together to get the job done. It is for this reason that so many engineering companies focus time and effort on understanding engineering processes and developing teamwork.

In this unit, you will examine common engineering processes, including health and safety legislation, regulations that apply to these processes and how individual and team performance can be affected by human factors. You will learn the principles of another important process, engineering drawing, and develop two-dimensional (2D) computer-aided drawing skills while producing orthographic projections and circuit diagrams. Finally, you will work as a team member and team leader to apply a range of practical engineering processes to manufacture a batch of an engineered product or to safely deliver a batch of an engineering service. To complete the assessment task within this unit, you will need to draw on your learning from across your programme.

It is important that engineers understand how engineering processes are used to safely transform ideas and materials into products and services, and how critical it is to be able to work as a valuable member of an effective team or as a team leader. This unit will enable you to apply the knowledge and understanding you gained in *Unit 1: Engineering Principles*. The unit will help to prepare you for an engineering apprenticeship, a higher education engineering degree or a technician-level role in a wide range of specialist engineering areas.

Learning aims

In this unit you will:

A Examine common engineering processes to create products or deliver services safely and effectively as a team

B Develop two-dimensional computer-aided drawings that can be used in engineering processes

C Carry out engineering processes safely to manufacture a product or to deliver a service effectively as a team.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine common engineering processes to create products or deliver services safely and effectively as a team	**A1** Common engineering processes **A2** Health and safety requirements **A3** Human factors affecting the performance of engineering processes	A report, prepared as an individual, detailing engineering processes and the impact that human factors can have on their performance, using a case study based on a given engineered product/ products or a given engineering service/services.
B Develop two-dimensional computer-aided drawings that can be used in engineering processes	**B1** Principles of engineering drawing **B2** 2D computer-aided drawing	Practical activities to be undertaken as an individual to produce 2D computer-aided drawings. The drawings should include an orthographic projection and an electric circuit diagram. The evidence will include the drawings, observation records/witness statements and annotated screenshots.
C Carry out engineering processes safely to manufacture a product or to deliver a service effectively as a team	**C1** Principles of effective teams **C2** Team set-up and organisation **C3** Health and safety risk assessment **C4** Preparation activities for batch manufacture or batch service delivery **C5** Delivery of manufacturing or service engineering processes	Complete practical engineering processes as a leader and as a member of a team. The evidence will include records of team meetings (minutes), activity logs, a risk assessment, set-up planning notes, quality control charts/annotated drawings, modified production plans, annotated photographs of the processes and observation records/witness statements.

Content

Learning aim A: Examine common engineering processes to create products or deliver services safely and effectively as a team

A1 Common engineering processes

- Transforming ideas and materials into products or services, including:
  - preparation processes undertaken before manufacture or service delivery – use of information sources and the creation of technical specifications, engineering drawings, work plans and quality control documentation with due regard to the scale of production (one-off, small batch, large batch, mass or continuous)
  - standards relevant to the specialist area of study – guidelines/rules to ensure conformity in processes or outputs, e.g. BS 8888, reference charts (limits and fits, tapping drills, bend allowances), procedure specifications.
- A product and a service are closely aligned concepts, define:
  - a product as a tangible and discernible item, e.g. a car
  - a service as an intangible benefit, either in its own right or as a significant element of a tangible product, e.g. a car service.
- Common processes used to create engineered products, including:
  - fitting, e.g. at a bench using manual tools (drilling, cutting, filing)
  - machining, e.g. turning, milling, grinding
  - fabrication, e.g. welding, sheet metal work (bending, stamping, punching)
  - electrical, e.g. installation of looms, use of connectors/cables
  - forming, e.g. casting, forging, moulding.
- Common processes used in engineering services, including:
  - disassembly, e.g. use of general tools and special tools to strip or remove
  - inspection, e.g. checking for faults/correct operation, testing
  - systems servicing, e.g. capture of fluid, depressurisation
  - installation/replacement, e.g. rigging, assembly, refitting.

A2 Health and safety requirements

The general contents of legislation and regulations or other relevant international equivalents and how they are satisfied by safe systems of work/procedures, including:

- Current Health and Safety at Work legislation – duties of employers, employees, the Health and Safety Executive (HSE) and others, general prohibitions
- Current Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) – duties of employers, the self-employed and people in control of work premises (the Responsible Person) to report certain serious workplace accidents, occupational diseases and specified dangerous occurrences
- Current Personal Protective Equipment (PPE) at Work Regulations – appropriateness if risk cannot be controlled in any other way, types of PPE, assessing suitable PPE given the hazard, supply, instructions/training, correct use, maintenance and storage
- Current Control of Substances Hazardous to Health Regulations (COSHH) – identifying harmful substances, assessing risks of exposure, types of exposure, safety data sheets, using/checking/maintaining control measures/equipment, training/instruction/information
- Current Manual Handling Operations Regulations (MHOR) – avoiding the need for manual handling, types of hazard, assessing risk of injury when manual handling is required, controlling and reducing the risk of injury, training in the use of techniques/mechanical aids.

A3 Human factors affecting the performance of engineering processes

- Understanding that human factors affect the productivity of processes, including conformance to quality standards, reliability and the safety of individuals.
- Understanding that human factors affect the performance of individuals and teams, including:
  - professionalism – adherence to codes of conduct, acting with due care, skill and diligence by recognising appropriate behaviours and possible limitations, preventing avoidable dangers/adverse impact on the environment, enhancing operational competence
  - ethical principles – rigour, honesty, integrity, respect, responsibility
  - behaviours – values, attitude, persuasion, coercion, rapport, authority
  - limitations – stress, time pressure, fatigue, memory, capability, motivation, knowledge, experience, health, inhibitors, e.g. alcohol and drugs.

Learning aim B: Develop two-dimensional computer-aided drawings that can be used in engineering processes

B1 Principles of engineering drawing

- Attributes of orthographic projections, including:
  - geometry – shape of the component represented as different views, how the component is viewed from various angles, visibility of component features
  - dimensions – size of the component in defined units
  - tolerances – allowable variations for defined dimensions
  - material – what the component is to be made from
  - surface texture – surface quality required, e.g. roughness, flatness
  - scale – relative to actual dimensions.
- Drawing conventions or other relevant international equivalents, including:
  - standards including BS 8888 and BS 60617 or other relevant international equivalents
  - title block/layout – drawing number(s), projection symbols, scale, units, general tolerances, name of author, date, border, parts referencing
  - views – elevation, plan, end, section, hatching style, auxiliary
  - line types – centre, construction, outline, hidden, leader, dimension
  - common features, e.g. screw threads, springs, splines, repeated items, holes, chamfers, radii
  - circuit diagram symbols and components, e.g. cell/battery, switch, resistor, diode, capacitor, transistor, integrated circuit, light-emitting diode (LED), motor, buzzer
  - lettering – titles, notes, annotation
  - abbreviations – A/F, CHAM, DIA, R, PCD, M.

B2 2D computer-aided drawing

Using a computer-aided design (CAD) system to produce engineering drawings and circuit diagrams, including:

- coordinates – absolute, relative, polar
- drawing template – border, title block with all necessary information
- layers – names, line types, colours, visibility
- commands – line, circle, arc, polygon, chamfer, fillet, grid, snap, copy, rotate, erase, stretch, trim, scale, dimensioning, text, pan, zoom-in, zoom-out, insertion and editing commands to produce and erase circuit components and connections
- cross-hatching – simple and complex areas, predefined hatch patterns, application to cross-sectioning.

Learning aim C: Carry out engineering processes safely to manufacture a product or to deliver a service effectively as a team

C1 Principles of effective teams

- Good communication – verbal, written (e.g. electronic documents and data, activity logs, meeting minutes), effective listening, respect for others' opinions, negotiation, assertiveness and non-verbal actions, e.g. smiling.
- Planning – thinking ahead, organisation, consideration of alternatives.
- Motivation – shared goals, collaboration, reaching agreements, adapting behaviour, fairness and consideration, opportunities to take responsibility, constructive feedback.
- Working with others – team player, flexibility/adaptability, social skills, supporting others.
- Working environment – conducive to successful outcomes, safe, supportive, challenging, opportunities to show initiative and leadership.

C2 Team set-up and organisation

- A team is defined as containing three or more individual members who have a shared common objective to complete.
- Strengths and limitations of team members – perceived competencies and constructive peer feedback.
- Allocation of responsibilities – roles, activities.
- Timescales – planning the activities.
- Objectives – team targets.

C3 Health and safety risk assessment

Risk assessment in an engineering workshop and for specific engineering processes, following guidance from the HSE (or other relevant international equivalents), including:

- identification of hazards – bad housekeeping, poor lighting, lack of grip/uneven surfaces/heights, lifting and handling operations, hand tools, machines, substances, heat/flammability
- assessing risk by determining how hazards can cause injury – contact, being struck, lifting and handling injury, fall, slip, trip, trap, exposure
- choosing and using appropriate control measures and precautions to reduce risk – good work area design, substitution, safe means of access and egress, safe system of work (permits to work), periodic inspection, testing and maintenance, physical barriers (guarding), PPE, supervision and training, good housekeeping, cleaning regime
- recording all findings – standard HSE (five steps) pro forma
- reviewing the risk assessment after new equipment/work activities have been undertaken, at regular intervals.

C4 Preparation activities for batch manufacture or batch service delivery

- A batch is defined as a quantity of three or more of a product or service delivered together.
- Understanding the requirements of production plans, specifications, engineering drawings and other technical documentation, including:
  - operations – sequence of production
  - health and safety factors – product or service based
  - processes – disassembly, mechanical, electrical, assembly, testing
  - materials, parts and components – to be disassembled, worked on, processed, joined, assembled and checked
  - equipment – marking out, hand tools, machinery, measuring
  - quality checks – critical production control points, how quality will be checked and inspected.

C5 Delivery of manufacturing or service engineering processes

- For engineered products or engineering services.
- Examples of engineered products, e.g. screwdriver, toolmakers' clamp, fabricated box/enclosure, outside calipers, ball joint splitter, clamp stand, assembling looms.
- Selecting, setting up and using engineering equipment to manufacture engineered products, including:
  - marking out processes, e.g. using a scriber, rule/tape, punch, square, vernier height gauge, marking out medium
  - manual processes, e.g. using shears, punch, guillotine, bender, saw, tap, die, file
  - machining processes, e.g. using a drill, lathe, milling machine
  - assembly processes, e.g. using adhesive, mechanical fasteners, cables/connectors
  - quantity production, e.g. using form tools, template, jig, mould, fixture, stops
  - measuring processes, e.g. using a micrometer, vernier calipers, comparators.
- Examples of engineering services, e.g. dismantling/assembly of alternators, including replacing worn parts and testing, removing and replacing fluid plumbing and checking for leaks, stripping out a variety of hardware and reinstalling/testing, assembly of pipework, including the connection of valves and operational checks, assembly and testing of electrical switch panels.
- Selecting, setting up and using engineering equipment to deliver engineering services, including:
  - disassembly/removal/strip processes, e.g. using a screwdriver, wrench, spanner, sockets, pliers/grips, keys
  - manual processes, e.g. using snips, cutters, knives, punch, saw, file, hammer
  - assembly processes, e.g. using a soldering iron, mechanical fasteners, cables/connectors, crimping tools, pneumatic tools, clamps
  - inspection/testing processes, e.g. using a multimeter, flow meter, torque meter, pressure sensor/gauge.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine common engineering processes to create products or deliver services safely and effectively as a team		**A.D1** Evaluate, using high-quality written language, the effectiveness of using different engineering processes to manufacture a product or to deliver a service and how human factors, as an individual and as a team, affect the performance of engineering processes.
A.P1 Explain how three engineering processes are used safely when manufacturing a given product or when delivering a given service. **A.P2** Explain how human factors, as an individual or as a team, affect the performance of engineering processes.	**A.M1** Analyse why three engineering processes are used to manufacture a product or to deliver a service and how human factors, as an individual and as a team, affect the performance of engineering processes.	
Learning aim B: Develop two-dimensional computer-aided drawings that can be used in engineering processes		**B.D2** Refine, using layers, an accurate orthographic projection of a component containing at least three different common feature types and a circuit diagram containing at least six different component types to an international standard.
B.P3 Create an orthographic projection of a given component containing at least three different feature types. **B.P4** Create a diagram of a given electronic circuit containing at least six different component types.	**B.M2** Produce, using layers, an accurate orthographic projection of a component containing at least three different feature types and a circuit diagram containing at least six different component types that mostly meet an international standard.	
Learning aim C: Carry out engineering processes safely to manufacture a product or to deliver a service effectively as a team		**C.D3** Consistently manage own contributions effectively using feedback from peers, as a team member and as a team leader, to set up, organise and manufacture a product or deliver a service safely, demonstrating forward thinking, adaptability or initiative.
C.P5 Manage own contributions to set up and organise a team in order to manufacture a product or deliver a service. **C.P6** Produce, as an individual team member, a risk assessment of at least one engineering process. **C.P7** Set up, as an individual team member, at least one process safely by interpreting technical documentation. **C.P8** Manage own contributions safely, as a team member and as a team leader, to manufacture a batch of an engineered product or to deliver a batch of an engineering service.	**C.M3** Manage own contributions safely and effectively using feedback from peers, as a team member and as a team leader, to manufacture a product or to deliver a service.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aim: B (B.P3, B.P4, B.M2, B.D2)

Learning aim: C (C.P5, C.P6, C.P7, C.P8, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to:

- a range of technical documentation (such as engineering drawings, production plans, specifications, health and safety regulations), components and circuits
- suitable CAD workstations and output devices, e.g. printers and plotters, and 2D CAD software that is capable of professional 2D drawings and their output, e.g. AutoCAD 2D, AutoCAD Lt, TurboCAD Deluxe, DraftSight
- standard engineering workshop equipment and resources (as specified in the learning aims and unit content section), so learners can carry out common engineering processes to manufacture an engineered product batch or deliver an engineering service as a member of a team.

Essential information for assessment decisions

Learning aim A

The processes to be considered for learning aim A do not have to be the same as those used for learning aim C.

For distinction standard, learners will produce evidence that evaluates the relative merits of using different common engineering processes to manufacture a given product or deliver a given service, by comparing and contrasting the advantages and limitations of the chosen processes and of using other possible processes. Learners will provide detailed and justified reasons as to which processes are most effective, by referring to the specific requirements of the given product or service, for example by considering why a product is cast rather than machined, or whether to test or disassemble at a given interval.

Learners will also produce evidence that shows they can evaluate the impact that a range of human factors, as an individual and as a team, can have on the performance of engineering processes, for example, how coercion by someone in authority could lead to an individual or team introducing unnecessary hazards and risks into the engineering processes.

Overall, the evidence will be easy to read by a third party, who may or may not be an engineer, and will be easily understood. It will be logically structured and will use correct technical engineering terms with a high standard of written language, i.e. consistent use of correct grammar and spelling.

For merit standard, learners will produce evidence that shows they can give detailed reasons as to why three common engineering processes have been chosen to manufacture a given product or to deliver a given service. The analysis will be consistent across all the processes and will include a contextual commentary. For example, for each process it will refer to scale of manufacture, the achievement of accuracy in comparison to a standard, and specific health and safety requirements.

Learners will also produce contextual evidence that shows they can analyse how human factors, as an individual and as a team, can impact on the performance of the three common engineering processes, for example by anticipating and preventing common errors, avoidable dangers or adverse impacts on the environment.

Overall, the analysis should be logically structured, technically accurate and easy to understand.

For pass standard, learners will produce evidence that shows they understand how three common engineering processes are used to manufacture a product or deliver a service. The evidence will be factually accurate and will include clear references to health and safety legislation and regulations, for example how drilling, turning and milling are used to produce a given product/products, or how to dismantle and replace worn parts and test an item using safe working practices and personal protective equipment, including why and how to report a dangerous occurrence during a process.

Learners will also produce evidence that shows they recognise the impact that human factors, either as an individual or as a team, can have on the three common engineering processes, for example the productivity of the processes being affected by an individual's attitude or capability, or safety being affected by fatigue.

Overall, the explanations may be basic in parts and may have some inaccuracies relating to engineering terminology.

Learning aim B

The orthographic drawings must be created on a 2D CAD package and not on a 3D CAD package. The component and electrical circuit to be drawn for learning aim B do not have to be used for learning aims A or C. The drawing should be created from an actual engineered component that must contain at least three different types of common feature. Learners will create the drawings using the knowledge and understanding gained in *Unit 1: Engineering Principles*. For example, taking measures from and performing calculations using the physical component, which could include geometry/vectors, basic arithmetic, trigonometry, and surface area and volume.

For distinction standard, learners will show in their evidence that they used a full range of CAD commands when generating the drawings and prepared and used additional layers as required for the drawing template, dimensioning and annotation.

Overall, all details in the 2D CAD orthographic projection and the electrical circuit diagram must be produced to typically represent the standards found in BS 8888 and BS 60617 (or other relevant international equivalents), with no omissions or errors evident.

For merit standard, learners will show in their evidence that they used a layer for a drawing template with a full title block, border and appropriate text.

Overall, all details in the 2D CAD orthographic projection and the electrical circuit diagram must be produced to typically represent the standards found in BS 8888 and BS 60617 (or other relevant international equivalents), although there may be some minor errors evident, such as the lack of a visible gap between some features of the component and extension lines, or some text that is incorrectly orientated.

For pass standard, learners will produce elevations that are technically correct but there may be some errors, such as a repeated dimension or inaccurate annotation.

Overall, all details in the 2D CAD orthographic projection drawing and the electric circuit diagram must be suitable for a competent third party to manufacture the component or the electric circuit from the drawings.

Learning aim C

Learners will work as a team to deliver an engineering service or to manufacture a product. They will use the knowledge and understanding gained in *Unit 1: Engineering Principles* to undertake and manage a practical service or manufacturing task. During assessment, a team should manufacture a batch of an engineered product or deliver a batch of an engineering service, not both. The choice is likely to be dependent on the sector context and/or the resources available. All planning and manufacturing or service activities should take no more than 15 hours in total. A team should consist of three or four learners and it is expected that the role of team leader will be undertaken by all team members (in rotation) after the initial planning activities. The number of items in a batch, and the number of processes in a product or service, should be between three and six.

Teams should be given a range of technical documentation (such as engineering drawings, production plans and specifications) prior to the manufacture of a batch of an engineered product or the delivery of a batch of an engineering service. Materials can be prepared and engineering equipment can be laid out prior to team activities, but each learner must set up and undertake at least one engineering process.

For distinction standard, learners will consistently demonstrate at least one of the following traits during the planning and manufacturing or service activities: forward thinking, adaptability or initiative. For example, learners may respond to opportunities as they arise by convincing the team to adopt a more efficient approach to the manufacturing or service activities, or a different approach if a lack of equipment or resources demands it, or they may adapt to circumstances quickly by providing feedback to team members or by coaching others who are struggling with an activity or process. Learners may also prove their capability to adapt a process and/or machines to manufacture quantities of a product, for example by setting stops or by using simple techniques to process components at the same time. Similar approaches could be used in the delivery of a batch of an engineering service.

Learners will show their ability to objectively review team targets at suitable points and reach agreements with other team members as to an appropriate way forward given current progress.

Overall, the evidence should be presented clearly and in a way that would be understood by a third party who may or may not be an engineer.

For merit standard, learners will demonstrate an active role in making decisions concerning the allocation of roles and responsibilities, time planning and setting team targets, for example by explicitly taking into account the preferences and perceived strengths of team members.

Learners will produce a risk assessment, which will be laid out on an appropriate industry-standard template and will include detailed attention to all five steps, for example clear identification of all significant hazards, who might be harmed and how, current precautions in place, further control measures needed and a suitable time period until review.

Learners will interpret technical documentation to set up safely and effectively at least one engineering process, for example, so that others in the team could also carry out the process with minimal explanation required.

During the delivery of manufacturing or service processes, learners will show that they can work effectively as a team member and as a team leader to make effective progress towards team targets. For example, they will modify their approach based on feedback from peers and will generate a progress log to allow team members to quickly review progress.

Overall, the evidence will be clear, but some parts of it may be presented in an inconsistent fashion, making it more difficult for a third party to understand.

For pass standard, learners will manage their contribution to making decisions concerning the allocation of roles and responsibilities, time planning and setting team targets. These activities will be completed as a minimum to set up and organise the team to manufacture a batch of an engineered product or to deliver a batch of an engineered service.

It will be essential to ensure that each team member has clear responsibilities and that everyone makes a contribution to the end result during the manufacture of a batch of an engineered product or the delivery of a batch of an engineering service. All individual team members must be clear about who is responsible and accountable for each aspect of the work, and team targets should be set and reviewed. To facilitate this, each team must carry out a series of meetings both prior to and during the manufacture of a batch of an engineered product or the delivery of a batch of an engineering service. Each member of the team must produce their own evidence against the assessment criteria, as evidence cannot be shared.

Learners will produce their own risk assessment to show how health and safety is managed in the engineering workplace, for at least one engineering process to be used when manufacturing the engineered product or when delivering the engineering service. The risk assessment should consider the most significant hazards with details of suitable control measures and be laid out on an appropriate industry-standard template. It will be appropriate, but may lack detail. For example, it may focus on the more obvious hazards and control measures, including those already in place.

Learners will also interpret technical documentation, including a production plan and an engineering drawing given to them, to set up safely at least one engineering process, for example, so that they can carry out the process in a consistent manner.

During the delivery of manufacturing or service processes, learners will show that they can act independently as a team member and as a team leader to make progress towards team targets, although learners may demonstrate some reluctance to adapt to changing circumstances. The products or services delivered by the team do not have to be accurate and do not need to be tested for functionality, but teams must keep quality records. For example, the dimensions of a hole would be checked for conformance against the technical documentation and notes would be made on the outcome of the quality check. Also, teams do not need to rework any non-conforming product or service outcomes.

Overall, the evidence will be logically structured but may be imprecise and basic in some parts, meaning that only a third party with technical knowledge can understand aspects of it.

Links to other units

In the Certificate (180 GLH) qualification this unit should be completed towards the end of the programme. In order to complete the synoptic assessment task in this unit, learners should select and apply relevant knowledge and skills from other areas of the mandatory content. Learners should build on their knowledge of engineering approaches and their applications from *Unit 1: Engineering Principles*.

Employer involvement

Centres may involve employers in the delivery of this unit if there are local opportunities. There is no specific guidance related to this unit.

4 Planning your programme

How do I choose the right BTEC National qualification for my learners?

BTEC Nationals come in a range of sizes, each with a specific purpose. You will need to assess learners very carefully to ensure that they start on the right size of qualification to fit into their 16–19 study programme, and that they take the right pathways or optional units that allow them to progress to the next stage.

If a learner is clear that they want to progress to the workplace, they should be directed towards an occupationally-specific qualification, such as a BTEC National Diploma, from the outset.

Some learners may want to take a number of complementary qualifications or keep their progression options open. These learners may be suited to taking a BTEC National Certificate or Extended Certificate. Learners who then decide to continue with a fuller vocational programme can transfer to a BTEC National Diploma or Extended Diploma, for example for their second year.

Some learners are sure of the sector they want to work in and are aiming for progression into that sector via higher education. These learners should be directed to the two-year BTEC National Extended Diploma as the most suitable qualification.

As a centre, you may want to teach learners who are taking different qualifications together. You may also wish to transfer learners between programmes to meet changes in their progression needs. You should check the qualification structures and unit combinations carefully as there is no exact match among the different sizes. You may find that learners need to complete more than the minimum number of units when transferring.

When learners are recruited, you need to give them accurate information on the title and focus of the qualification for which they are studying.

Is there a learner entry requirement?

As a centre it is your responsibility to ensure that learners who are recruited have a reasonable expectation of success on the programme. There are no formal entry requirements but we expect learners to have qualifications at or equivalent to Level 2.

Learners are most likely to succeed if they have:

- five GCSEs at good grades and/or
- BTEC qualification(s) at Level 2
- achievement in English and mathematics through GCSE or Functional Skills.

Learners may demonstrate ability to succeed in various ways. For example, learners may have relevant work experience or specific aptitude shown through diagnostic tests or non-educational experience.

What is involved in becoming an approved centre?

All centres must be approved before they can offer these qualifications – so that they are ready to assess learners and so that we can provide the support that is needed. Further information is given in *Section 8*.

What level of sector knowledge is needed to teach these qualifications?

We do not set any requirements for teachers but recommend that centres assess the overall skills and knowledge of the teaching team to ensure that they are relevant and up to date. This will give learners a rich programme to prepare them for employment in the sector.

What resources are required to deliver these qualifications?

As part of your centre approval you will need to show that the necessary material resources and work spaces are available to deliver BTEC Nationals. For some units, specific resources are required. This is indicated in the units.

Which modes of delivery can be used for these qualifications?

You are free to deliver BTEC Nationals using any form of delivery that meets the needs of your learners. We recommend making use of a wide variety of modes, including direct instruction in classrooms or work environments, investigative and practical work, group and peer work, private study and e-learning.

What are the recommendations for employer involvement?

BTEC Nationals are vocational qualifications and, as an approved centre, you are encouraged to work with employers on the design, delivery and assessment of the course to ensure that learners have a programme of study that is engaging and relevant and that equips them for progression. There are suggestions in many of the units about how employers could become involved in delivery and/or assessment but these are not intended to be exhaustive and there will be other possibilities at local level.

What support is available?

We provide a wealth of support materials, including curriculum plans, delivery guides, authorised assignment briefs, additional papers for external assessments and examples of marked learner work.

You will be allocated a Standards Verifier early on in the planning stage to support you with planning your assessments. There will be extensive training programmes as well as support from our Subject Advisor team.

For further details see *Section 10*.

How will my learners become more employable through these qualifications?

All BTEC Nationals are mapped to relevant occupational standards (see *Appendix 1*).

Employability skills, such as teamwork and entrepreneurialism, and practical hands-on skills have been built into the design of the learning aims and content. This gives you the opportunity to use relevant contexts, scenarios and materials to enable learners to develop a portfolio of evidence that demonstrates the breadth of their skills and knowledge in a way that equips them for employment.

5 Assessment structure and external assessment

Introduction

BTEC Nationals are assessed using a combination of *internal assessments*, which are set and marked by teachers, and *external assessments* which are set and marked by Pearson:

- mandatory units have a combination of internal and external assessments
- all optional units are internally assessed.

We have taken great care to ensure that the assessment method chosen is appropriate to the content of the unit and in line with requirements from employers and higher education.

In developing an overall plan for delivery and assessment for the programme, you will need to consider the order in which you deliver units, whether delivery is over short or long periods and when assessment can take place. Some units are defined as synoptic units (see *Section 2*). Normally, a synoptic assessment is one that a learner would take later in a programme and in which they will be expected to apply learning from a range of units. Synoptic units may be internally or externally assessed. Where a unit is externally assessed you should refer to the sample assessment materials (SAMs) to identify where there is an expectation that learners draw on their wider learning. For internally-assessed units, you must plan the assignments so that learners can demonstrate learning from across their programme. A unit may be synoptic in one qualification and not another because of the relationship it has to the rest of the qualification.

We have addressed the need to ensure that the time allocated to final assessment of internal and external units is reasonable so that there is sufficient time for teaching and learning, formative assessment and development of transferable skills.

In administering internal and external assessment, the centre needs to be aware of the specific procedures and policies that apply, for example to registration, entries and results. An overview with signposting to relevant documents is given in *Section 7*.

Internal assessment

Our approach to internal assessment for these qualifications will be broadly familiar to experienced centres. It offers flexibility in how and when you assess learners, provided that you meet assessment and quality assurance requirements. You will need to take account of the requirements of the unit format, which we explain in *Section 3*, and the requirements for delivering assessment given in *Section 6*.

External assessment

A summary of the external assessment for this qualification is given in *Section 2*. You should check this information carefully, together with the unit specification and the sample assessment materials, so that you can timetable learning and assessment periods appropriately.

Learners must be prepared for external assessment by the time they undertake it. In preparing learners for assessment, you will want to take account of required learning time, the relationship with other external assessments and opportunities for retaking. You should ensure that learners are not entered for unreasonable amounts of external assessment in one session. Learners may resit an external assessment to obtain a higher grade of near pass or above. If a learner has more than one attempt, then the best result will be used for qualification grading, up to the permitted maximum. It is unlikely that learners will need to or benefit from taking all assessments twice so you are advised to plan appropriately. Some assessments are synoptic and learners are likely to perform best if these assessments are taken towards the end of the programme.

Key features of external assessment in engineering

In engineering, after consultation with stakeholders, we have developed the following.

- Unit 1: Engineering Principles – the knowledge and understanding contained in the unit can be reliably and validly assessed through an external exam and covers both mechanical and electrical/electronic principles. Learners are expected to solve a range of problems as 'multi-skilled' engineers. The range of content covered and the rigor of this assessment approach is approved by industry and higher education.

Units

The externally-assessed unit has a specific format which we explain in *Section 3*. The content of the unit will be sampled across external assessments over time through appropriate papers and tasks. The ways in which learners are assessed are shown through the assessment outcomes and grading descriptors. External assessments are marked and awarded using the grade descriptors. The grades available are Distinction (D), Merit (M), Pass (P) and Near Pass (N). The Near Pass (N) grade gives learners credit below a Pass, where they have demonstrated evidence of positive performance which is worth more than an unclassified result but not yet at the Pass standard.

Sample assessment materials

The externally-assessed unit has a set of sample assessment materials (SAMs) that accompanies this specification. The SAMs are there to give you an example of what the external assessment will look like in terms of the feel and level of demand of the assessment. In the case of units containing synoptic assessment, the SAMs will also show where learners are expected to select and apply from across the programme.

The SAMs show the range of possible question types that may appear in the actual assessments and give you a good indication of how the assessments will be structured. While SAMs can be used for practice with learners, as with any assessment the content covered and specific details of the questions asked will change in each assessment.

A copy of each of these assessments can be downloaded from our website. An additional sample of each of the Pearson-set units will be available before the first sitting of the assessment to allow your learners further opportunities for practice.

6 Internal assessment

This section gives an overview of the key features of internal assessment and how you, as an approved centre, can offer it effectively. The full requirements and operational information are given in the *Pearson Quality Assurance Handbook*. All members of the assessment team need to refer to this document.

For BTEC Nationals it is important that you can meet the expectations of stakeholders and the needs of learners by providing a programme that is practical and applied. Centres can tailor programmes to meet local needs and use links with local employers and the wider vocational sector.

When internal assessment is operated effectively it is challenging, engaging, practical and up to date. It must also be fair to all learners and meet national standards.

Principles of internal assessment

Assessment through assignments

For internally-assessed units, the format of assessment is an assignment taken after the content of the unit, or part of the unit if several assignments are used, has been delivered. An assignment may take a variety of forms, including practical and written types. An assignment is a distinct activity completed independently by learners that is separate from teaching, practice, exploration and other activities that learners complete with direction from, and formative assessment by, teachers.

An assignment is issued to learners as an assignment brief with a defined start date, a completion date and clear requirements for the evidence that they need to provide. There may be specific observed practical components during the assignment period. Assignments can be divided into tasks and may require several forms of evidence. A valid assignment will enable a clear and formal assessment outcome based on the assessment criteria.

Assessment decisions through applying unit-based criteria

Assessment decisions for BTEC Nationals are based on the specific criteria given in each unit and set at each grade level. To ensure that standards are consistent in the qualification and across the suite as a whole, the criteria for each unit have been defined according to a framework. The way in which individual units are written provides a balance of assessment of understanding, practical skills and vocational attributes appropriate to the purpose of qualifications.

The assessment criteria for a unit are hierarchical and holistic. For example, if an M criterion requires the learner to show 'analysis' and the related P criterion requires the learner to 'explain', then to satisfy the M criterion a learner will need to cover both 'explain' and 'analyse'. The unit assessment grid shows the relationships among the criteria so that assessors can apply all the criteria to the learner's evidence at the same time. In *Appendix 2* we have set out a definition of terms that assessors need to understand.

Assessors must show how they have reached their decisions using the criteria in the assessment records. When a learner has completed all the assessment for a unit then the assessment team will give a grade for the unit. This is given simply according to the highest level for which the learner is judged to have met all the criteria. Therefore:

- to achieve a Distinction, a learner must have satisfied all the Distinction criteria (and therefore the Pass and Merit criteria); these define outstanding performance across the unit as a whole
- to achieve a Merit, a learner must have satisfied all the Merit criteria (and therefore the Pass criteria) through high performance in each learning aim
- to achieve a Pass, a learner must have satisfied all the Pass criteria for the learning aims, showing coverage of the unit content and therefore attainment at Level 3 of the national framework.

The award of a Pass is a defined level of performance and cannot be given solely on the basis of a learner completing assignments. Learners who do not satisfy the Pass criteria should be reported as Unclassified.

The assessment team

It is important that there is an effective team for internal assessment. There are three key roles involved in implementing assessment processes in your centre, each with different interrelated responsibilities, the roles are listed below. Full information is given in the *Pearson Quality Assurance Handbook*.

- The Lead Internal Verifier (the Lead IV) has overall responsibility for the programme, its assessment and internal verification to meet our requirements, record keeping and liaison with the Standards Verifier. The Lead IV registers with Pearson annually. The Lead IV acts as an assessor, supports the rest of the assessment team, makes sure that they have the information they need about our assessment requirements and organises training, making use of our guidance and support materials.
- Internal Verifiers (IVs) oversee all assessment activity in consultation with the Lead IV. They check that assignments and assessment decisions are valid and that they meet our requirements. IVs will be standardised by working with the Lead IV. Normally, IVs are also assessors but they do not verify their own assessments.
- Assessors set or use assignments to assess learners to national standards. Before taking any assessment decisions, assessors participate in standardisation activities led by the Lead IV. They work with the Lead IV and IVs to ensure that the assessment is planned and carried out in line with our requirements.

Effective organisation

Internal assessment needs to be well organised so that the progress of learners can be tracked and so that we can monitor that assessment is being carried out in line with national standards. We support you through, for example, providing training materials and sample documentation.

It is particularly important that you manage the overall assignment programme and deadlines to make sure that learners are able to complete assignments on time.

Learner preparation

To ensure that you provide effective assessment for your learners, you need to make sure that they understand their responsibilities for assessment and the centre's arrangements.

From induction onwards, you will want to ensure that learners are motivated to work consistently and independently to achieve the requirements of the qualifications. Learners need to understand how assignments are used, the importance of meeting assignment deadlines, and that all the work submitted for assessment must be their own.

You will need to give learners a guide that explains how assignments are used for assessment, how assignments relate to the teaching programme, and how learners should use and reference source materials, including what would constitute plagiarism. The guide should also set out your approach to operating assessment, such as how learners must submit work and request extensions.

Setting effective assignments

Setting the number and structure of assignments

In setting your assignments, you need to work with the structure of assignments shown in the *Essential information for assignments* section of a unit. This shows the structure of the learning aims and criteria that you must follow and the recommended number of assignments that you should use. For some units we provide authorised assignment briefs, for all the units we give you suggestions on how to create suitable assignments. You can find these materials along with this specification on our website. In designing your own assignment briefs you should bear in mind the following points.

- The number of assignments for a unit must not exceed the number shown in *Essential information for assignments*. However, you may choose to combine assignments, for example to create a single assignment for the whole unit.
- You may also choose to combine all or parts of different units into single assignments, provided that all units and all their associated learning aims are fully addressed in the programme overall. If you choose to take this approach, you need to make sure that learners are fully prepared so that they can provide all the required evidence for assessment and that you are able to track achievement in the records.
- A learning aim must always be assessed as a whole and must not be split into two or more tasks.
- The assignment must be targeted to the learning aims but the learning aims and their associated criteria are not tasks in themselves. Criteria are expressed in terms of the outcome shown in the evidence.
- You do not have to follow the order of the learning aims of a unit in setting assignments but later learning aims often require learners to apply the content of earlier learning aims and they may require learners to draw their learning together.
- Assignments must be structured to allow learners to demonstrate the full range of achievement at all grade levels. Learners need to be treated fairly by being given the opportunity to achieve a higher grade if they have the ability.
- As assignments provide a final assessment, they will draw on the specified range of teaching content for the learning aims. The specified content is compulsory. The evidence for assessment need not cover every aspect of the teaching content as learners will normally be given particular examples, case studies or contexts in their assignments. For example, if a learner is carrying out one practical performance, or an investigation of one organisation, then they will address all the relevant range of content that applies in that instance.

Providing an assignment brief

A good assignment brief is one that, through providing challenging and realistic tasks, motivates learners to provide appropriate evidence of what they have learned.

An assignment brief should have:

- a vocational scenario, this could be a simple situation or a full, detailed set of vocational requirements that motivates the learner to apply their learning through the assignment
- clear instructions to the learner about what they are required to do, normally set out through a series of tasks
- an audience or purpose for which the evidence is being provided
- an explanation of how the assignment relates to the unit(s) being assessed.

Forms of evidence

BTEC Nationals have always allowed for a variety of forms of evidence to be used, provided that they are suited to the type of learning aim being assessed. For many units, the practical demonstration of skills is necessary and for others, learners will need to carry out their own research and analysis. The units give you information on what would be suitable forms of evidence to provide learners with the opportunity to apply a range of employability or transferable skills. Centres may choose to use different suitable forms for evidence to those proposed. Overall, learners should be assessed using varied forms of evidence.

Full definitions of types of assessment are given in *Appendix 2*. These are some of the main types of assessment:

- written reports
- projects
- time-constrained practical assessments with observation records and supporting evidence
- recordings of performance
- sketchbooks, working logbooks, reflective journals
- presentations with assessor questioning.

The form(s) of evidence selected must:

- allow the learner to provide all the evidence required for the learning aim(s) and the associated assessment criteria at all grade levels
- allow the learner to produce evidence that is their own independent work
- allow a verifier to independently reassess the learner to check the assessor's decisions.

For example, when you are using performance evidence, you need to think about how supporting evidence can be captured through recordings, photographs or task sheets.

Centres need to take particular care that learners are enabled to produce independent work. For example, if learners are asked to use real examples, then best practice would be to encourage them to use their own or to give the group a number of examples that can be used in varied combinations.

Making valid assessment decisions

Authenticity of learner work

Once an assessment has begun, learners must not be given feedback on progress towards fulfilling the targeted criteria.

An assessor must assess only learner work that is authentic, i.e. learners' own independent work. Learners must authenticate the evidence that they provide for assessment through signing a declaration stating that it is their own work.

Assessors must ensure that evidence is authentic to a learner through setting valid assignments and supervising them during the assessment period. Assessors must take care not to provide direct input, instructions or specific feedback that may compromise authenticity.

Assessors must complete a declaration that:

- the evidence submitted for this assignment is the learner's own
- the learner has clearly referenced any sources used in the work
- they understand that false declaration is a form of malpractice.

Centres can use Pearson templates or their own templates to document authentication.

During assessment, an assessor may suspect that some or all of the evidence from a learner is not authentic. The assessor must then take appropriate action using the centre's policies for malpractice. Further information is given in *Section 7*.

Making assessment decisions using criteria

Assessors make judgements using the criteria. The evidence from a learner can be judged using all the relevant criteria at the same time. The assessor needs to make a judgement against each criterion that evidence is present and sufficiently comprehensive. For example, the inclusion of a concluding section may be insufficient to satisfy a criterion requiring 'evaluation'.

Assessors should use the following information and support in reaching assessment decisions:

- the *Essential information for assessment decisions* section in each unit gives examples and definitions related to terms used in the criteria
- the explanation of key terms in *Appendix 2*
- examples of assessed work provided by Pearson
- your Lead IV and assessment team's collective experience, supported by the standardisation materials we provide.

Pass and Merit criteria relate to individual learning aims. The Distinction criteria as a whole relate to outstanding performance across the unit. Therefore, criteria may relate to more than one learning aim (for example A.D1) or to several learning aims (for example DE.D3). Distinction criteria make sure that learners have shown that they can perform consistently at an outstanding level across the unit and/or that they are able to draw learning together across learning aims.

Dealing with late completion of assignments

Learners must have a clear understanding of the centre policy on completing assignments by the deadlines that you give them. Learners may be given authorised extensions for legitimate reasons, such as illness at the time of submission, in line with your centre policies.

For assessment to be fair, it is important that learners are all assessed in the same way and that some learners are not advantaged by having additional time or the opportunity to learn from others. Therefore, learners who do not complete assignments by your planned deadline or the authorised extension deadline may not have the opportunity to subsequently resubmit.

If you accept a late completion by a learner, then the assignment should be assessed normally when it is submitted using the relevant assessment criteria.

Issuing assessment decisions and feedback

Once the assessment team has completed the assessment process for an assignment, the outcome is a formal assessment decision. This is recorded formally and reported to learners.

The information given to the learner:

- must show the formal decision and how it has been reached, indicating how or where criteria have been met
- may show why attainment against criteria has not been demonstrated
- must not provide feedback on how to improve evidence
- must be validated by an IV before it is given to the learner.

Resubmission of improved evidence

An assignment provides the final assessment for the relevant learning aims and is normally a final assessment decision, except where the Lead IV approves one opportunity to resubmit improved evidence based on the completed assignment brief.

The Lead IV has the responsibility to make sure that resubmission is operated fairly. This means:

- checking that a learner can be reasonably expected to perform better through a second submission, for example that the learner has not performed as expected
- making sure that giving a further opportunity can be done in such a way that it does not give an unfair advantage over other learners, for example through the opportunity to take account of feedback given to other learners
- checking that the assessor considers that the learner will be able to provide improved evidence without further guidance and that the original evidence submitted remains valid.

Once an assessment decision has been given to the learner, the resubmission opportunity must have a deadline within 15 working days in the same academic year.

A resubmission opportunity must not be provided where learners:

- have not completed the assignment by the deadline without the centre's agreement
- have submitted work that is not authentic.

Retake of internal assessment

A learner who has not achieved the level of performance required to pass the relevant learning aims after resubmission of an assignment may be offered a single retake opportunity using a new assignment. The retake may only be achieved at a pass.

The Lead Internal Verifier must only authorise a retake of an assignment in exceptional circumstances where they believe it is necessary, appropriate and fair to do so. For further information on offering a retake opportunity, you should refer to the *BTEC Centre Guide to Assessment*. We provide information on writing assignments for retakes on our website (www.btec.co.uk/keydocuments).

Planning and record keeping

For internal processes to be effective, an assessment team needs to be well organised and keep effective records. The centre will also work closely with us so that we can quality assure that national standards are being satisfied. This process gives stakeholders confidence in the assessment approach.

The Lead IV must have an assessment plan, produced as a spreadsheet. When producing a plan, the assessment team may wish to consider:

- the time required for training and standardisation of the assessment team
- the time available to undertake teaching and carry out assessment, taking account of when learners may complete external assessments and when quality assurance will take place
- the completion dates for different assignments
- who is acting as IV for each assignment and the date by which the assignment needs to be verified
- setting an approach to sampling assessor decisions though internal verification that covers all assignments, assessors and a range of learners
- how to manage the assessment and verification of learners' work so that they can be given formal decisions promptly
- how resubmission opportunities can be scheduled.

The Lead IV will also maintain records of assessment undertaken. The key records are:

- verification of assignment briefs
- learner authentication declarations
- assessor decisions on assignments, with feedback given to learners
- verification of assessment decisions.

Examples of records and further information are given in the *Pearson Quality Assurance Handbook.*

7 Administrative arrangements

Introduction

This section focuses on the administrative requirements for delivering a BTEC qualification. It will be of value to Quality Nominees, Lead IVs, Programme Leaders and Examinations Officers.

Learner registration and entry

Shortly after learners start the programme of learning, you need to make sure that they are registered for the qualification and that appropriate arrangements are made for internal and external assessment. You need to refer to the *Information Manual* for information on making registrations for the qualification and entries for external assessments.

Learners can be formally assessed only for a qualification on which they are registered. If learners' intended qualifications change, for example if a learner decides to choose a different pathway specialism, then the centre must transfer the learner appropriately.

Access to assessment

Both internal and external assessments need to be administered carefully to ensure that all learners are treated fairly, and that results and certification are issued on time to allow learners to progress to chosen progression opportunities.

Our equality policy requires that all learners should have equal opportunity to access our qualifications and assessments, and that our qualifications are awarded in a way that is fair to every learner. We are committed to making sure that:

- learners with a protected characteristic are not, when they are undertaking one of our qualifications, disadvantaged in comparison to learners who do not share that characteristic
- all learners achieve the recognition they deserve for undertaking a qualification and that this achievement can be compared fairly to the achievement of their peers.

Further information on access arrangements can be found in the Joint Council for Qualifications (JCQ) document *Access Arrangements, Reasonable Adjustments and Special Consideration for General and Vocational Qualifications*.

Administrative arrangements for internal assessment

Records

You are required to retain records of assessment for each learner. Records should include assessments taken, decisions reached and any adjustments or appeals. Further information can be found in the *Information Manual.* We may ask to audit your records so they must be retained as specified.

Reasonable adjustments to assessment

A reasonable adjustment is one that is made before a learner takes an assessment to ensure that they have fair access to demonstrate the requirements of the assessments. You are able to make adjustments to internal assessments to take account of the needs of individual learners. In most cases this can be achieved through a defined time extension or by adjusting the format of evidence. We can advise you if you are uncertain as to whether an adjustment is fair and reasonable. You need to plan for time to make adjustments if necessary.

Further details on how to make adjustments for learners with protected characteristics are given on our website in the document *Supplementary guidance for reasonable adjustment and special consideration in vocational internally-assessed units*.

Special consideration

Special consideration is given after an assessment has taken place for learners who have been affected by adverse circumstances, such as illness. You must operate special consideration in line with our policy (see previous paragraph). You can provide special consideration related to the period of time given for evidence to be provided or for the format of the assessment if it is equally valid. You may not substitute alternative forms of evidence to that required in a unit, or omit the application of any assessment criteria to judge attainment. Pearson can consider applications for special consideration in line with the policy.

Appeals against assessment

Your centre must have a policy for dealing with appeals from learners. These appeals may relate to assessment decisions being incorrect or assessment not being conducted fairly. The first step in such a policy could be a consideration of the evidence by a Lead IV or other member of the programme team. The assessment plan should allow time for potential appeals after assessment decisions have been given to learners. If there is an appeal by a learner, you must document the appeal and its resolution. Learners have a final right of appeal to Pearson but only if the procedures that you have put in place have not been followed. Further details are given in the document *Enquiries and appeals about Pearson vocational qualifications and end point assessment policy*.

Administrative arrangements for external assessment

Entries and resits

For information on the timing of assessment and entries, please refer to the annual examinations timetable on our website.

Access arrangements requests

Access arrangements are agreed with Pearson before an assessment. They allow students with special educational needs, disabilities or temporary injuries to:

- access the assessment
- show what they know and can do without changing the demands of the assessment.

Access arrangements should always be processed at the time of registration. Learners will then know what type of arrangements are available in place for them.

Granting reasonable adjustments

For external assessment, a reasonable adjustment is one that we agree to make for an individual learner. A reasonable adjustment is defined for the individual learner and informed by the list of available access arrangements.

Whether an adjustment will be considered reasonable will depend on a number of factors, to include:

- the needs of the learner with the disability
- the effectiveness of the adjustment
- the cost of the adjustment; and
- the likely impact of the adjustment on the learner with the disability and other learners.

Adjustment may be judged unreasonable and not approved if it involves unreasonable costs, timeframes or affects the integrity of the assessment.

Special consideration requests

Special consideration is an adjustment made to a student's mark or grade after an external assessment to reflect temporary injury, illness or other indisposition at the time of the assessment. An adjustment is made only if the impact on the learner is such that it is reasonably likely to have had a material effect on that learner being able to demonstrate attainment in the assessment.

Centres are required to notify us promptly of any learners who they believe have been adversely affected and request that we give special consideration. Further information can be found in the special requirements section on our website.

Conducting external assessments

Centres must make arrangements for the secure delivery of external assessments. External assessments for BTEC qualifications include examinations, set tasks and performance.

Each external assessment has a defined degree of control under which it must take place. Some external assessments may have more than one part and each part may have a different degree of control. We define degrees of control as follows.

High control

This is the completion of assessment in formal invigilated examination conditions.

Medium control

This is completion of assessment, usually over a longer period of time, which may include a period of controlled conditions. The controlled conditions may allow learners to access resources, prepared notes or the internet to help them complete the task.

Low control

These are activities completed without direct supervision. They may include research, preparation of materials and practice. The materials produced by learners under low control will not be directly assessed.

Further information on responsibilities for conducting external assessment is given in the document *Instructions for Conducting External Assessments*, available on our website.

Dealing with malpractice in assessment

Malpractice means acts that undermine the integrity and validity of assessment, the certification of qualifications, and/or that may damage the authority of those responsible for delivering the assessment and certification.

Pearson does not tolerate actions (or attempted actions) of malpractice by learners, centre staff or centres in connection with Pearson qualifications. Pearson may impose penalties and/or sanctions on learners, centre staff or centres where incidents (or attempted incidents) of malpractice have been proven.

Malpractice may arise or be suspected in relation to any unit or type of assessment within the qualification. For further details regarding malpractice and advice on preventing malpractice by learners, please see Pearson's *Centre guidance: Dealing with malpractice and maladministration in vocational qualifications*, available on our website.

The procedures we ask you to adopt vary between units that are internally assessed and those that are externally assessed.

Internally-assessed units

Centres are required to take steps to prevent malpractice and to investigate instances of suspected malpractice. Learners must be given information that explains what malpractice is for internal assessment and how suspected incidents will be dealt with by the centre. The *Centre Guidance: Dealing with Malpractice* document gives full information on the actions we expect you to take.

Pearson may conduct investigations if we believe that a centre is failing to conduct internal assessment according to our policies. The above document gives further information, examples and details the penalties and sanctions that may be imposed.

In the interests of learners and centre staff, centres need to respond effectively and openly to all requests relating to an investigation into an incident of suspected malpractice.

Externally-assessed units

External assessment means all aspects of units that are designated as external in this specification, including preparation for tasks and performance. For these assessments, centres must follow the JCQ procedures set out in the latest version of *JCQ Suspected Malpractice in Examinations and Assessments Policies and Procedures* (www.jcq.org.uk).

In the interests of learners and centre staff, centres need to respond effectively and openly to all requests relating to an investigation into an incident of suspected malpractice.

Learner malpractice

Heads of Centres are required to report incidents of any suspected learner malpractice that occur during Pearson external assessments. We ask that centres do so by completing a *JCQ Form M1* (available at www.jcq.org.uk/exams-office/malpractice) and emailing it and any accompanying documents (signed statements from the learner, invigilator, copies of evidence, etc.) to the Investigations Team at candidatemalpractice@pearson.com. The responsibility for determining appropriate sanctions or penalties to be imposed on learners lies with Pearson.

Learners must be informed at the earliest opportunity of the specific allegation and the centre's malpractice policy, including the right of appeal. Learners found guilty of malpractice may be disqualified from the qualification for which they have been entered with Pearson.

Teacher/centre malpractice

Heads of Centres are required to inform Pearson's Investigations Team of any incident of suspected malpractice by centre staff, before any investigation is undertaken. Heads of centres are requested to inform the Investigations Team by submitting a *JCQ Form M2(a)* (available at www.jcq.org.uk/exams-office/malpractice) with supporting documentation to pqsmalpractice@pearson.com. Where Pearson receives allegations of malpractice from other sources (for example Pearson staff or anonymous informants), the Investigations Team will conduct the investigation directly or may ask the head of centre to assist.

Incidents of maladministration (accidental errors in the delivery of Pearson qualifications that may affect the assessment of learners) should also be reported to the Investigations Team using the same method.

Heads of Centres/Principals/Chief Executive Officers or their nominees are required to inform learners and centre staff suspected of malpractice of their responsibilities and rights; see Section 6.15 of the *JCQ Suspected Malpractice in Examinations and Assessments Policies and Procedures* document.

Pearson reserves the right in cases of suspected malpractice to withhold the issuing of results and/or certificates while an investigation is in progress. Depending on the outcome of the investigation results and/or certificates may be released or withheld.

You should be aware that Pearson may need to suspend certification when undertaking investigations, audits and quality assurances processes. You will be notified within a reasonable period of time if this occurs.

Sanctions and appeals

Where malpractice is proven we may impose sanctions or penalties.

Where learner malpractice is evidenced, penalties may be imposed such as:

- mark reduction for external assessments
- disqualification from the qualification
- being barred from registration for Pearson qualifications for a period of time.

If we are concerned about your centre's quality procedures we may impose sanctions such as:

- working with you to create an improvement action plan
- requiring staff members to receive further training
- placing temporary blocks on your certificates
- placing temporary blocks on registration of learners
- debarring staff members or the centre from delivering Pearson qualifications
- suspending or withdrawing centre approval status.

The centre will be notified if any of these apply.

Pearson has established procedures for centres that are considering appeals against penalties and sanctions arising from malpractice. Appeals against a decision made by Pearson will normally be accepted only from Heads of Centres (on behalf of learners and/or members of staff) and from individual members (in respect of a decision taken against them personally). Further information on appeals can be found in our *Enquiries and appeals about Pearson vocational qualifications and end point assessment policy*, which is on our website. In the initial stage of any aspect of malpractice, please notify the Investigations Team by email via pqsmalpractice@pearson.com who will inform you of the next steps.

Certification and results

Once a learner has completed all the required components for a qualification, even if final results for external assessments have not been issued, then the centre can claim certification for the learner, provided that quality assurance has been successfully completed. For the relevant procedures please refer to our *Information Manual*. You can use the information provided on qualification grading to check overall qualification grades.

Results issue

After the external assessment session, learner results will be issued to centres. The result will be in the form of a grade. You should be prepared to discuss performance with learners, making use of the information we provide and post-results services.

Post-assessment services

Once results for external assessments are issued, you may find that the learner has failed to achieve the qualification or to attain an anticipated grade. It is possible to transfer or reopen registration in some circumstances. The *Information Manual* gives further information.

Changes to qualification requests

Where a learner who has taken a qualification wants to resit an externally-assessed unit to improve their qualification grade, you firstly need to decline their overall qualification grade. You may decline the grade before the certificate is issued. For a learner receiving their results in August, you should decline the grade by the end of September if the learner intends to resit an external assessment.

Additional documents to support centre administration

As an approved centre you must ensure that all staff delivering, assessing and administering the qualifications have access to this documentation. These documents are reviewed annually and are reissued if updates are required.

- *Pearson Quality Assurance Handbook*: this sets out how we will carry out quality assurance of standards and how you need to work with us to achieve successful outcomes.
- *Information Manual*: this gives procedures for registering learners for qualifications, transferring registrations, entering for external assessments and claiming certificates.
- *Lead Examiners' Reports*: these are produced after each series for each external assessment and give feedback on the overall performance of learners in response to tasks or questions set.
- *Instructions for the Conduct of External Assessments (ICEA)*: this explains our requirements for the effective administration of external assessments, such as invigilation and submission of materials.
- *Regulatory policies*: our regulatory policies are integral to our approach and explain how we meet internal and regulatory requirements. We review the regulated policies annually to ensure that they remain fit for purpose. Policies related to this qualification include:
  - adjustments for candidates with disabilities and learning difficulties, access arrangements and reasonable adjustments for general and vocational qualifications
  - age of learners
  - centre guidance for dealing with malpractice
  - recognition of prior learning and process.

This list is not exhaustive and a full list of our regulatory policies can be found on our website.

8 Quality assurance

Centre and qualification approval

As part of the approval process, your centre must make sure that the resource requirements listed below are in place before offering the qualification.

- Centres must have appropriate physical resources (for example, equipment, IT, learning materials, teaching rooms) to support the delivery and assessment of the qualification.
- Staff involved in the assessment process must have relevant expertise and/or occupational experience.
- There must be systems in place to ensure continuing professional development for staff delivering the qualification.
- Centres must have in place appropriate health and safety policies relating to the use of equipment by learners.
- Centres must deliver the qualification in accordance with current equality legislation.
- Centres should refer to the teacher guidance section in individual units to check for any specific resources required.

Continuing quality assurance and standards verification

On an annual basis, we produce the *Pearson Quality Assurance Handbook.* It contains detailed guidance on the quality processes required to underpin robust assessment and internal verification.

The key principles of quality assurance are that:

- a centre delivering BTEC programmes must be an approved centre, and must have approval for the programmes or groups of programmes that it is delivering
- the centre agrees, as part of gaining approval, to abide by specific terms and conditions around the effective delivery and quality assurance of assessment; it must abide by these conditions throughout the period of delivery
- Pearson makes available to approved centres a range of materials and opportunities, through online standardisation, intended to exemplify the processes required for effective assessment, and examples of effective standards. Approved centres must use the materials and services to ensure that all staff delivering BTEC qualifications keep up to date with the guidance on assessment
- an approved centre must follow agreed protocols for standardisation of assessors and verifiers, for the planning, monitoring and recording of assessment processes, and for dealing with special circumstances, appeals and malpractice.

The approach of quality-assured assessment is through a partnership between an approved centre and Pearson. We will make sure that each centre follows best practice and employs appropriate technology to support quality-assurance processes, where practicable. We work to support centres and seek to make sure that our quality-assurance processes do not place undue bureaucratic processes on centres. We monitor and support centres in the effective operation of assessment and quality assurance.

The methods we use to do this for BTEC Level 3 include:

- making sure that all centres complete appropriate declarations at the time of approval
- undertaking approval visits to centres
- making sure that centres have effective teams of assessors and verifiers who are trained to undertake assessment
- assessment sampling and verification, through requested samples of assessments, completed assessed learner work and associated documentation
- an overarching review and assessment of a centre's strategy for delivering and quality assuring its BTEC programmes, for example making sure that synoptic units are placed appropriately in the order of delivery of the programme.

Centres that do not fully address and maintain rigorous approaches to delivering, assessing and quality assurance cannot seek certification for individual programmes or for all BTEC Level 3 programmes. An approved centre must make certification claims only when authorised by us and strictly in accordance with requirements for reporting.

Centres that do not comply with remedial action plans may have their approval to deliver qualifications removed.

9 Understanding the qualification grade

Awarding and reporting for the qualification

This section explains the rules that we apply in awarding a qualification and in providing an overall qualification grade for each learner. It shows how all the qualifications in this sector are graded.

The awarding and certification of these qualifications will comply with regulatory requirements.

Eligibility for an award

In order to be awarded a qualification, a learner must complete all units, achieve a Near Pass (N) or above in all external units and a pass or above in all mandatory units unless otherwise specified. Refer to the structure in *Section 2*.

To achieve any qualification grade, learners must:

- complete and **have an outcome** (D, M, P, N or U) for all units within a valid combination
- achieve the **required units at Pass or above** shown in *Section 2*, and for the Extended Diploma achieve a minimum 900 GLH at Pass or above (or N or above in external units)
- achieve the **minimum number of points** at a grade threshold.

It is the responsibility of a centre to ensure that a correct unit combination is adhered to. Learners who do not achieve the required minimum grade (N or P) in units shown in the structure will not achieve a qualification.

Learners who do not achieve sufficient points for a qualification or who do not achieve all the required units may be eligible to achieve a smaller qualification in the same suite provided they have completed and achieved the correct combination of units and met the appropriate qualification grade points threshold.

Calculation of the qualification grade

The final grade awarded for a qualification represents an aggregation of a learner's performance across the qualification. As the qualification grade is an aggregate of the total performance, there is some element of compensation in that a higher performance in some units may be balanced by a lower outcome in others.

In the event that a learner achieves more than the required number of optional units, the mandatory units along with the optional units with the highest grades will be used to calculate the overall result, subject to the eligibility requirements for that particular qualification title.

BTEC Nationals are Level 3 qualifications and are awarded at the grade ranges shown in the table below.

Qualification	Available grade range
Certificate, Extended Certificate, Foundation Diploma	P to D*
Diploma	PP to D*D*
Extended Diploma	PPP to D*D*D*

The *Calculation of qualification grade* table, shown further on in this section, shows the minimum thresholds for calculating these grades. The table will be kept under review over the lifetime of the qualification. The most up to date table will be issued on our website.

Pearson will monitor the qualification standard and reserves the right to make appropriate adjustments.

Learners who do not meet the minimum requirements for a qualification grade to be awarded will be recorded as Unclassified (U) and will not be certificated. They may receive a Notification of Performance for individual units. The *Information Manual* gives full information.

Points available for internal units

The table below shows the number of **points** available for internal units. For each internal unit, points are allocated depending on the grade awarded.

	Unit size	
	60 GLH	**90 GLH**
U	0	0
Pass	6	9
Merit	10	15
Distinction	16	24

Points available for external units

Raw marks from the external units will be awarded **points** based on performance in the assessment. The table below shows the **minimum number of points** available for each grade in the external units.

	Unit size	
	90 GLH	**120 GLH**
U	0	0
Near Pass	6	8
Pass	9	12
Merit	15	20
Distinction	24	32

Pearson will automatically calculate the points for each external unit once the external assessment has been marked and grade boundaries have been set. For more details about how we set grade boundaries in the external assessment please go to our website.

Claiming the qualification grade

Subject to eligibility, Pearson will automatically calculate the qualification grade for your learners when the internal unit grades are submitted and the qualification claim is made. Learners will be awarded qualification grades for achieving the sufficient number of points within the ranges shown in the relevant *Calculation of qualification grade* table for the cohort.

Calculation of qualification grade

Applicable for registration from 1 September 2018.

Certificate		Extended Certificate		Foundation Diploma		Diploma		Extended Diploma	
180 GLH		360 GLH		540 GLH		720 GLH		1080 GLH	
Grade	**Points threshold**	**Grade**	**Points threshold**	**Grade**	**Points threshold**	**Grade**	**Points threshold**	**Grade**	**Points threshold**
U	0	U	0	U	0	U	0	U	0
Pass	18	P	36	P	54	PP	72	PPP	108
						MP	88	MPP	124
								MMP	140
Merit	26	M	52	M	78	MM	104	MMM	156
						DM	124	DMM	176
								DDM	196
Distinction	42	D	74	D	108	DD	144	DDD	216
						D*D	162	D*DD	234
								D*D*D	252
Distinction*	48	D*	90	D*	138	D*D*	180	D*D*D*	270

The table is subject to review over the lifetime of the qualification.

Examples of grade calculations based on table applicable to registrations from September 2018

Example 1: Achievement of a Certificate with a P grade

	GLH	Type (Int/Ext)	Grade	Unit points
Unit 1	120	Ext	Near Pass	8
Unit 2	60	Int	Merit	10
Totals	**180**		**P**	**18**

The learner has sufficient points for a P grade.

Example 2: Achievement of a Certificate with a D* grade

	GLH	Type (Int/Ext)	Grade	Unit points
Unit 1	120	Ext	Distinction	32
Unit 2	60	Int	Distinction	16
Totals	**180**		**D***	**48**

The learner has sufficient points for a D* grade.

Example 3: An Unclassified result for a Certificate

	GLH	Type (Int/Ext)	Grade	Unit points
Unit 1	120	Ext	Distinction	32
Unit 2	60	Int	U	0
Totals	**180**		**U**	**32**

The learner has a U in Unit 2.

The learner has sufficient points for a P grade but has not met the minimum requirement for an N grade or higher in Unit 1 and a P or higher in Unit 2.

10 Resources and support

Our aim is to give you a wealth of resources and support to enable you to deliver BTEC National qualifications with confidence. On our website you will find a list of resources to support teaching and learning, and professional development.

Support for setting up your course and preparing to teach

Specification

This **specification** (for teaching from September 2018) includes details on the administration of qualifications and information on all the units for the qualification.

Delivery Guide

This free guide gives you important advice on how to choose the right course for your learners and how to ensure you are fully prepared to deliver the course. It explains the key features of BTEC Nationals (for example employer involvement and employability skills). It also covers guidance on assessment (internal and external) and quality assurance. The guide tells you where you can find further support and gives detailed unit-by-unit delivery guidance. It includes teaching tips and ideas, assessment preparation and suggestions for further resources.

Schemes of work

Free sample schemes of work are provided for each mandatory unit. These are available in Word™ format for ease of customisation.

Curriculum models

These show how the BTECs in the suite fit into a 16–19 study programme, depending on their size and purpose. The models also show where other parts of the programme, such as work experience, maths and English, tutorial time and wider study, fit alongside the programme.

Study skills activities

A range of case studies and activities is provided; they are designed to help learners develop the study skills they need to successfully complete their BTEC course. The case studies and activities are provided in Word™ format for easy customisation.

Support for teaching and learning

Pearson Learning Services provides a range of engaging resources to support BTEC Nationals, including:

- textbooks in e-book and print formats
- revision guides and revision workbooks in e-book and print formats
- teaching and assessment packs, including e-learning materials via the Active Learn Digital Service.

Teaching and learning resources are also available from a number of other publishers. Details of Pearson's own resources and of all endorsed resources can be found on our website.

Support for assessment

Sample assessment materials for externally-assessed units

Sample assessments are available for the Pearson-set units. One copy of each of these assessments can be downloaded from the website/available in print. For each suite an additional sample for one of the Pearson-set units is also available, allowing your learners further opportunities for practice.

Further sample assessments will be made available through our website on an ongoing basis.

Sample assessment materials for internally-assessed units

We do not prescribe the assessments for the internally-assessed units. Rather, we allow you to set your own, according to your learners' preferences and to link with your local employment profile.

We do provide a service in the form of Authorised Assignment Briefs, which are approved by Pearson Standards Verifiers. They are available via our website.

Sample marked learner work

To support you in understanding the expectation of the standard at each grade, examples of marked learner work at PM/MD grades are linked to the Authorised Assignment Briefs.

Training and support from Pearson

People to talk to

There are many people who are available to support you and provide advice and guidance on delivery of your BTEC Nationals. These include:

- Subject Advisors – available for all sectors. They understand all Pearson qualifications in their sector and so can answer sector-specific queries on planning, teaching, learning and assessment
- Standards Verifiers – they can support you with preparing your assignments, ensuring that your assessment plan is set up correctly, and support you in preparing learner work and providing quality assurance through sampling
- Curriculum Development Managers (CDMs) – they are regionally based and have a full overview of the BTEC qualifications and of the support and resources that Pearson provides. CDMs often run network events
- Customer Services – the 'Support for You' section of our website gives the different ways in which you can contact us for general queries. For specific queries, our service operators can direct you to the relevant person or department.

Training and professional development

Pearson provides a range of training and professional development events to support the introduction, delivery, assessment and administration of BTEC National qualifications. These sector-specific events, developed and delivered by specialists, are available both face to face and online.

'Getting Ready to Teach'

These events are designed to get teachers ready for delivery of the BTEC Nationals. They include an overview of the qualifications' structures, planning and preparation for internal and external assessment, and quality assurance.

Teaching and learning

Beyond the 'Getting Ready to Teach' professional development events, there are opportunities for teachers to attend sector- and role-specific events. These events are designed to connect practice to theory; they provide teacher support and networking opportunities with delivery, learning and assessment methodology.

Details of our training and professional development programme can be found on our website.

Appendix 1 Links to industry standards

BTEC Nationals have been developed in consultation with industry and appropriate sector bodies to ensure that the qualification content and approach to assessment aligns closely to the needs of employers. Where they exist, and are appropriate, National Occupational Standards (NOS) and professional body standards have been used to establish unit content.

In the engineering sector, the following approaches have been used.

- The qualifications have been aligned to employer requirements as identified as part of the Apprenticeship Reform process.
- Content has been mapped to the requirements stated for EngTech registration as stated in UK-SPEC along with the output standards identified in the Approval of Qualifications and Apprenticeships Handbook produced by the Engineering Council.

A detailed mapping to the UK-SPEC can be found on our website.

Appendix 2 Glossary of terms used for internally-assessed units

This is a summary of the key terms used to define the requirements within units.

Term	Definition
Carry out (when used in learning aim)	Learners demonstrate skills through practical activities.
Design (when used in learning aim)	The process of deciding on the look and functioning of a product or process.
Develop (when used in learning aim)	Learners acquire and apply skills through practical activities.
Examine (when used in learning aim)	Learners select and apply knowledge to less familiar contexts.
Explore (when used in learning aim)	Learners apply their skills and/or knowledge to practical testing or trialling.
Implement (when used in learning aim)	Learners put a plan or decision into effect/execution.
Interpret (when used in learning aim)	Learners demonstrate and apply understanding of something to convey a particular meaning.
Investigate (when used in learning aim)	Learners' knowledge is based on personal research and development.
Modify	Learners make partial or minor changes to something.
Plan (when used in learning aim)	Learners map outcomes related to a given or limited task. Learners create a way of doing a task or a series of tasks to achieve specific requirements or objectives showing progress from start to finish.
Reflect on	Learners draw conclusions from their own learning, skills and development.
Review (when used in learning aim)	Process for learning (knowledge or skills) through research, peer review or reflection.
Select (when used in learning aim)	Learners make the best or most suitable choice of something for a specific purpose.
Set up (when used in learning aim)	Learners set the way in which something, for example equipment, is organised, planned or arranged.
Undertake (when used in learning aim)	Learners demonstrate skills. Often referring to given processes or techniques.
Accurate	Free from error, defect or within a tolerance that is appropriate for the context.
Adapt	To change something to suit different conditions or uses.
Analyse	Learners present the outcome of methodical and detailed examination either: • breaking down a theme, topic or situation in order to interpret and study the interrelationships between the parts and/or • of information or data to interpret and study key trends and interrelationships.
Application	The action of putting something into operation.
Apply	Bring or put into operation or use.

Term	Definition
Assemble	Fit together the separate component parts of (a machine or other object).
Assess	Learners present careful consideration of varied factors or events that apply to a specific situation, or identify those which are the most important or relevant and arrive at a conclusion.
Build	Construct (something) by putting parts or material together.
Calculate	Produce a numerical answer, showing relevant working.
Capabilities	The ability of a machine/product to meet specified requirements.
Capture	To represent an electronic circuit accurately using software.
Carry out (when used in assessment criterion)	To do or complete something, as in a process to produce an outcome.
Characteristic	A feature or quality belonging typically to an object or thing and serving to identify them.
Check	Examine (something) in order to determine its accuracy, quality, or condition, or to detect the presence of something.
Client brief	A document produced by a client specifying the requirements for a product they are commissioning.
Compare (and contrast)	Learners can identify the main factors relating to two or more items/situations or aspects of a subject that is extended to explain the similarities, differences, advantages and disadvantages. This is used to show depth of knowledge through selection and isolation of characteristics.
Complete	Make or do something to completion.
Component	A part or element of a larger whole, especially a part of a machine or product.
Conduct	Undertaking a series of activities as part of a task.
Consistently	In every case or every occasion.
Constraints	The state of being restricted or confined within prescribed bounds.
Construct	Build or make something.
Create	Bring something into existence, e.g. drawings.
Critically analyse	In a way that involves the objective analysis and evaluation of an issue to form a judgement.
Demonstrate	Learners' work shows the ability to carry out and apply knowledge, understanding and/or skills in a practical situation.
Describe	Learners' work gives a clear, objective account in their own words showing recall and, in some cases application, of the relevant features and information about a subject.
Design (when used in assessment criterion)	The process of creating the form, function and characteristics of a product, system or process.
Determine (the characteristics of…)	To discover the facts or truth about a process or product.
Develop (when used in assessment criterion)	To design, build/manufacture and test a product, circuit or system.

Term	Definition
Diagnose	Identify the nature of a problem or fault by examination of the situation or artefact.
Diagram	A simple plan that represents a machine, system, or idea, etc., often drawn to explain how it works.
Discuss	Learners consider different aspects of: • a theme or topic • how they interrelate • the extent to which they are important. A conclusion is not required.
Draw	Make a graphical representation of engineering data or information.
Evaluate	Learners draw on varied information, themes or concepts to consider aspects such as: • strengths or weaknesses • advantages or disadvantages • alternative actions • relevance or significance. Learners' enquiries should lead to a supported judgement showing relationship to its context. This will often be in a conclusion.
Examine (when used in assessment criterion)	To test or assess the characteristics of a process or product.
Experiment	A test done in order to learn something or to discover if something works or is true.
Explain	Learners' work shows clear details and gives reasons and/or evidence to support an opinion, view or argument. It could show how conclusions are drawn.
Explore (when used in assessment criterion)	To enquire into or discuss something (for example an option or possibility) in detail.
Feature	A distinctive attribute or aspect of an object or thing.
Find	Ascertain by calculation or enquiry or to discover the facts about something.
Hazards	Something that is dangerous and likely to cause damage to an object or harm to an individual(s).
Identify	Learners indicate the main features or purpose of something by recognising it and/or being able to discern and understand facts or qualities.
Implement (when used in assessment criterion)	Learners consider the relevant factors to put a plan into practice, requiring self-direction of selection of outcome, planning, research, exploration, outcome and review.
Inspect	Look at (someone or something) closely, typically to assess their condition or to discover any shortcomings.
Interpret (when used in assessment criterion)	Learners state the meaning, purpose or qualities of something through the use of images, words or other expressions.
Investigate (when used in assessment criterion)	Learners' work tests the following through practical exploration: • qualities of materials • techniques • processes or contexts

Term	Definition
Justify	Learners give reasons or evidence to: • support an opinion; or • prove something right or reasonable.
Label	Add text to a graphical representation to identify specific parts.
List	Learners provide information as an item by item record of names or things.
Manage	Learners engage with and influence an activity or process.
Manufacture	To make something using machinery, tools and materials.
Measure	The action of measuring something, for example dimensions, surface finish and voltage.
Methods	A particular procedure for accomplishing or approaching something, especially a systematic or established one.
Models	A representation, either in a graphical, physical or numerical format of something.
Optimise	The process of improving and perfecting a process or product by incremental steps to achieve the best performance possible (given constraints).
Organisation	An organised group of people with a particular purpose, such as a business, company or government department.
Outline	Learners' work, performance or practice provides a summary or overview or a brief description of something.
Perform	Learners can carry out or execute what has to be done to complete a given activity.
Plan (when used in assessment criterion)	Learners create a way of doing a task or a series of tasks to achieve specific requirements or objectives showing progress from start to finish.
Practical	Learners apply knowledge and demonstrate skills to a given task to produce an outcome.
Prepare	Learners gather materials, tools and procedures ready to undertake a process and/or make something ready for use.
Present	To give, provide, or make something known.
Principles	A general scientific theorem or law that has numerous special applications.
Procedure	A set of actions that is the official or accepted way of doing something.
Processes	A series of actions or steps taken in order to achieve a particular end.
Produce	Learners' knowledge, understanding and/or skills are applied to develop a particular type of evidence, for example a plan or report.
Product	A product contains one or more than one component and is offered for sale or use.
Quality control	The process of looking at products or components when they are being manufactured to make certain that all the items are of the intended standard.
Recommend	To suggest that a particular action should be done.
Refine	To improve an idea, method, system, product etc. by making small changes.

Term	Definition
Repair	Restore (something damaged, faulty, or worn) to a good condition.
Research	An analysis of substantive research organised by learners from secondary and if applicable primary sources.
Review (when used in assessment criterion)	Learners make a formal assessment of their work. They appraise existing information or prior events, or reconsider information with the intention of making changes if necessary.
Risks	The possibility of something, most likely negative, happening or a future event which could adversely or positively impact project processes or outcomes.
Select	Learners choose the best or most suitable option whether this is of materials, techniques, equipment or processes. The options and choices should be based on specific criteria.
Set up (when used in assessment criterion)	To set up a machine or process ready for operation or to assemble.
Simulate	A representation, either in a graphical or numerical format, of something or a realistic work situation.
Solve	Find an answer to, explanation for, or means of effectively dealing with an engineering problem.
State	Declare definitely or specifically.
Sustainability	The ability of a product or process to be sustained, supported, upheld, or confirmed over a long period of time.
System(s)	An assemblage or combination of things or parts forming a complex or unitary whole.
Test	Take measures to check the quality, performance, or reliability of something, especially before putting it into widespread use or practice.
Tolerance	The permissible range of variation in a dimension of a product or component as determined by the constraints.
Undertake (when used in assessment criterion)	Learners select and apply knowledge to demonstrate skills.
Use	Take, hold, or deploy (something) as a means of accomplishing or achieving something; employ. Learners' practice evidences the ability to carry out and apply knowledge, understanding and skills in a practical situation.

This is a key summary of the types of evidence used for BTEC Nationals.

Type of evidence	Definition and purpose
Artefact	An object or output from a human devised process.
Case study	A specific example to which all learners must select and apply knowledge. Used to show application to a realistic context where direct experience cannot be gained.
Design documentation	A way to communicate the design itself, the rationale for decisions made, and the tools for clients to carry on once the project is complete.
Logbook	A record made by learners of how a process of development was carried out, including experimental stages, testing, selection and rejection of alternatives, practice or development steps.
Observation record	An observation record is used to provide a formal record of a judgement of learners' performance (for example during presentations, practical activities) against the targeted assessment criteria. It must be completed by the assessor of the unit or qualification. An observation record alone does not confer an assessment decision.
Portfolio of evidence	A collection of documents which demonstrate knowledge-based skills and work that has been undertaken to be assessed as evidence to meet required skills outcomes.
Practical task	Learners undertake a defined or self-defined task to produce an outcome of a defined quality.
Production of plan	Learners produce plans as an outcome related to a given or limited task.
Project management	A large-scale activity requiring self-direction of selection of outcome, planning, research, exploration, outcome and review.
Reflective account/development log or logbook	A record kept by learners to show the process of development. Used to show method, self-management, skill development, experimental stages, testing, selection and rejection of alternatives, practice or development steps.
Report/research report	A self-directed, large-scale activity requiring, planning, research, exploration, outcome and review. Used to show self-management, project management and/or deep learning, including synopticity.
Research project	An analysis of substantive research organised by learners from secondary and if applicable primary sources.
Test plan	A document detailing the objectives and processes for a specific test for a product. The plan typically contains a detailed understanding of the eventual workflow.
Witness statement	Can be used to provide a written record of learners' performance against targeted assessment criteria. Anyone within the work experience placement who has witnessed the skills being demonstrated can complete a witness statement, including staff who do not have direct knowledge of the qualification, unit or evidence requirements, but who are able to make a professional judgement about learners' performance in the given situation.

Pearson BTEC Level 3 Nationals in Engineering

Certificate in Engineering

Extended Certificate in Engineering

Foundation Diploma in Engineering

Diplomas in:
- Engineering
- Electrical and Electronic Engineering
- Mechanical Engineering
- Computer Engineering
- Manufacturing Engineering
- Aeronautical Engineering

Extended Diplomas in:
- Engineering
- Electrical and Electronic Engineering
- Mechanical Engineering
- Computer Engineering
- Manufacturing Engineering
- Aeronautical Engineering

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