Pearson
BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets

Specification

BTEC Specialist qualification

For first teaching September 2011

Issue 2

Edexcel, BTEC and LCCI qualifications

Edexcel, BTEC and LCCI qualifications are awarded by Pearson, the UK's largest awarding body offering academic and vocational qualifications that are globally recognised and benchmarked. For further information, please visit our qualifications website at qualifications.pearson.com. Alternatively, you can get in touch with us using the details on our contact us page at qualifications.pearson.com/contactus

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This specification is Issue 2. Key changes are listed in the summary table on the next page. We will inform centres of any changes to this issue. The latest issue can be found on the Pearson website: qualifications.pearson.com

These qualifications were previously known as:

Edexcel BTEC Level 2 certificate, extended certificate and diploma in aviation studies for air cadets (QCF)

The QNs remain the same.

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Summary of Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets specification Issue 2 changes

Summary of changes made between previous issue and this current issue	Page number
All references to QCF have been removed throughout the specification	
Definition of TQT added	1
Definition of sizes of qualifications aligned to TQT	1
Credit value range removed and replaced with lowest credit value for the shortest route through the qualification	3
TQT value added	3
GLH range removed and replaced with lowest GLH value for the shortest route through the qualification	4-6
QCF references removed from unit titles and unit levels in all units	19-167
Guided learning definition updated	13

Earlier issue(s) show(s) previous changes.
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.

BTEC Specialist qualification titles covered by this specification

Pearson BTEC Level 2 Certificate in Aviation Studies for Air Cadets

Pearson BTEC Level 2 Extended Certificate in Aviation Studies for Air Cadets

Pearson BTEC Level 2 Diploma in Aviation Studies for Air Cadets

Each unit within a qualification will have a unit code.

The qualification and unit codes will appear on learners' final certification documentation. Qualifications eligible and funded for post-16-year-olds can be found on the funding Hub. The Skills Funding Agency also publishes a funding catalogue that lists the qualifications available for 19+ funding.

The Qualification Numbers for the qualifications in this publication are:

Pearson BTEC Level 2 Certificate in Aviation Studies for Air Cadets	600/1892/6
Pearson BTEC Level 2 Extended Certificate in Aviation Studies for Air Cadets	600/1895/1
Pearson BTEC Level 2 Diploma in Aviation Studies for Air Cadets	600/1894/X

These qualification titles will appear on learners' certificates. Learners need to be made aware of this when they are recruited by the centre and registered with Pearson.

These qualifications are accredited by Ofqual as being Stand Alone.

Welcome to the Pearson BTEC Level 2 qualifications in Aviation Studies for Air Cadets

Focusing on the Pearson BTEC Level 2 qualifications in Aviation Studies for Air Cadets

The purpose of these qualifications is to provide a framework for developing an understanding of aviation. They help Air Cadets to prepare for further aviation-related qualifications or a specific career. Many of these units are technical in nature and provide a good grounding in basic aviation engineering principles. The qualifications are primarily designed for Air Cadets of the Air Training Corps and Royal Air Force Section of the Combined Cadet Force. The training and assessment is controlled by Headquarters Air Cadets at RAF Cranwell.

Straightforward to implement, teach and assess

Implementing Pearson BTECs couldn't be easier. They are designed to fit easily into your curriculum and can be studied independently or alongside existing qualifications, to suit the interests and aspirations of learners. The clarity of assessment makes grading learner attainment simpler.

Engaging for everyone

Learners of all abilities flourish when they can apply their own knowledge, skills and enthusiasm to a subject. Pearson BTEC qualifications make explicit the link between theoretical learning and the world of work by giving learners the opportunity to apply their research, skills and knowledge to work-related contexts and case studies. These applied and practical BTEC approaches give all learners the impetus they need to achieve and the skills they require for workplace or education progression.

Recognition

Pearson BTECs are understood and recognised by a large number of organisations in a wide range of sectors. Pearson BTEC qualifications are developed with key industry representatives and Sector Skills Councils (SSC) to ensure that they meet employer and learner needs — **in this case, Go Skills**.

All you need to get started

To help you off to a flying start, we've developed an enhanced specification that gives you all the information you need to start teaching Pearson BTEC. This includes:

- a framework of equivalencies, so you can see how these qualifications compare with other Pearson vocational qualifications
- information on rules of combination, structures and quality assurance, so you can deliver the qualification with confidence
- explanation of the content's relationship with the learning outcomes
- guidance on assessment, and what the learner must produce to achieve the unit.

Don't forget that we're always here to offer curriculum and qualification updates, local training and network opportunities, advice, guidance and support.

Contents

What are Pearson BTEC Level 2 Specialist qualifications?

BTEC Specialist qualifications are work-related qualifications available from Entry to Level 3 in a range of sectors. They give learners the knowledge, understanding and skills they need to prepare for employment in a specific occupational area. The qualifications also provide career development opportunities for those already in work. The qualifications may be offered as full-time or part-time courses in schools or colleges. Training centres and employers may also offer these qualifications.

Sizes of Specialist qualifications

For all regulated qualifications, we specify a total number of hours that learners are expected to undertake in order to complete and show achievement for the qualification – this is the Total Qualification Time (TQT). The TQT value indicates the size of a qualification.

Within the TQT, we identify the number of Guided Learning Hours (GLH) that a centre delivering the qualification needs to provide. Guided learning means activities that directly or immediately involve tutors and assessors in teaching, supervising, and invigilating learners, for example lectures, tutorials, online instruction and supervised study.

As well as guided learning, there may be other required learning that is directed by tutors or assessors. This includes, for example, private study, preparation for assessment and undertaking assessment when not under supervision, such as preparatory reading, revision and independent research.

As well as TQT and GLH, qualifications can also have a credit value – equal to one tenth of TQT, rounded to the nearest whole number.

TQT and credit values are assigned after consultation with users of the qualifications.

BTEC Specialist qualifications are available in the following sizes:

- Award – a qualification with a TQT value of 120 or less (equivalent to a range of 1–12 credits)
- Certificate – a qualification with a TQT value in the range of 121–369 (equivalent to a range of 13–36 credits)
- Diploma – a qualification with a TQT value of 370 or more (equivalent to 37 credits and above).

Pearson BTEC Level 2 Certificate

The target group for the Pearson BTEC Level 2 Certificate in Aviation Studies for Air Cadets is the ATC First Class and CCF (RAF) Part 1 cadets. The Pearson BTEC Level 2 Certificate offers an engaging programme for those who are clear about the vocational area they want to learn more about. These learners may wish to extend their programme through the study of a related GCSE, a complementary NVQ or another related vocational or personal and social development qualification. These learning programmes can be developed to allow learners to study complementary qualifications without duplication of content.

Pearson BTEC Level 2 Extended Certificate

The target group for the Pearson BTEC Level 2 Extended Certificate in Aviation Studies for Air Cadets is ATC Leading Cadets and CCF (RAF) Part 2 Cadets. The Pearson BTEC Level 2 Extended Certificate consolidates the learning undertaken as basic training and focuses on the main principles of aviation.

Pearson BTEC Level 2 Diploma

The Pearson BTEC Level 2 Diploma in Aviation Studies for Air Cadets extends the work-related focus from the Pearson BTEC Level 2 Extended Certificate. The optional routes of learning develop specific areas of interest and technical knowledge. There is potential for the qualification to prepare learners for employment in a particular vocational sector and it is suitable for those who have decided that they wish to enter a specific area of work.

Key features of the Pearson BTEC Level 2 qualifications in Aviation Studies for Air Cadets

The Pearson BTEC level 2 qualifications in Aviation Studies for Air Cadets have been developed to give learners the opportunity to:

- engage in learning that is relevant to them and which will provide opportunities to develop a range of skills and techniques, personal skills and attributes essential for successful performance in working life
- achieve a nationally recognised level 2 vocationally related qualification
- progress to related general and/or vocational qualifications.

National Occupational Standards

Where relevant, Pearson BTEC level 2 qualifications are designed to provide some of the underpinning knowledge and understanding for the National Occupational Standards (NOS), as well as developing practical skills in preparation for work and possible achievement of NVQs in due course. NOS form the basis of National Vocational Qualifications (NVQs). Pearson BTEC level 2 qualifications do not purport to deliver occupational competence in the sector, which should be demonstrated in a work context.

Rules of combination

The rules of combination specify the credits that need to be achieved, through the completion of particular units, for the qualification to be awarded. All accredited qualifications have rules of combination.

Rules of combination for the Pearson BTEC level 2 qualifications

When combining units for a Pearson BTEC Level 2 qualification in Aviation Studies for Air Cadets it is the centre's responsibility to ensure that the following rules of combination are adhered to.

Pearson BTEC Level 2 Certificate in Aviation Studies for Air Cadets

1 Qualification TQT: 150. Qualification credit value: 15 credits.

2 All credits must be achieved from the units listed in this specification.

Pearson BTEC Level 2 Extended Certificate in Aviation Studies for Air Cadets

1 Qualification TQT: 300 Hours. Qualification credit value: 30 credits.

2 All credits must be achieved from the units listed in this specification.

Pearson BTEC Level 2 Diploma in Aviation Studies for Air Cadets

1 Qualification TQT: 600. Qualification credit value: 60 credits.

2 All credits must be achieved from the units listed in this specification.

Pearson BTEC Level 2 Certificate in Aviation Studies for Air Cadets

The Pearson BTEC Level 2 Certificate in Aviation Studies for Air Cadets is a 15-credit and 120-guided-learning-hour (GLH) qualification that consists of 2 mandatory units, plus 1 optional unit.

Pearson BTEC Level 2 Certificate in Aviation Studies for Air Cadets			
Unit	**Mandatory units**	**Credit**	**Level**
1	Fundamental Principles of Airmanship for Air Cadets	5	2
2	Map Reading for Air Cadets	5	2
	Optional units		
3	Planning Safe Walking Expeditions	5	2
4	Radio Communications for Air Cadets	5	2
5	Principles of Flight	5	2
6	Airmanship Knowledge for Air Cadets	5	2
7	Navigating on Land Using Map and Compass	5	2

Pearson BTEC Level 2 Extended Certificate in Aviation Studies for Air Cadets

The Pearson BTEC Level 2 Extended Certificate in Aviation Studies for Air Cadets is a 30-credit and 240-guided-learning-hour (GLH) qualification that consists of 4 mandatory units **plus** 2 optional units.

Pearson BTEC Level 2 Extended Certificate in Aviation Studies for Air Cadets			
Unit	**Mandatory units**	**Credit**	**Level**
1	Fundamental Principles of Airmanship for Air Cadets	5	2
2	Map Reading for Air Cadets	5	2
3	Planning Safe Walking Expeditions	5	2
4	Radio Communications for Air Cadets	5	2
Unit	**Optional units**		
5	Principles of Flight	5	2
6	Airmanship Knowledge for Air Cadets	5	2
7	Navigating on Land Using Map and Compass	5	2

Pearson BTEC Level 2 Diploma in Aviation Studies for Air Cadets

The Pearson BTEC Level 2 Diploma in Aviation Studies for Air Cadets is a 60-credit and 480-guided-learning-hour (GLH) qualification that consists of 4 mandatory units **plus** 8 optional units.

Pearson BTEC Level 2 Diploma in Aviation Studies for Air Cadets			
Unit	**Mandatory units**	**Credit**	**Level**
1	Fundamental Principles of Airmanship for Air Cadets	5	2
2	Map Reading for Air Cadets	5	2
3	Planning Safe Walking Expeditions	5	2
4	Radio Communications for Air Cadets	5	2
Unit	**Optional units**		
5	Principles of Flight	5	2
6	Airmanship Knowledge for Air Cadets	5	2
7	Navigating on Land Using Map and Compass	5	2
8	Aircraft Handling and Flying Techniques	5	2
9	Principles of Air Power	5	2
10	Principles of Piston Engine Propulsion	5	2
11	Principles of Jet Engine Propulsion	5	2
12	Development and Principles of Rocketry	5	2
13	Principles of Airframes for Air Cadets	5	2
14	Avionic and Aircraft Electric Systems	5	2
15	Military Aircraft Systems	5	2
16	Air Navigation for Air Cadets	5	2
17	Principles of Pilot Navigation	5	2
18	Radio and Radar for Air Cadets	5	2
19	Satellite and Data Communication for Air Cadets	5	2

Assessment

All units within these qualifications are internally assessed. The qualifications are criterion referenced, based on the achievement of all the specified learning outcomes.

Each of the units within the qualifications has specified assessment criteria and grading criteria which must be used. A summative unit grade can be awarded at pass, merit or distinction.

- To achieve a 'pass' a learner must have successfully completed **all** the assessment criteria
- To achieve a 'merit' a learner must **additionally** have successfully completed **all** the merit grading criteria
- To achieve a 'distinction' a learner must **additionally** have successfully completed **all** the distinction grading criteria.

Guidance

The purpose of assessment is to ensure that effective learning has taken place to give learners the opportunity to:

- meet the standard determined by the assessment and grading criteria and
- achieve the learning outcomes.

All the assignments created by centres should be reliable and fit for purpose, and should be built on the unit assessment and grading criteria. Assessment tasks and activities should enable learners to produce valid, sufficient and reliable evidence that relates directly to the specified criteria. Centres should enable learners to produce evidence in a variety of different forms, including performance observation, presentations and posters, along with projects, or time-constrained assessments.

Centres are encouraged to emphasise the practical application of the assessment and grading criteria, providing a realistic scenario for learners to adopt, and making maximum use of practical activities. The creation of assignments that are fit for purpose is vital to achievement and their importance cannot be over-emphasised.

The assessment and grading criteria must be clearly indicated in the assignments briefs. This gives learners focus and helps with internal verification and standardisation processes. It will also help to ensure that learner feedback is specific to the assessment criteria.

When designing assignments briefs, centres are encouraged to identify common topics and themes. A central feature of vocational assessment is that it allows for assessment to be:

- current, ie to reflect the most recent developments and issues
- local, ie to reflect the employment context of the delivering centre
- flexible to reflect learner needs, ie at a time and in a way that matches the learner's requirements so that they can demonstrate achievement.

Calculation of the qualification grade

Pass qualification grade

Learners who achieve the minimum eligible credit value specified by the rule of combination will achieve the qualification at pass grade.

Qualification grades above pass grade

Learners will be awarded a merit or distinction or distinction* qualification grade by the aggregation of points gained through the successful achievement of individual units. The number of points available is dependent on the unit level and grade achieved, and the credit size of the unit (as shown in the 'points available for credits achieved at different levels and unit grades' below).

Points available for credits achieved at different levels and unit grades

The table below shows the **number of points scored per credit** at the unit level and grade.

Unit level	Points per credit		
	Pass	Merit	Distinction
Level 1	3	4	5
Level 2	**5**	**6**	**7**
Level 3	7	8	9

Learners who achieve the correct number of points within the ranges shown in the 'qualification grade' table will achieve the qualification merit or distinction or distinction* grade.

Qualification grade

Qualification	Points range above pass grade		
	Merit	Distinction	Distinction*
Pearson BTEC Level 2 Certificate	85–94	95–99	100 and above
Pearson BTEC Level 2 Extended Certificate	170–189	190–199	200 and above
Pearson BTEC Level 2 Diploma	340–379	380–399	400 and above

Please refer to Annexe G for examples of calculation of qualification grade above pass grade.

Quality assurance of centres

Key principles of quality assurance

- A centre delivering Pearson qualifications must be a Pearson-recognised centre and must have approval for its qualifications.
- The centre agrees, as part of gaining recognition, to abide by specific terms and conditions relating to the effective delivery and quality assurance of assessment. The centre must abide by these conditions throughout the period of delivery.
- Pearson makes available to approved centres a range of materials and opportunities to exemplify the processes required for effective assessment and provide examples of effective standards. Approved centres must use the guidance on assessment to ensure that staff who are delivering Pearson qualifications are applying consistent standards.
- An approved centre must follow agreed protocols for: standardisation of assessors; planning, monitoring and recording of assessment processes; internal verification and recording of internal verification processes and dealing with special circumstances, appeals and malpractice.

Quality assurance processes

The approach to quality assured assessment is made through a partnership between a recognised centre and Pearson. Pearson is committed to ensuring that it follows best practice and employs appropriate technology to support quality assurance processes where practicable. The specific arrangements for working with centres will vary. Pearson seeks to ensure that the quality assurance processes it uses do not inflict undue bureaucratic processes on centres, and works to support them in providing robust quality assurance processes.

The learning outcomes and assessment criteria in each unit within this specification set out the standard to be achieved by each learner in order to gain each qualification. Pearson operates a quality assurance process, designed to ensure that these standards are maintained by all assessors and verifiers.

For the purposes of quality assurance, all individual qualifications and units are considered as a whole. Centres offering these qualifications must be committed to ensuring the quality of the units and qualifications they offer, through effective standardisation of assessors and internal verification of assessor decisions. Centre quality assurance and assessment processes are monitored by Pearson.

The Pearson quality assurance processes will involve:

- gaining centre recognition and qualification approval if a centre is not currently approved to offer Pearson qualifications
- annual visits to centres by Pearson for quality review and development of overarching processes and quality standards. Quality review and development visits will be conducted by a Pearson quality development reviewer
- annual visits by occupationally competent and qualified Pearson Standards Verifiers for sampling of internal verification and assessor decisions for the occupational sector

- the provision of support, advice and guidance towards the achievement of National Occupational Standards.

Centres are required to declare their commitment to ensuring quality and appropriate opportunities for learners that lead to valid and accurate assessment outcomes. In addition, centres will commit to undertaking defined training and online standardisation activities.

Quality Assurance Guidance

Details of quality assurance for the Pearson BTEC level 2 qualifications are set out in centre guidance which is published on our website (qualifications.pearson.com).

Programme design and delivery

Mode of delivery

Pearson does not normally define the mode of delivery for Pearson BTEC Entry to level 3 qualifications. Centres are free to offer the qualifications using any mode of delivery (such as full-time, part-time, evening only, distance learning) that meets their learners' needs. Whichever mode of delivery is used, centres must ensure that learners have appropriate access to the resources identified in the specification and to the subject specialists delivering the units. This is particularly important for learners studying for the qualification through open or distance learning.

Learners studying for the qualification on a part-time basis bring with them a wealth of experience that should be utilised to maximum effect by tutors and assessors. The use of assessment evidence drawn from learners' work environments should be encouraged. Those planning the programme should aim to enhance the vocational nature of the qualification by:

- liaising with employers to ensure a course relevant to learners' specific needs
- accessing and using non-confidential data and documents from learners' workplaces
- including sponsoring employers in the delivery of the programme and, where appropriate, in the assessment
- linking with company-based/workplace training programmes
- making full use of the variety of experience of work and life that learners bring to the programme.

Resources

Pearson BTEC level 2 qualifications are designed to give learners an understanding of the skills needed for specific vocational sectors. Physical resources need to support the delivery of the programme and the assessment of the learning outcomes, and should therefore normally be of industry standard. Staff delivering programmes and conducting the assessments should be familiar with current practice and standards in the sector concerned. Centres will need to meet any specific resource requirements to gain approval from Pearson.

Where specific resources are required these have been indicated in individual units in the *Essential resources* sections.

Delivery approach

It is important that centres develop an approach to teaching and learning that supports the vocational nature of Pearson BTEC level 2 qualifications and the mode of delivery. Specifications give a balance of practical skill development and knowledge requirements, some of which can be theoretical in nature. Tutors and assessors need to ensure that appropriate links are made between theory and practical application and that the knowledge base is applied to the sector. This requires the development of relevant and up-to-date teaching materials that allow learners to apply their learning to actual events and activity within the sector. Maximum use should be made of learners' experience.

Access and recruitment

Pearson's policy regarding access to its qualifications is that:

- they should be available to everyone who is capable of reaching the required standards
- they should be free from any barriers that restrict access and progression
- there should be equal opportunities for all wishing to access the qualifications.

Centres are required to recruit learners to Pearson BTEC qualifications with integrity. This will include ensuring that applicants have appropriate information and advice about the qualifications and that the qualification will meet their needs. Centres should take appropriate steps to assess each applicant's potential and make a professional judgement about their ability to successfully complete the programme of study and achieve the qualification. This assessment will need to take account of the support available to the learner within the centre during their programme of study and any specific support that might be necessary to allow the learner to access the assessment for the qualification. Centres should consult Pearson's policy on learners with particular requirements.

Centres will need to review the entry profile of qualifications and/or experience held by applicants, considering whether this profile shows an ability to progress to a higher-level qualification.

Restrictions on learner entry

The Pearson BTEC level 2 qualifications in Aviation Studies for Air Cadets are accredited for learners aged 14 and above.

In particular sectors the restrictions on learner entry might also relate to any physical or legal barriers, for example people working in health, care or education are likely to be subject to Criminal Records Bureau (CRB) checks.

This qualification is available only to cadets who have access to assessment under the conditions laid down by the Headquarters Air Cadets, RAF Cranwell. It is not available to organisations other than the Air Training Corps (ATC) Wings and Combined Cadet Force (CCF) RAF Sections.

ATC and CCF wishing to make the qualification available to their cadets need to seek approval from Headquarters Air Cadets, RAF Cranwell.

Access arrangements and special considerations

Pearson's policy on access arrangements and special considerations for Pearson BTEC and Pearson NVQ qualifications aims to enhance access to the qualifications for learners with disabilities and other difficulties (as defined by the 2Act) without compromising the assessment of skills, knowledge, understanding or competence.

Further details are given in the policy document *Access Arrangements and Special Considerations for Pearson BTEC and Pearson NVQ Qualifications*, which can be found on the Pearson website (qualifications.pearson.com). This policy replaces the previous Pearson policy (Assessment of Vocationally Related Qualifications: Regulations and Guidance Relating to Learners with Special Requirements, 2002) concerning learners with particular requirements.

Recognition of Prior Learning

Recognition of Prior Learning (RPL) is a method of assessment (leading to the award of credit) that considers whether a learner can demonstrate that they can meet the assessment requirements for a unit through knowledge, understanding or skills they already possess and so do not need to develop through a course of learning.

Pearson encourages centres to recognise learners' previous achievements and experiences whether at work, home and at leisure, as well as in the classroom. RPL provides a route for the recognition of the achievements resulting from continuous learning.

RPL enables recognition of achievement from a range of activities using any valid assessment methodology. Provided that the assessment requirements of a given unit or qualification have been met, the use of RPL is acceptable for accrediting a unit, units or a whole qualification. Evidence of learning must be sufficient, reliable and valid.

Unit format

All units in the Pearson BTEC level 2 Specialist qualifications have a standard format. The unit format is designed to give guidance on the requirements of the qualification for learners, tutors, assessors and those responsible for monitoring national standards.

Each unit has the following sections.

Unit title

This is the formal title of the unit that will appear on the learner's certificate.

Unit code

Each unit is assigned a unit code that appears with the unit title on the Register of Regulated Qualifications.

Level

All units and qualifications have a level assigned to them. The level assigned is informed by the level descriptors by Ofqual, the qualifications regulator.

Credit value

All units have a credit value. The minimum credit value that may be determined for a unit is one, and credits can only be awarded in whole numbers. Learners will be awarded credits for the successful completion of whole units.

Guided learning hours

Guided Learning Hours (GLH) is the number of hours that a centre delivering the qualification needs to provide. Guided learning means activities that directly or immediately involve tutors and assessors in teaching, supervising, and invigilating learners, for example lectures, tutorials, online instruction and supervised study.

Unit aim

The aim provides a clear summary of the purpose of the unit and is a succinct statement that summarises the learning outcomes of the unit.

Unit introduction

The unit introduction gives the reader an appreciation of the unit in the vocational setting of the qualification, as well as highlighting the focus of the unit. It gives the reader a snapshot of the unit and the key knowledge, skills and understanding gained while studying the unit. The unit introduction also highlights any links to the appropriate vocational sector by describing how the unit relates to that sector.

Learning outcomes

The learning outcomes of a unit set out what a learner is expected to know, understand or be able to do as the result of a process of learning.

Assessment and grading criteria

The assessment and grading criteria of a unit specify the standard a learner is expected to meet to demonstrate that a learning outcome, or set of learning outcomes, has been achieved. The learning outcomes and assessment and grading criteria clearly articulate the learning achievement for which the credit will be awarded at the level assigned to the unit.

Unit content

The unit content identifies the breadth of knowledge, skills and understanding needed to design and deliver a programme of learning to achieve each of the learning outcomes. This is informed by the underpinning knowledge and understanding requirements of the related National Occupational Standards (NOS), where relevant. The content provides the range of subject material for the programme of learning and specifies the skills, knowledge and understanding required for achievement of the unit.

Each learning outcome is stated in full and then the key phrases or concepts related to that learning outcome are listed in italics followed by the subsequent range of related topics.

Relationship between content and assessment criteria

The learner should have the opportunity to cover all of the unit content.

It is not a requirement of the unit specification that all of the content is assessed. However, the indicative content will need to be covered in a programme of learning in order for learners to be able to meet the standard determined in the assessment criteria.

Content structure and terminology

The information below shows how the unit content is structured and gives the terminology used to explain the different components within the content.

- Learning outcome: this is shown in bold at the beginning of each section of content.
- Italicised sub-heading: it contains a key phrase or concept. This is content which must be covered in the delivery of the unit. Colons mark the end of an italicised sub-heading.

- Elements of content: the elements are in plain text and amplify the sub-heading. The elements must be covered in the delivery of the unit. Semi-colons mark the end of an element.
- Brackets contain amplification of content which must be covered in the delivery of the unit.
- 'eg' is a list of examples, used for indicative amplification of an element (that is, the content specified in this amplification could be covered or could be replaced by other, similar material).

Essential guidance for tutors

This section gives tutors additional guidance and amplification to aid understanding and a consistent level of delivery and assessment. It is divided into the following sections.

- *Delivery* – explains the content's relationship to the learning outcomes and offers guidance about possible approaches to delivery. This section is based on the more usual delivery modes but is not intended to rule out alternative approaches.
- *Assessment and grading* – gives amplification about the nature and type of evidence that learners need to produce in order to achieve the unit. This section should be read in conjunction with the assessment and grading criteria.
- *Essential resources* – identifies any specialist resources needed to allow learners to generate the evidence required for each unit. The centre will be asked to ensure that any requirements are in place when it seeks approval from Pearson to offer the qualification.
- *Indicative resource materials* – gives a list of learner resource material that benchmarks the level of study.

Units

Unit 1: Fundamental Principles of Airmanship for Air Cadets

Unit code: D/503/1999

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is for learners to gain knowledge of the important features of an airfield, of a passenger pre-flight briefing and types and features of aircraft used for air experience flying and gliding.

Unit introduction

One of the exciting activities available to Air Cadets is flying. Learners are given the opportunity to fly in powered aircraft and gliders. Learners will be able to take control of an aircraft and fly it under supervision. Then they can take part in a flying or gliding scholarship, giving them the opportunity to fly a powered aircraft or glider solo.

This unit provides foundation knowledge to prepare learners to undertake their first powered aircraft or glider flight. It details some important facts that learners must know in preparation for this kind of flying. It familiarises learners with the airfield, its layout, the aircraft and the procedures required to ensure a safe and pleasant flying experience.

The unit also provides the learner with the underpinning knowledge to develop their understanding of military and civilian flying. This is further developed in other units (eg *Unit 6: Airmanship Knowledge*, *Unit 8: Aircraft Handling and Flying Techniques* and *Unit 9: Principles of Air Power*).

Learning outcomes

On completion of this unit a learner should:

1 Know the features of an airfield

2 Know requirements for pre-flight briefings

3 Know features and types of aircraft used for Air Cadet flying and gliding

4 Know processes used to launch gliders and maintain flight

Unit content

1 **Know the features of an airfield**

Types of airfields and runways: airfield types, eg grass, triangle pattern, main instrument runway; advantages and disadvantages of each type

Runways: terminology and description for layout; identification of markings and numbering, eg magnetic heading; identifying various components of runway marking, eg taxiways, centre lines, runway, threshold markers; method of take-off/landing into wind

Features of an airfield: control tower; wind sock; runway; taxi way; barriers; dispersal areas; hangers; operational readiness platforms; aircraft servicing platforms; overrun areas; arrestor gear; airfield lighting (airfield identification beacon, obstruction lights, floodlighting, taxiway lights, holding position, approach lighting, threshold lights, runway lights, identification of types and locations)

2 **Know requirements for pre-flight briefings**

Pre-flight briefing: weather briefing; safety around the aircraft; getting into the aircraft

Safety equipment: fitting of safety equipment; understand the function and operation of the helmet; understand the function and operation of the parachute; understand the function and operation of the buoyancy aid

Emergency in air: dealing with emergencies; exiting aircraft on the ground; exiting the aircraft in flight; emergency radio contact

3 **Know features and types of aircraft used for Air Cadet flying and gliding**

Training aircraft: features of aircraft type (Tutor, Vigilant, Viking); altimeter; attitude indicator; airspeed indicator; vertical speed indicator; turn slip indicator

Aircraft control surfaces and their purpose: rudder; aileron; elevator; airbrakes

4 **Know processes used to launch gliders and maintain flight**

Process to get gliders airborne: winch launch gliders and use of the winch, eg Viking; self-launched gliders eg Vigilant

Soaring: principles of thermals and lift; use of instruments that aid soaring, eg variometer

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Describe types of runway layouts found on airfields	M1 Explain purpose of types of runway markings	
P2 Describe main features of airfields	M2 Explain purposes of types of airfield lighting	D1 Evaluate the strengths and weaknesses of airfield designs
P3 Describe pre-flight briefings	M3 Explain purpose of pre-flight briefings	
P4 Identify functions and operations of safety equipment as part of pre-flight briefings		
P5 Describe actions required in emergencies by pilots and passengers		
P6 Describe key features of Tutor, Vigilant and Viking aircraft	M4 Explain purpose and use of flight instrument of featured aircraft types	D2 Analyse effects of control surfaces on aircraft's attitude from straight and level flight
P7 Identify important aircraft control surfaces used in flight		
P8 Describe processes used to launch gliders		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduce the features of an airfield.
Introduce the development and types of airfields and runways. Explain the development of airfields and runways through history. Explain the different airfield types, eg grass, triangle pattern and main instrument runway. Explain the advantages and disadvantages of each type of airfield.
Introduce runways. Explain the identification of markings and numbering of runways. Explain how to identify various components of runway marking, including taxiways, centre lines, runway and threshold markers. Explain the method of take-off/landing into wind. Explain the identification of runway numbering, including magnetic heading.
Explain the layout of an airfield. Explain the correct terminology and description.

Topic and suggested assignments, activities and assessment
Introduce the main components of an airfield. Explain the main features of an airfield, including control tower, wind sock, runway, taxi-way, barriers, dispersal areas, hangers, operational readiness platforms, aircraft servicing platforms, overrun areas and arrestor gear.
Introduce airfield lighting. Explain the identification of types and locations, including airfield identification beacon, obstruction lights, floodlighting, taxiway lights, holding position, approach lighting, threshold lights and runway lights.
Learners should research aerial maps and aviation charts to compare different airfield layouts. Google Earth is a good source.
Learners should build a simple model of an airfield, including layout runways, features and components.
Formative assessment of the features of an airfield.
Introduce what is required for a passenger pre-flight briefing.
Introduce the pre-flight briefing. Explain the weather briefing. Explain safety around the aircraft. Explain getting into the aircraft.
Introduce safety equipment. Explain the fitting of safety equipment. Explain the function and operation of the helmet. Explain the function and operation of the parachute. Explain the function and operation of the buoyancy aid.
Introduce the processes of dealing with emergency in air. Explain dealing with emergencies. Explain exiting aircraft on the ground. Explain exiting the aircraft in flight. Explain emergency radio contact.
Learners should watch the pre-flight safety video.
Learners should practice emergencies in a flight simulator.
Formative assessment of what is required for a passenger pre-flight briefing.
Introduce the features and types of aircraft used for air experience flying and gliding.
Introduce the Tutor, Vigilant and Viking training aircraft. Explain how to recognise the features of the Tutor. Explain how to recognise the features of the Vigilant. Explain how to recognise the features of the Viking.

Topic and suggested assignments, activities and assessment
Explain how to recognise flight instruments and their role in training aircraft, including altimeter, attitude indicator, airspeed indicator, vertical speed indicator and turn slip indicator (Viking and Vigilant).
Explain the aircraft control surfaces and their effects on aircraft, including rudder, aileron, elevator and airbrakes.
Introduce the process to get gliders airborne. Explain how winch launch gliders get airborne and use of the winch, using the Viking as an example. Explain how self-launched gliders get airborne using the Vigilant as an example.
Explain the purpose and methods of soaring in gliders. Explain the principles of thermals and lift. Explain the use of instruments aid soaring, including the variometer.
Formative assessment of the features and types of aircraft used for air experience flying and gliding.
Learners should practice flying skills and instrument recognition on flight simulators.
Learners visit an operational airfield and if possible a second airfield to look for differences.
Learners undertake a flight in a powered light aircraft or glider and experience the safety aspects, pre-flight and post-flight checks, use of instruments and controls, circuit procedures and ground handling methods.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 2: Map Reading for Air Cadets

Unit code: F/503/2000

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to enable learners to gain knowledge in the scales and features of Ordnance Survey maps, and of how to plan routes using Ordnance Survey maps. Learners will also gain skills in using UK grid reference systems to find a location.

Unit introduction

This unit provides learners with the understanding necessary at ATC First Class Cadet/CCF Part 1 – Basic training level for them to appreciate how to read and use a map.

The unit introduces the learner to the basics of map reading, starting with learning about latitude and longitude, before progressing to the concept of the National Grid, map types, scale and the language of maps.

The learner will examine and read maps to enable them to become familiar with interpreting features of the land, such as ground types, roads and pathways and the general lie of the land from map contour lines. Finally, the learner will be expected to plan a route from a map, taking into consideration the gradient of slopes and line of sight.

Learning outcomes

On completion of this unit a learner should:

1 Know scales and features of Ordnance Survey maps

2 Be able to use the UK grid reference system

3 Be able to plan routes using Ordnance Survey map features and contour lines

Unit content

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1 **Know scales and features of Ordnance Survey maps**

Maps: need for maps; types and uses; curved surface flattened to fit on paper

Scale and main symbols on an Ordnance Survey map: information found on maps; trig points; conventional signs and symbols; contour lines; map revision; map identification; distance and scales, eg scale lines

2 **Be able to use the UK grid reference system**

Grid referencing: use of the National Grid system; longitude (Prime Meridian, lines of longitude, degrees and minutes); latitude; grid referencing systems (UK 4-figure and 6-figure); eastings and northings; north (true, grid, magnetic); distance (calculations to find distance on Ordnance Survey maps)

3 **Be able to plan routes using Ordnance Survey map features and contour lines**

Considerations when planning routes: features of the land shown on maps (convex and concave slopes, lie of the land, ridges, saddles and cols, spurs and re-entrants, escarpment and knoll, vertical interval and horizontal equivalent, intervisibility, elevation); projection (draw section of land profile by projection; line of sight may not be reliable); relief (methods of showing height, units of measurement); methods of showing shape (hachures, hill shading); steepness and direction (steep or gentle slopes, facing which way)

Contour lines: purpose, eg calculating the gradient of a slope from information obtained; contour plans; gradients expressed as a ratio; visualising gradients; visualising techniques

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Describe the types and uses of maps	M1 Explain the importance of the use of scale and symbols on Ordnance Survey	
P2 Identify the main symbols on Ordnance Survey maps		
P3 Use grid-referencing systems on Ordnance Survey maps to find locations		
P4 Describe the main land features found on Ordnance Survey maps when planning routes	M2 Explain why land features shown on Ordnance Survey maps are important for planning routes	D1vPlan accurate routes using the features of an Ordnance Survey map
P5 Use contour lines on Ordnance Survey maps to plan routes	M3 Assess the slope gradient when planning routes	D2 Analyse sections of land profile by projection from map contour lines to get accurately from one point to the next

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content, and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Discuss the need for maps and their early examples. Learners to research the types and uses of maps and share with group. Demonstrate the care of maps. Explain how maps are made; curved surface flattened to fit on paper.
Introduce the scale and main symbols found on Ordnance Survey maps. Learners to examine the information found on maps; trig points, conventional signs and symbols, contour lines, map revision, map identification, distance and scales. Learners are to relate the symbols to the real-life features that they represent.
Practical field exercise identifying map symbols.
Review the features of an Ordnance Survey map and undertake formative assessment.

Topic and suggested assignments, activities and assessment
Introduce the UK grid reference system. Use of the UK National Grid system. Examine latitude and longitude, its history, uses, the Prime Meridian, lines of latitude and longitude, degrees and minutes. UK 4-figure and 6-figure grid-referencing systems – demonstrate and practice. Explain what true, grid and magnetic north are and what are the differences. Explain the principle of easting and northings. Learners to calculate distances on Ordnance Survey maps and relate them to actual distances on the ground.
Practical field exercise using the grid referencing systems to identify location, route and destination.
Review the UK grid referencing system and undertake formative assessment.
Introduce route planning using Ordnance Survey map features and contour lines. Explain and demonstrate the use of contour lines. Calculate the gradient of a slope and expressed gradients as a ratio – use visualising techniques to be able to visualise gradients.
Explain how the features of the land are shown on a map and what they are called. Convex and concave slopes. Ridges, saddles and cols. Spurs and re-entrants. Escarpment and knoll. Vertical interval and horizontal equivalent. Intervisibility. Elevation. How these features describe the lie of the land.
Explain how relief is shown on Ordnance Survey maps. Demonstrate the methods of showing height and the units of measurement. Demonstrate the methods of showing shape using hachures and hill shading. Examine how steepness and direction are displayed on Ordnance Survey maps.
Explain the principle of projection. Learners to draw a section of land profile by projection and discuss why line of sight may not be reliable.
Practical field exercise to put into practice the identification and use of map features, contour lines and basic route planning.
Review the map features, contour lines and basic route planning and undertake formative assessment.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 3: Planning Safe Walking Expeditions

Unit code: J/503/2001

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to give learners an understanding of the basics of safe expedition training and planning. Learners will also explore the principles of camp-craft, expedition walking skills and learn how to recognise and treat the effects of heat and cold on individuals.

Unit introduction

This unit provides the learner with an understanding of the basics in expedition training required at ATC First Class Cadet level. The unit introduces the learner to the expedition planning and walking skills needed to prepare for a walking expedition.

The equipment and clothing needed for this type of expedition are examined, in addition to how they are used and carried. The principles of camp-craft are explored, including how to set-up a campsite, basic hygiene methods and the use of cooking equipment. The idea that an enjoyable experience while camping includes being safe, warm and comfortable is explained.

The effects of heat and cold while undertaking an expedition are explored in detail. The learner will be expected to recognise the effects of heat and cold on individuals, and be able to treat exposure and heat exhaustion or heat stroke. Importantly, the learner will also need to know how to prevent these conditions.

Learning outcomes

On completion of this unit a learner should:

1 Know how to plan and prepare for safe walking expeditions

2 Be able to use tents and carrying equipment safely

3 Understand the principles of safe camp-craft on an expedition

4 Understand how to recognise and treat the effects of hypothermia and heat on individuals

Unit content

1 **Know how to plan and prepare for safe walking expeditions**

Factors to consider when planning walking expeditions: expedition factors, eg length of route, type of ground, weather conditions; personnel factors, eg experience, age, fitness of individual and group as a whole, number of individuals in group

Considerate use of the countryside: preservation and conservation the countryside, eg footpath erosion, care of walls, fences, gates and stiles, litter, accidental fires, care of plants and animals, pollution; Countryside Code

Route planning: route; terrain; escape routes; route cards; use of Naismith's Rule; use of private land; timetable; planning for distance to travel; weather; time to destination

Equipment and clothing: personal equipment, eg boots, waterproof clothing, map, compass, whistle, rucksack, large polythene bag, personal first aid kit, emergency rations, foot care and blister material; additional equipment for leader, group first aid kit, sleeping bag, mobile telephone, group shelter if no tents

Maintaining safety during expeditions: map-reading knowledge; how to summon help; walking pace and rhythm; care of feet; knowledge of weather conditions and precaution against adverse weather

2 **Be able to use tents and carrying equipment safely**

Tents: different types of design and their uses for different condition and varying types of expedition; methods for erection

Rucksacks: different types and their uses for varying types of expedition; packing methods and techniques

3 **Understand the principles of safe camp-craft on an expedition**

Warmth and comfort: types of sleeping bags, eg 2-season, 3-season; storage of sleeping bags; handling of wet clothing; storage of boots

Campsites: siting and striking camps; pitching a tent

Food and cooking: what to eat; how to prepare a meal; what to take on the expedition; how to pack food into a rucksack; stoves (main types, eg gas, methylated spirit, solid fuel or gel; storage; use; safety)

Hygiene: aspects, eg clean water, cleanliness, food handling, litter and rubbish; toilets

4 **Understand how to recognise and treat the effects of hypothermia and heat on individuals**

Hypothermia: homeotherm; causes; dangers; recognition of signs and symptoms; factors that exacerbate condition; treatment; prevention

Effects of heat: types; sunburn; heat exhaustion; heat stroke; causes; recognition; factors that exacerbate condition; treatment; prevention

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Describe factors for consideration when planning a walking expedition	M1 Explain the importance of factors for consideration when planning a walking expedition	D1 Evaluate safety considerations for walking expeditions
P2 List the Countryside Code		
P3 Describe the purpose of a route card in a walking expedition		
P4 Identify how to prepare expedition equipment and clothing suitable for the walk being planned	M2 Explain the importance of correct equipment for safety for everyone in an expedition	
P5 Demonstrate the erection of tents for a walking expedition	M3 Use tents and carrying equipment appropriate for a specific expedition	D2 Justify selection of tents and carrying equipment for specific expedition scenarios
P6 Demonstrate methods of kit packing for an expedition		
P7 Describe the principles of warmth and comfort in camp		
P8 Describe the essentials of siting, pitching and striking a camp	M4 Explain principles of safe camp-craft on an expedition	

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9 Explain food and cooking safety considerations for expeditions		
P10 Explain the symptoms of hypothermia and heat excess		
P11 Describe how to treat hypothermia and heat excess		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF. The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training.

This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Outline the principles of walking expedition planning. Explain expedition factors, including length of route, type of ground, weather conditions. Explain personnel factors, including experience, age, fitness of individual and group as a whole, number of individuals in group.
Outline the principles of expedition skills. Explain what is required for map-reading knowledge. Explain and demonstrate how to summon help. Explain and demonstrate walking pace and rhythm. Explain care of feet. Explain weather conditions and precaution against adverse weather.
Introduce the principles of consideration of the countryside while on expeditions.

Topic and suggested assignments, activities and assessment
Introduce the concept of considerate camping. Explain the preservation and conservation of the countryside, including footpath erosion, care of walls, fences, gates and stiles, litter, accidental fires, care of plants and animals and pollution. Explain the Countryside Code.
Introduce the need for a timetable when on an expedition. Explain and demonstrate planning for distance to travel, weather, time to destination.
Learners to plan expedition timetables.
Outline the principles of route planning. Explain the use of routes. Explain how factors of terrain affect planning. Explain escape routes. Explain and demonstrate route cards. Explain use of Naismith's Rule. Explain the methods for the use of private land.
Learners to plan expedition routes and complete route cards.
Outline the principle of appropriate equipment and clothing. Explain and demonstrate personal equipment, including boots, waterproof clothing, map, compass, whistle, rucksack, large polythene bag, personal first-aid kit, emergency rations, foot care and blister material. Explain and demonstrate additional equipment for leader, including group first-aid kit, sleeping bag, mobile telephone, group shelter if no tents.
Learners to view training videos and online training material such as those produced by the Duke of Edinburgh Award.
Formative assessment on planning and preparation for walking expeditions.
Introduce the purpose of different tents and methods of carrying equipment.
Explain different types of design of tent and their uses for different condition and varying types of expedition. Explain and demonstrate tent erection methods.
Learners practise tent erection.
Explain and demonstrate different types of rucksack and their uses for varying types of expedition. Explain and demonstrate rucksack packing methods and techniques.
Learners to practise rucksack packing.
Formative assessment of the purpose of different tents and methods of carrying equipment.

Topic and suggested assignments, activities and assessment
Explain the siting and striking of camps. Explain and demonstrate pitching a tent.
Introduce the topic of food and cooking on expeditions. Explain what to eat. Explain and demonstrate how to prepare a meal. Explain what to take on the expedition. Explain and demonstrate how to pack food into a rucksack.
Learners to plan menus for expeditions.
Introduce the topic of the types of stoves used on expeditions. Explain and demonstrate main types of stoves, including gas, methylated spirit, solid fuel and gel. Explain and demonstrate storage. Explain and demonstrate use. Explain and demonstrate safety.
Learners to cook meals on expedition stoves.
Introduce the concept of warmth and comfort on expeditions. Explain and demonstrate the types of sleeping bags, including 2-season, 3-season. Explain and demonstrate the storage of sleeping bags. Explain and demonstrate the handling of wet clothing. Explain and demonstrate the storage of boots.
Introduce the concept of hygiene. Explain aspects of hygiene, including clean water, cleanliness, food handling, litter and rubbish. Explain the use the types of toilets on tent sites.
Formative assessment of principles of camp-craft use for expeditions.
Introduce how to recognise and treat the effects of hypothermia and heat on individuals.
Introduce the subject of hypothermia. Explain the term ‘homeotherm’. Explain the causes and dangers of hypothermia. Explain the methods of recognition of the signs and symptoms of hypothermia. Explain the factors that exacerbate the condition. Explain the treatment and prevention of hypothermia.

Topic and suggested assignments, activities and assessment
Introduce the subject of the effects of heat. Explain the types of heat effect, including sunburn, heat exhaustion and heat stroke. Explain the causes of heat effects and their recognition. Explain the factors that exacerbate the condition. Explain the treatment and prevention of the effects of heat.
Formative assessment of effects of hypothermia and heat on individuals.
Learners should plan, prepare and undertake a walking expedition.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 4: Radio Communications for Air Cadets

Unit code: L/503/2002

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

This unit gives learners an appreciation of the communication equipment and techniques used by Air Cadets and the Air Cadet Organisation. The unit covers the use of phonetics, message sending and radio equipment.

Unit introduction

This unit gives the learner an understanding of communications required at ATC First Class Cadet level. It serves as an introduction to the Air Cadet radio network.

The unit explores the principles of message passing and its key features. It considers aspects of radio communication, including the phonetic alphabet, message structure and the limitations and effectiveness of types of radio. The unit also develops learners' awareness of effective communications networks.

Learning outcomes

On completion of this unit a learner should:

1 Understand types of radio equipment used within the Air Cadet Organisation

2 Be able to send messages on the Air Cadet radio network

3 Be able to follow procedures needed for the safe use of radio

Unit content

1 **Understand types of radio equipment used within the Air Cadet Organisation**

Type of equipment: base stations (permanent, temporary); mobile units in vehicles; hand held transceiver; output power; batteries; battery life

Frequency of operation: radio spectrum; HF; VHF; UHF; choice for range; type of aerial; calculation of length of aerial size

Radio station set-up: choice and location of aerial; power supply; cables; radio relay systems

2 **Be able to send messages on the Air Cadet Radio Network**

Message-passing methods: radio check; signal strength; readability; send and receive message process; battleships; message-passing exercise; abbreviated callsigns; authentication

Procedures: security; callsigns; phonetic alphabet; pronunciation; discipline; message format; prowords, eg over, out, wilco, roger; microphone technique RSVP, eg rhythm, speed, volume, pitch; map reference processes; giving the time

Networks: directed; free; net control station; choice of control station; function; location

Send radio message: practical message-sending and receiving exercise

3 **Be able to follow procedures needed for the safe use of radio**

S*afety procedures and handling:* care and transportation of batteries; choice of battery types; assembly of hand held transceiver; correct method of holding unit for clear speech; correct method of carriage of a hand held transceiver

Health and safety: dangers of radio frequency radiation; aerial proximity; trip hazards with cables; proximity of foods and beverages to equipment/power supply; fire safety precautions

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Describe characteristics of types of radio equipment used within the Air Cadet radio networks		
P2 Describe how radio equipment's operational frequency can limit its use		
P3 Outline the link between aerials and the range of radio transmissions	M1 Explain the relationship between frequency and aerial length	
P4 Describe the features of an Air Cadet radio network that enable sending messages	M2 Explain the construction of the callsign used by an Air Cadet unit and how a mobile callsign would be constructed from a base callsign	D1 Evaluate the factors which will influence the choice of control station
P5 Use the phonetic alphabet to spell words and convey figures in radio messages		
P6 Use radio procedures to obtain radio checks	M3 Use radio procedures to convey messages using correct messaging techniques	D2 Use radio procedures to relay message to other stations which are out of reach from the originating station

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P7 Demonstrate the safe care, handling and disposal of radio batteries	M4 Demonstrate the safe assembly of a handheld radio, battery and aerial	
P8 Show correct safety procedures when using portable radio equipment		
P9 Identify health and safety issues associated with radio operations when using radio equipment		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to the radio equipment used within the Air Cadet Organisation. Explain and demonstrate types of Air Cadet radio stations. Explain and demonstrate types of networks, directed and free. Explain a net control station.
Explain types of equipment. Explain and demonstrate base stations, permanent and temporary. Explain and demonstrate mobile units in vehicles. Explain and demonstrate hand held transceiver. Explain and demonstrate output power. Explain and demonstrate batteries and battery life.

Topic and suggested assignments, activities and assessment
Explain frequency of operation. Explain radio spectrum. Explain HF, VHF and UHF. Explain choice for range. Explain and demonstrate the types of aerial. Explain the calculation of length of aerial size.
Explain and demonstrate radio station set-up. Explain and demonstrate the choice and location of aerial. Explain and demonstrate power supplies. Explain and demonstrate cables. Explain radio relay systems.
Formative assessment of radio equipment and uses.
Introduce the methods and processes for sending messages on the Air Cadet radio network.
Explain radio networks. Explain the choice of a control station. Explain functions. Explain locations. Explain experience.
Explain and demonstrate radio procedures. Explain security methods and procedures and processes. Explain and demonstrate callsigns. Explain and demonstrate phonetic alphabet. Explain and demonstrate pronunciation. Explain radio discipline and why it is needed. Explain and demonstrate message format. Explain and demonstrate prowords. Explain and demonstrate microphone technique and RSVP (rhythm, speed, volume, pitch).
Explain and demonstrate map reference processes for radio messaging. Explain and demonstrate giving the time for radio messaging.

Topic and suggested assignments, activities and assessment
Explain and demonstrate message-passing methods. Explain and demonstrate radio check method. Explain signal strength. Explain and demonstrate readability method. Explain and demonstrate send and receive message process. Explain and demonstrate how a battleships game can be carried out over a radio network. Explain and demonstrate a message-passing exercise. Explain and demonstrate abbreviated callsigns. Explain and demonstrate authentication methods.
Learners to practise methods of message-sending and receiving and procedures. Learners to undertake a series of radio-operating exercises with support. Learners to undertake a series of radio-operating exercises without support.
Formative assessment of message sending over radio networks.
Introduce the procedures to be followed for the safe use of radio within the Air Cadet Organisation.
Explain and demonstrate safety procedures and safe handling. Explain and demonstrate the care and transportation of batteries. Explain and demonstrate the choice of battery types. Explain and demonstrate the assembly of hand held transceiver. Explain and demonstrate the correct method of holding a unit for clear speech. Explain and demonstrate the correct method of carriage of a handheld transceiver.
Explain health and safety related to radio equipment and use. Explain the dangers of radio frequency radiation. Explain aerial proximity. Explain trip hazards with cables. Explain the proximity of foods and beverages to equipment/power supply. Explain fire safety precautions.
Formative assessment of the safe use of radio equipment.
Learners to visit a radio museum, research online information on radio types and use, or visits to public services like police, fire and ambulance.
Learners to visit an aerospace museum or active airfield to see radios in use in aircraft.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers and observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 5: Principles of Flight

Unit code: R/503/2003

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to enable learners to gain knowledge of the principles of flight and the application of these principles to gliders and rotary wing aircraft.

Unit introduction

This unit gives the learner an understanding of the principles of flight required at ATC Leading Cadet and CCF Part 2 level.

The unit explores the principles by which heavier-than-air aircraft fly. It considers basic aerodynamics, factors that affect lift, stability and control of aircraft in flight and the application of these principles to gliders and rotary wing aircraft.

Learning outcomes

On completion of this unit a learner should:

1 Understand the principles of flight

2 Understand how the stability and manoeuvrability of an aeroplane are controlled

3 Know the principles of flight and control for gliders

4 Know the principles of flight and control for rotary wing aircraft

Unit content

1 **Understand the principles of flight**

Factors affecting aeroplanes in flight: Newton's Third Law; air as a substance and the effects of moving air; Bernoulli's principle; lift creation and distribution; variation of lift with airspeed; angle of attack; air density and wing shape; creation and effect of drag; gravity and weight; centres of gravity and pressure; variation of drag with airspeed

Aircraft design: methods of producing lift; parts of the wing, eg chord line, leading edge, trailing edge; wing shapes and areas, eg high lift, high speed, general purpose; effect of streamlining

Effects on aircrafts in flight: lift and weight in straight and level flight; thrust and total drag in straight and level flight; principle of aircraft in balance

2 **Understand how the stability and manoeuvrability of an aeroplane are controlled**

How stability and manoeuvrability are controlled: effects of tail-plane and tail-fin; dihedral main-plane configuration; movement of aircraft in three dimensions; pitching, yawing and rolling planes; lateral, longitudinal and normal axes; need for stability

Design features that control stability and manoeuvrability: centre of gravity; centre of pressure; stability and aircraft role; why it varies from aircraft to aircraft; controls that provide stability and manoeuvrability and their location

Effect of aircraft flying controls: effects of elevators, ailerons and rudder; use and effects of trimming tabs, flaps and slats; need for manoeuvrability; use of pilot controls, eg control column and rudder pedals

Stalling: effects of increasing angle of attack; cause of stalling; stalling angle; conditions affecting stalling speed; stalling and aircraft attitude; effects of flaps and slats; role of airbrakes

3 **Know the principles of flight and control for gliders**

Effect of principles of flight and control on gliders: methods of maintaining airspeed and lift; methods of controlling speed, lift and stalling; use of airbrakes; balance of forces on a glider; range of flight and glide angle; effect of wind

4 **Know the principles of flight and control for rotary wing aircraft**

Factors that affect flight and control of rotary wing aircraft: generation of lift by rotating wings; altering angle of attack of rotary wings; collective pitch control; horizontal helicopter flight and cyclic pitch control; countering torque reaction with tail rotor; contra-rotating rotors; use of helicopter cyclic pitch, collective, foot pedals and throttle; effect of flight and control on rotary wing aircraft; use and location of flapping and drag hinges

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Identify factors that affect the creation of lift in an aircraft in flight	M1 Explain ways in which a "swing wing" aeroplane's performance changes with wing geometry	D1 Analyse how force of lift acting on an aeroplane in flight can be varied to compensate for variations in the other forces
P2 Describe how thrust and drag, weight and lift affect aircraft in flight	M2 Explain how lift, weight, drag and thrust could change while an aeroplane is in flight	
P3 Explain how stability of an aeroplane is maintained	M3 Explain how flaps, slats and airbrakes are used by aircraft during safe landing	D2 Analyse the effect of manoeuvring at critically low airspeed
P4 Explain factors which cause an aeroplane wing to stall		
P5 Explain how aeroplanes are designed to provide manoeuvrability		
P6 Describe how aircraft and controls can be used for manoeuvrability		
P7 Identify forces acting on a glider in flight		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P8 Identify the features of rotary wing aircraft that enable flight and control	M4 Compare and contrast the principles behind use of helicopter rotor and fixed wing aircraft rudder to manoeuvre aircraft in the yawing plane	

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduce the principles of lift, weight, thrust and drag and how a balance of forces affects an aeroplane in flight. Introduce basic aerodynamic concepts. Examine Newton's Third Law. Discuss air as a substance and the effects of moving air. Demonstrate Bernoulli's principle. Explain lift creation and distribution. Explain variation of lift with airspeed. Demonstrate angle of attack principles. Explain air density and wing shape. Demonstrate the creation and effect of drag. Discuss gravity and weight. Explain and demonstrate centres of gravity and pressure. Demonstrate the variation of drag with airspeed.

Topic and suggested assignments, activities and assessment
Introduce engineering and design concepts. Discuss methods of producing lift. Examine parts of the wing, including chord line, leading edge and trailing edge. Examine wing shapes and areas, including high lift, high speed and general purpose. Demonstrate the effects of streamlining.
Introduce advanced aerodynamic concepts. Explain lift and weight in straight and level flight. Explain thrust and total drag in straight and level flight. Explain the principle of the aircraft in balance.
Learners demonstrate the practical application of aerodynamic principles using models of their own design.
Formative assessment of principles of lift, weight, thrust and drag and how a balance of forces affects an aeroplane in flight.
Introduce how the stability of an aeroplane is maintained in flight and how manoeuvrability is controlled. Demonstrate the effects of the tail-plane and tail-fin. Explain dihedral main-plane configuration. Demonstrate movement of aircraft in three dimensions, about its pitching, yawing and rolling planes, and lateral, longitudinal and normal axes. Explain the need for stability.
Introduce engineering and design concepts. Explain how the centres of gravity and pressure are incorporated into the design. Explain how stability and aircraft role is designed into the aircraft. Explain why it varies from aircraft to aircraft. Explain the controls that provide stability and manoeuvrability and their location.
Explain and demonstrate the effects of elevators, ailerons and rudder. Explain the use and effects of trimming tabs, flaps and slats. Demonstrate the need for manoeuvrability. Explain the use of pilot controls, including control column and rudder pedals.
Formative assessment of principles of lift, weight, thrust and drag and how a balance of forces affects an aeroplane in flight.

Topic and suggested assignments, activities and assessment
Introduce the principles of stalling. Demonstrate the effects of increasing angle of attack. Explain the cause of stalling. Explain the stalling angle and the conditions affecting stalling speed. Examine the relationship between stalling and aircraft attitude. Explain the effects of flaps and slats and role of airbrakes.
Formative assessment of the principles of stalling.
Learners should be introduced to videos of the concepts developed so far.
Learners should visit an operational airfield or aerospace museum.
Learners should experience a flight in a light aircraft to consolidate learning.
Introduce the principles of flight and control related to gliders. Examine the methods of maintaining airspeed and lift. Explain the methods of controlling speed, lift and stalling. Demonstrate the range of flight and glide angle. Explain the effect of wind. Demonstrate the balance of forces on a glider. Explain the construction and use of airbrakes. Learners should build a model glider and experiment with the principles of flight that relate to gliders.
Formative assessment of the principles of flight and control related to gliders.
Learners should an air experience flight in a glider to understand the concepts.
Introduce the principles of flight and control to rotary wing aircraft. Explain the generation of lift by rotating wings. Demonstrate altering angle of attack of rotary wings. Explain the collective pitch control. Explain horizontal helicopter flight and cyclic pitch control. Explain the countering torque reaction with tail rotor. Explain contra-rotating rotors. Explain the use of helicopter cyclic pitch, collective, foot pedals and throttle. Explain the use and location of flapping and drag hinges. Learners should view videos of these principles in action and if possible visit an airfield to see helicopters in action, or visit an aerospace museum.
Formative assessment of the principles of flight and control to rotary wing aircraft.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 6: Airmanship Knowledge for Air Cadets

Unit code: H/503/2006

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is for learners to gain knowledge of the airfield operations and develop their knowledge of military service aircraft.

Unit introduction

This unit builds on the knowledge learnt in *Unit 1: Fundamental Principles of Airmanship for Air Cadets*. The aim of the unit is to further the learner's awareness and understanding of aircraft operations, develop their appreciation of the rules of the air and increase their familiarity with aircraft flown and operated by military air forces.

This unit looks at developing the knowledge of airfield organisation. The focus is on the principles of air traffic control, identifying the key roles and components of an air traffic control system and looking at aids which control aircraft movements on and around the airfield and in the air.

Learners develop an understanding of the Rules of the Air. This is underpinning information for practical flying courses and pilot training. It gives an outline of what is effectively a 'Highway Code' of aviation and how this is applied in day and night conditions. This also provides vital underpinning knowledge for *Unit 8: Aircraft Handling and Flying Techniques.*

The final part of the unit examines methods of identifying military aircraft.

Learning outcomes

On completion of this unit a learner should:

1 Know types of airfield operations used for the control of aircraft

2 Know the Rules of the Air

3 Know how to identify military aircraft

Unit content

1 **Know types of airfield operations used for the control of aircraft**

Components of an air traffic control system: aerodrome controller; approach controller; runway controller; roles and areas of responsibilities of controllers; their locations in/on airfields; how aircraft are managed around an airfield according to each air traffic control system

Communications: main systems used by air traffic control; special telephones; tele-talk; radio telephony; their special roles within the air traffic control system; positive and negative points of each

Aids: signs and symbols on the airfield; control of aircraft movements on the ground; air traffic control aids for aircraft in flight; surveillance radar; precision approach radar; instrument landing systems

2 **Know the Rules of the Air**

Rules of the Air: main types of aircraft defined, eg balloon, glider, airship, powered aircraft; reasons for rules of the air; identifying aircraft at night (navigation light placements)

Right of way: rights of way for dissimilar aircraft types; rights of way for each type of aircraft (aircraft overtaking, approaching head-on, converging, approaching to land, landing in an emergency)

Clock code: describing the location of an aircraft in the air using the clock system; altitude, eg high, level, low

3 Know how to identify military aircraft

Identity: aircraft suffix titles; uses of the type or reporting name; role letters, eg AEW airborne early warning, AH army helicopter, AL army liaison, ASaC airborne surveillance and control, B bomber, C transport cargo, CC transport cargo and communications, F fighter, GR ground attack and reconnaissance, HAR helicopter air rescue, HAS helicopter anti-submarine, HC helicopter transport cargo, HM helicopter maritime, HMA helicopter maritime attack, HT helicopter training, HU helicopter utility, K tanker, KC tanker and transport cargo, MR maritime reconnaissance, MRA maritime reconnaissance and attack, R reconnaissance, T training

Military aircraft types: characteristics; roles in air power, eg ground attack, fighter, airborne early warning, reconnaissance, air transport, air-to-air refuelling, helicopter transport, training, historic, maritime, attack

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Describe roles of aerodrome, approach and runway controllers	M1 Explain the process used to hand responsibility between different air traffic controllers	D1 Justify the importance of effective communication around the airfield
P2 Describe main communication methods used by air traffic control	M2 Compare methods of communication used by air traffic control	
P3 Describe radar methods used in airfield operations		
P4 Identify the classes of aircraft within Rules of the Air	M3 Explain why each class of aircraft has different rights of way within the Rules of Air	D2 Assess the importance of following the Rules of the Air
P5 Describe the rules for similar aircraft when: overtaking, approaching head on, converging, approaching to land and landing in an emergency		
P6 Identify the navigation light placements for classes of aircraft	M4 Explain the importance of different navigation lights for each aircraft class	
P7 Describe the clock code reporting method		
P8 Describe military aircraft suffix titles and their meanings		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduce the components of an air traffic control system. Explain the roles and areas of responsibilities of aerodrome controllers. Explain the roles and areas of responsibilities of approach controllers. Explain the roles and areas of responsibilities of runway controllers. Explain the locations in or on airfields of these controllers. Explain how aircraft are managed around an airfield according to each air traffic control system.
Introduce the communications used in airfield operations and air traffic control. Explain the main systems used by air traffic control. Explain special telephones. Explain tele-talk. Explain radio telephony. Explain the special roles of communications equipment within the air traffic control system. Explain the positive and negative points of each type of equipment.

Topic and suggested assignments, activities and assessment
Introduce the aids used in airfield operations and air traffic control. Explain the signs and symbols used on an airfield. Explain the control of aircraft movements on the ground. Explain the air traffic control aids for aircraft in flight. Explain the use of surveillance radar. Explain the use of precision approach radar. Explain the use of instrumental landing systems.
Learners should view videos which relate to airfields and aircraft control.
Learners should go to an active airfield to visit the air traffic control tower and talk to the controllers. Learners should also look for the visual aids used on an airfield.
Formative assessment of the types of airfield operations used for the control of aircraft.
Introduce the basic principles of the Rules of the Air.
Introduce the rules of the air. Explain the main types of aircraft defined in the rules of the air, including balloon, glider, airship and powered aircraft. Explain the reasons for the rules of the air. Explain how to identify aircraft at night.
Introduce the right of way of aircraft. Explain the rights of way for dissimilar aircraft types. Explain the rights of way for each type of aircraft, including aircraft overtaking, approaching head on, converging, approaching to land and landing in an emergency.
Introduce the clock code. Explain how to describe the location of an aircraft in the air using the clock system. Explain how to describe altitude, including high, level and low.
Learners should use themselves or aircraft models to simulate the practical use of the rules of the air.
Formative assessment of the basic principles of the Rules of the Air.
Introduce the method of identifying military aircraft types.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 7: Navigating on Land Using Map and Compass

Unit code: M/503/2008

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

This unit provides learners with the skills and knowledge to use an Ordnance Survey map and compass safely and accurately. The learner is also introduced to recognising weather conditions and how these can affect navigation on land.

Unit introduction

This unit provides the learner with the understanding necessary at Leading Cadet/CCF Part 2, this level of training introduces the use of map and compass safely, accurately and effectively.

The unit enables the learner to find north without a compass, orientate a map and know and understand the different types of north. It shows the learner how to use and describe the features of a lightweight compass for practical navigation. The unit introduces the learner to weather conditions and how they affect land navigation.

Learning outcomes

On completion of this unit a learner should:

1 Be able to show the different types of north

2 Be able to use a map and lightweight walking compass for practical navigation

3 Know land navigation methods

4 Know weather conditions that affect land navigation

Unit content

1 **Be able to show the different types of north**

Types of north: true north; grid north; magnetic north; effects on navigation

Different between the types of north: variation between true north and grid north

Magnetic variation: reason and affect; grid magnetic angle; how displayed on Ordnance Survey maps

Find north without a compass: pole star; watch; shadows; physical features

2 **Be able to use a map and lightweight walking compass for practical navigation**

Compass types: types, eg lightweight, hand held compass

Parts of a compass: name of moving and static parts; purpose of the parts

Limitations: contact with magnetic sources; magnetic deviation; damage

Setting a map with a compass: purpose; method

Compass bearings: set a compass heading; walking on a bearing; transfer bearing to a map; resection, eg triangulation, finding a position using a compass; back bearing; search patterns

Scales and roamers: using a roamer to calculate grid reference and distance

Other methods to calculate distance on a map: ruler; string

3 **Know land navigation methods**

Timing and distance: methods; Naismith's Rule; factors, eg uphill, downhill, fitness, terrain; pace counting; errors; area of uncertainty; methods of reducing error

Handrailing: use of linear features to navigate, eg following a power line or wall

Aiming off: not aiming for a particular point but to one side and knowing which way to turn when the aim off point is reached

Contouring: walking around a hill instead of over the top; advantages and disadvantages

Attack points: aim for an easily identifiable feature to improve accuracy

4 **Know weather conditions that affect land navigation**

Atmosphere: movement of air masses; main air masses, their origin and typical weather conditions, eg arctic maritime, polar maritime, polar continental, returning polar maritime, tropical maritime, tropical continental

Fronts and frontal depressions: typical weather maps; measurement, eg isobars; anticyclones, warm and cold fronts; occluded front; upper winds

Cloud formations: how clouds types are named, eg cirrus, alto, cumulus, stratus; how clouds are related to altitude and specific weather conditions, eg cumulonimbus, a low-level rain cloud

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Identify the different types of north	M1 Explain what is meant by different types of north and the variation between them	
P2 Explain how to find true north using a map without a compass		
P3 Identify the features of a lightweight walking compass	M2 Explain how a map and compass are used to navigate between two points	D1 Justify position on a map using a compass
P4 Carry out basic calculations using map and compass to calculate direction of travel and position		
P5 Calculate timings of walks using Naismith's Rule		
P6 Identify what is meant by handrailing, aiming off, contouring and attack points		
P7 Identify how high and low atmospheric pressure affects land navigation	M3 Describe the influence of weather frontal systems on land navigation	D2 Evaluate the effect of depressions on land navigation
P8 Describe cloud formations that affect land navigation		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduction to finding a position with an Ordnance Survey map using the physical features of the land. Finding north without a compass using pole star, using a watch, shadows, physical features of the land to orient the map to determine north.
Practical field exercise practising methods of finding positions using the physical features.
Formative assessment of how to find north without using a compass.
Introduction to different types of north. True, grid and magnetic north and their effects on navigation. Different between the types of north. Variation between true north and grid north. Magnetic variation: reason and affect; grid magnetic angle; how displayed on Ordnance Survey maps. Practical exercises.
Formative assessment of definitions and uses of north.

Topic and suggested assignments, activities and assessment
Introduction to a lightweight compass for practical navigation. Examine different types of compass and their uses. Examine the parts of a compass, naming them and their purpose. Discuss the limitations such as contact with magnetic sources, magnetic deviation and damage. Learners to experiment with different magnetic sources to see the results. Use a roamer to calculate grid reference and distance. Examine other methods to calculate distance on a map with a ruler, string, etc. Learners use different methods to calculate distances on a map.
Demonstrate how to set a map with a compass and the reasons why. Learners to practice in a field exercise.
Introduce compass bearings. Demonstrate and practice how to set a compass heading. Demonstrate and practice how to walking on a bearing. Demonstrate and practice how to transfer bearing to a map. Demonstrate and practice resection methods. Demonstrate and practice how to take and use back bearings. Explain search patterns and learners to practice.
Practical field exercise in using compass bearings.
Formative assessment of compass navigation.
Introduction to land navigation methods. Discuss methods of measuring distance on the ground when walking, the reasons and advantages. Learners to practice distance measurement. Explain timing methods, including Naismith's Rule and the factors affecting the time taken to travel a distance, eg uphill, downhill, fitness, terrain and load. Learners to practically experiment with timing methods and their factors. Introduce pacing and pace counting. Learners to practically experiment with pace counting. Discuss errors, percentages of error, area of uncertainty, methods of reducing error. Explain handrailing, use of linear features to navigate. Explain aiming off and why it is an important technique. Explain contouring, walking around a hill instead of over the top, including the advantages and disadvantages of this technique. Explain attack points, aiming for an easily identifiable feature to improve accuracy.

Topic and suggested assignments, activities and assessment
Practical field exercise practising land navigation methods.
Formative assessment of land navigation methods.
Introduce the weather conditions that affect land navigation.
Introduce the concept of atmosphere. Explain the movement of air masses and main air masses. Explain the origin of air mass movement and the typical weather conditions they represent, eg arctic maritime, polar maritime, polar continental, returning polar maritime, tropical maritime, tropical continental.
Explain fronts and frontal depressions. Examine typical weather maps and the measurements used. Explain anticyclones, warm and cold fronts. Explain occluded front. Explain upper winds. Learners should research examples of weather fronts and frontal depressions and the effects they had on people and places.
Introduce cloud formations. Explain how clouds are named. Explain types of clouds and how they are related to altitude. Demonstrate the different shapes of each type of cloud. Explain which clouds are related to specific weather conditions.
Practical field exercise practising cloud recognition.
Formative assessment of the weather conditions that affect land navigation.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 8: Aircraft Handling and Flying Techniques

Unit code: F/503/2014

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

This unit gives learners the knowledge of aircraft maintenance and techniques for ground handling aircraft, and of flight preparation procedures. Learners will also be introduced to the principles of general, aerobatic and formation flying.

Unit introduction

This unit examines the principles of aircraft maintenance in detail and the techniques of ground handling aircraft. Hazards are identified and safety aspects are examined. Preparation for a flight is a vital part of the process of flying and greatly contributes towards safety. General, acrobatic and formation flying are each examined. From circuit flying for training purposes to aerobatic flying, the range of military aircraft flying is explored.

Learning outcomes

On completion of this unit a learner should:

1 Know about aircraft maintenance and ground handling techniques

2 Know the procedures required for preparation for flight

3 Know the principles of general, aerobatics and formation flying

Unit content

1 **Know about aircraft maintenance and ground handling techniques**

Aircraft maintenance policy and objectives: balance between preventive and corrective maintenance and reasons; main categories, eg operational and maintenance; operational objectives eg provide aircraft needed to support commitments; maintenance objectives eg minimise costs and faults, improve reliability; forms of maintenance (preventative, corrective, contingency)

Preventative maintenance: servicing; scheduled maintenance; condition-based maintenance; out of phase maintenance

Corrective maintenance: fault based maintenance; condition monitoring techniques

Contingency maintenance: circumstances, eg war operations, transition to war; uses eg level of preventative maintenance considered essential in particular circumstances, planned programme maintenance for each aircraft type

Modifications: reasons, eg remedy, incorporate new technology, improve performance and safety; authorised and controlled, eg control costs, minimise downtime, safety of aircraft

Ground handling techniques: marshalling aircraft in the day and at night; marshalling procedures and signals; chocks; handling safety devices; blanks and coves; manhandling aircraft; towing aircraft; refuelling aircraft, types of fuel, eg AVGAS, AVTUR, AVTAG, AVCAT; aircraft loading; ground handling crew, roles and responsibilities

Ground handling hazards and how to reduce them: to personnel and aircraft due to ground handling; manual handling techniques; danger areas and zones eg propellers, rotor blades; wheel and brake fires; precautions whilst refuelling, eg earthing, correct grade of fuel, expansion space, location, filtering, footwear, naked flame, spillage, radio hazard, walkways, suitable fire extinguishers

2 **Know the procedures required for preparation for flight**

Personal preparation: familiar with aircraft and role; trained; understand aim of flight; fitness; orders read and understood; flying clothing

Flight planning key factors: roles and responsibility of crew; mission tasking; weather; navigation; flight planning; flight coordination; crew briefing and passenger briefings

Pre-flight checks: weather conditions; flight authorisation; air traffic control clearance; navigation calculation and preparation; maintenance records; approaching the aircraft; external checks; internal checks; checks before starting; checks after starting; taxiing aircraft

Briefing passengers: who is in command; use of seat straps; crash and dinghy positions; escape hatches; oxygen masks; parachutes; no naked flames; radio procedures

Taxiing: check brakes; check steering; taxiing speeds; consider wind direction and speed; lookout for obstacles and other aircraft

3 **Know the principles of general, aerobatics and formation flying**

Pre-flight principles: airfield holding position; internal checks, eg flying controls tested; external checks, eg ground control checking for damage, loose panels, fuel leaks; throttle technique; factors affecting length of take-off run, eg all-up weight, power, wind, gradient, conditions, temperature, elevation

In-flight principles: undercarriage, eg maximum speed with undercarriage down, when to retract; use of reheat; principles of circuits; procedures for joining a circuit; circuit patterns; land approach, eg use of flap, effect of wind speed, gradients and gusts

Landing: final approach; round-out; hold-off; touch down; nose wheel aircraft technique; tail wheel aircraft technique; cross-wind approaches and landings; use of brakes; effect of flaps; after landing procedures, eg clear runway, taxiing

Aerobatic flying: purpose; checks eg HASELL; basic manoeuvres, eg loop, barrel roll, slow roll, stall turn, roll off the top; advanced manoeuvres, eg half Rolland pull through, upward roll, aileron turn, derry turn, vertical eight, horizontal figure eight

Inverted flight: aircraft type; flying principles; flight controls

Formation flying: leadership; categories; section formations, eg vic, echelon, line abreast, line astern, box; close formation techniques and uses, eg relative speeds, apparent size, distance; tactical formation and uses; joining formation; positions in basic formation; keeping station, eg longitudinal, lateral, vertical

In-flight emergencies: degrees of emergency, eg distress, urgency; emergency transmissions, eg PAT HAS ATNIE; emergency procedures and fixer services; use of secondary surveillance radar; final transmission, eg when ditching, crash landing; UHF emergency fixer service; search and rescue satellite-aided tracking; process for emergencies involving another aircraft; process for communications failure; speechless communications procedures; emergency organisations

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Outline the reasons and objectives for aircraft maintenance	M1 Describe the differences between preventative, corrective and contingency maintenance	D1 Evaluate the strengths and weaknesses of preventative, corrective and contingency maintenance
P2 Describe what is meant by aircraft modifications		
P3 Outline ground handling techniques		
P4 Identify hazards and risks when ground handling aircraft	M2 Describe actions taken to minimise risks when ground-handling aircraft	D2 Analyse the processes used to minimise risk when ground-handling aircraft
P5 Describe aircrew's pre-flight personal preparation		
P6 Identify key features of flight planning		
P7 Outline pre-flight check processes	M3 Describe the importance of the pre-flight check process	
P8 List requirements for passenger briefing prior to take-off		
P9 Describe preparations for taxiing prior to take-off		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P10 Outline in-flight general flying principles		
P11 Describe the landing process		
P12 List checks used prior to aerobatic flying	M4 Describe the factors that can affect formation flying	
P13 Outline types of aerobatic manoeuvres		
P14 Identify differences between tactical and close formation flying		
P15 Outline processes for handling in-flight emergencies		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduction to aircraft handling and flying techniques unit content and outline assessment methods.
Introduction to aircraft maintenance and ground-handling techniques.
Explain aircraft maintenance policy and objectives. Explain the balance between preventive and corrective maintenance and the reasons for it. Explain the main categories, including operational and maintenance. Explain operational objectives, including provide aircraft needed to support commitments. Explain maintenance objectives, including to minimise costs and faults and to improve reliability.
Explain the principles of preventative maintenance. Explain the servicing methods. Explain scheduled maintenance. Explain condition-based maintenance. Explain out-of-phase maintenance.

Topic and suggested assignments, activities and assessment
Explain the principles of corrective maintenance. Explain fault-based maintenance. Explain condition-monitoring techniques.
Introduce contingency maintenance. Explain the circumstances, including war operations and transition to war. Explain the uses, including the level of preventative maintenance considered essential in particular circumstances and planned programme maintenance for each aircraft type.
Explain the principles of modifications. Explain the reasons, including remedying faults, incorporating new technology and improving performance and safety. Explain authorised and controlled modifications, including cost control, minimisation of downtime and safety of aircraft.
Explain the roles and responsibilities of ground-handling crews.
Introduce the principles of ground-handling techniques. Explain the methods for marshalling aircraft in the day and at night. Explain marshalling procedures and signals. Explain the methods for handling chocks. Explain methods of handling safety devices. Explain methods of handling blanks and coves. Explain methods of manhandling aircraft. Explain methods of towing aircraft. Explain methods of refuelling aircraft and types of fuel, including AVGAS, AVTUR, AVTAG, AVCAT. Explain methods of aircraft loading.
Introduce the topic of ground-handling hazards and how to reduce them. Explain the hazards to personnel and aircraft due to ground handling. Explain manual-handling techniques, danger areas and zones, including propellers and rotor blades. Explain the handling and prevention of wheel and brake fires. Explain precautions whilst refuelling, including earthing, correct grade of fuel, expansion space, location, filtering, footwear, naked flame, spillage, radio hazard, walkways, suitable fire extinguishers.
Formative assessment of aircraft maintenance and ground-handling techniques.
Introduce the procedures required for preparation for flight.

Topic and suggested assignments, activities and assessment
Introduce personal preparation. Explain why and how to be familiar with the aircraft and role. Explain the purpose of training. Explain why understanding the aim of flight is important. Explain the purpose of fitness. Explain how and why orders are read and understand. Explain flying clothing.
Introduce flight planning. Explain the key factors. Explain the roles and responsibility of the crew, mission tasking, weather, navigation, flight planning, flight coordination, crew briefing and passenger briefings.
Pre-flight checks: weather conditions; flight authorisation; air traffic control clearance; navigation calculation and preparation; maintenance records; approaching the aircraft; external checks; internal checks; checks before starting; checks after starting; taxiing aircraft.
Introduce the principle of briefing passengers. Explain who is in command. Explain the use of seat straps. Explain crash and dinghy positions. Explain the use of escape hatches, oxygen masks and parachutes. Explain importance of no naked flames. Explain radio procedures.
Introduce taxiing. Explain brakes and steering checks. Explain taxiing speeds. Explain why wind direction and speed should be considered. Explain the process for looking out for obstacles and other aircraft.
Formative assessment of the procedures required for preparation for flight.
Introduce the principles of general, aerobatics and formation flying.

Topic and suggested assignments, activities and assessment
Introduce pre-flight principles. Explain the airfield holding position. Explain internal checks, including flying controls tests. Explain external checks, including ground control checking for damage, loose panels and fuel leaks. Explain pre-flight throttle techniques. Explain the factors affecting the length of the take-off run, including all-up weight, power, wind, gradient, conditions, temperature and elevation.
Introduce in-flight principles. Explain the use of the undercarriage, including maximum speed with undercarriage down and when to retract. Explain the use of reheat. Explain the principles of circuits. Explain the procedures for joining a circuit. Explain circuit patterns. Explain the land approach, including use of flap, effect of wind speed, gradients and gusts and techniques.
Introduce the basic principles of landing. Explain the methods for final approach, round-out, hold-off and touch down. Explain the techniques for nose wheel aircraft and tail wheel aircraft. Explain the techniques for cross-wind approaches and landings. Explain the use of brakes and the effect of flaps. Explain after-landing procedures, including clearing the runway and taxiing.
Introduce aerobatic flying. Explain the purpose of aerobatic flying. Explain the checks necessary, including HASELL. Explain the basic manoeuvres, including loop, barrel roll, slow roll, stall turn and roll off the top. Explain the advanced manoeuvres, including half Rolland pull through, upward roll, aileron turn, Derry turn, vertical eight and horizontal figure eight.
Explain the principles of inverted flight. Explain the aircraft types used for aerobatic flying. Explain the flying principles involved and flight controls used to achieve it.

Topic and suggested assignments, activities and assessment
Introduce the principles of formation flying. Explain the role of leadership. Explain the categories. Explain section formations, eg vic, echelon, line abreast, line astern, box. Explain close formation techniques and uses, eg relative speeds, apparent size, distance. Explain tactical formation and uses. Explain the joining formation. Explain the positions in basic formation. Explain what is meant by keeping station, eg longitudinal, lateral, vertical.
Introduce the methods and procedures for in-flight emergencies. Explain the degrees of emergencies, including distress and urgency. Explain emergency transmissions, including PAT HAS ATNIE. Explain the emergency procedures and fixer services. Explain the use of secondary surveillance radar. Explain the final transmission process, including when ditching and crash landing. Explain the UHF emergency fixer service. Explain search and rescue satellite-aided tracking. Explain the process for emergencies involving another aircraft. Explain the process for communications failure. Explain speechless communications procedures. Explain the types and roles of emergency organisations.
Formative assessment of the principles of general, aerobatics and formation flying.
Learners should visit an aircraft maintenance facility to view the activities.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 9: Principles of Air Power

Unit code: F/503/2028

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

This unit enables learners to develop knowledge of air power and its applications, combat and combat support, together with the role ground combat support for air operations.

Unit introduction

In the early years of military aviation, aircraft tended to be used solely to help ground and naval forces. They were never considered to be an independent military force. As time went by, however, aircraft performances had improved to such an extent, that many people considered air power to be the solution to all military problems.

Today, most air power thinkers take a middle course, seeing air power as playing the significant part in any military operation when used in close harmony with both land and sea forces.

This unit gives an overview of air power in an operational flying context and builds on knowledge from *Unit 1: Fundamental Principles of Airmanship for Air Cadets* and *Unit 6: Airmanship Knowledge*. It looks at air power and its applications, as well as highlighting the types of activities involved in combat air operations, combat support air operations and ground combat support.

Learning outcomes

On completion of this unit a learner should:

1 Know applications of air power

2 Know about combat and combat support air operations

3 Know roles of ground combat support for air operations

Unit content

1 **Know applications of air power**

Air power principles: definitions, eg conceptual, moral, training, physical; principle strengths eg height, speed, reach, flexible; response; limitations, eg air time, payload, fragility

British defence doctrine: doctrine, eg selection and maintenance of aim, maintenance of morale, security, surprise, and offensive action, concentration of force, economy of effort, flexibility, cooperation, and sustainability

Applications of air power: use of air power, eg preservation of peace, managing international crisis and wartime applications; conflict, eg general war, limited conflict, regional conflict, civil war, insurgency, terrorism; strategy, eg operational, tactical; strategic considerations, eg ends, ways, means; types of military operation, eg preventative diplomacy, conflict prevention and defence diplomacy, peace support operations, peacekeeping, peace enforcement, post conflict activity and peace building, humanitarian operations, deterrence, deployment with consent, coercion, destruction, denial, disruption

Air power factors: factors, eg aircraft carriers, airfield, basing considerations, coalition capability, flexibility and versatility, fragility and ease of destruction, impermanence, pace and tempo, payload, penetration, perspective, poise and stand-off, reach, speed of response, sustainability, tasking, ubiquity of space

2 **Know about combat and combat support air operations**

Combat air operations principles: roles of combat air support; offensive counter air operation, eg SEAD, fighter sweep, combat air patrol, escort, airfield attack; defensive anti air, eg detection, command and control, weapons systems; anti surface operations and supporting ground forces, eg air interdiction, battlefield air interdiction, close air support, maritime operations; strategic air offensive, eg conventional and nuclear weapons

Combat support air operations: how air support is given to ground forces, eg air transport, air to air refuelling, search and rescue, electronic warfare, information exploitation using information, surveillance and reconnaissance, intelligence surveillance target acquisition reconnaissance (ISTAR), information fusion, space operations and control of space

3 **Know roles of ground combat support for air operations**

Ground defence methods: types; active defence, eg force protection; passive defence eg dispersal, deception, protection, resilience; role, eg ground defence, force protection, supporting air operations

Training and logistics: ground support; training locations and schools; logistics and its role in ground combat support for air operations, eg parts, rations, ammunition

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Outline air power principles		
P2 Outline British defence doctrine		
P3 Outline main applications of air power		
P4 Describe factors that need to be considered in the application of air power	M1 Compare the advantages and disadvantages of air power applications	D1 Evaluate the limitations of air power and their impact upon missions
P5 Outline types of combat air operations		
P6 Describe offensive counter air operations	M2 Explain how combat air operations support military operations	D2 Evaluate importance of combat air operations in military strategy
P7 Describe strategic air offensives		
P8 Describe anti-surface operations		
P9 Describe how air support is given to ground forces	M3 Explain the importance of combat air support on military operations	
P10 Identify types of active and passive defence methods of ground combat support	M4 Explain the role of a ground defence method that provides direct support for air operations	

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P11 Describe role of training and logistics in ground support and air operations		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content, and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduce the meaning of air power and its applications.
Introduce air power. Explain the definitions. Explain the principle strengths, eg height, speed, reach, flexible, response and limitations, eg air time, payload, fragility.
Introduce the applications. Explain the use of air power, eg preservation of peace, managing international crisis and wartime applications.
Introduce the historical perspectives. Explain the development of modern warfare.
Introduce British defence doctrine. Explain the doctrine, eg selection and maintenance of aim, maintenance of morale, security, surprise, and offensive action, concentration of force, economy of effort, flexibility, cooperation, and sustainability.

Topic and suggested assignments, activities and assessment
Introduce the types of conflict, strategy and military operation. Explain conflict, eg general war, limited conflict, regional conflict, civil war, insurgency, terrorism. Explain strategy, eg operational, tactical. Explain the strategic considerations, eg, ends, ways, means. Explain the types of military operation, eg preventative diplomacy, conflict prevention and defence diplomacy, peace support operations, peacekeeping, peace enforcement, post conflict activity and peace building, humanitarian operations, deterrence, deployment with consent, coercion, destruction, denial and disruption.
Introduce air power factors. Explain the factors, eg aircraft carriers, airfield, basing considerations, coalition capability, flexibility and versatility, fragility and ease of destruction, impermanence, pace and tempo, payload, penetration, perspective, poise and stand-off, reach, speed of response, sustainability, tasking and ubiquity of space.
Introduce air power principles. Explain the principles, eg conceptual, moral, training and physical.
Formative assessment of the meaning of air power and its applications.
Introduce combat and combat support air operations.
Introduce combat air operations. Explain the principles. Explain the roles of combat air support. Explain offensive counter air operation, eg SEAD, fighter sweep, combat air patrol, escort and airfield attack. Explain defensive anti air, eg detection, command and control, weapons systems. Explain anti surface operations and supporting ground forces, eg air interdiction, battlefield air interdiction, close air support, maritime operations. Explain strategic air offensive, eg conventional and nuclear weapons.
Introduce combat support air operations. Explain how air support is given to ground forces, eg air transport, air-to-air refuelling, search and rescue, electronic warfare, information exploitation using information, surveillance and reconnaissance, intelligence surveillance target acquisition reconnaissance (ISTAR), information fusion, space operations and control of space.
Formative assessment of about combat and combat support air operations.
Introduce the role of ground combat support for air operations.
Introduce ground defence methods. Explain the types ground defence methods. Explain active defence, eg force protection. Explain passive defence, eg dispersal, deception, protection, resilience.

Topic and suggested assignments, activities and assessment
Introduce the role of ground defence. Explain ground defence and force protection and its role in supporting air operations.
Introduce training and logistics. Explain ground support. Explain training locations and schools. Explain logistics and its role in ground combat support for air operations, eg parts, rations, ammunition.
Formative assessment of the role of ground combat support for air operations.
Learners should undertake a series of role playing scenarios related to air power.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 10: Principles of Piston Engine Propulsion

Unit code: A/503/2030

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to give learners knowledge and understanding of aircraft propulsion methods and the differences between petrol and diesel engines. Basic operating principles of a propeller and its control systems are also introduced.

Unit introduction

This unit provides learners with an understanding of aircraft propulsion methods required at ATC Senior Cadet and Master Air Cadet level. Learners are expected to explain the differences between petrol and diesel engines and know about the operation of rotary type engines.

The unit provides the learner with a basic introduction to aircraft propulsion by considering the operating principles of the piston engine and its associated operating systems. The learner also has the opportunity to consider propellers and related safety features and control systems.

Learning outcomes

On completion of this unit a learner should:

1 Know types of aircraft engines

2 Know the purpose of components in petrol piston engines

3 Understanding operating principles of piston engines

4 Understand operating principles of propellers

Unit content

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1 **Know types of aircraft engines**

Petrol and diesel: how an engine works; differences between petrol and diesel engines; benefits and disadvantages of petrol and diesel engines

2-stroke engine: uses; designs; operating cycle; benefits and disadvantages

Rotary type engines: uses; designs; operating method; benefits and disadvantage

2 **Know the purpose of components in petrol piston engines**

Carburettor and injection fuel systems: operation; parts of a simple carburettor, eg air intake and choke tube, main jet, float chamber and float mechanism, throttle valve; size of fuel valve; carburettor refinements; air to fuel ratio; rich or lean mixtures; injection flow control; distribution; pumps, eg accelerator pump; filter; tank operation; problems of aircraft fuel system and how they are overcome

Oil system: operation; distribution; pumps; filter; tank operation

Ignition system: uses, operation and parts of coils, spark plugs, magneto, condensers, distributor, contact breakers electronic systems

Air and fluid cooling systems: types and properties of lubricants; engine lubrication systems; types and use of oil pumps; air cooling and liquid cooling systems (types, uses); advantages and disadvantages of different cooling systems

Power boosting systems: types and uses of turbo and super charging and other systems

3 **Understanding operating principles of piston engines**

Basic principles of a piston engine: principles of compression, combustion and linear force producing rotary movement; design; piston configurations and layout, eg line-4, V6, flat-4

Operating principles: terms, eg stroke, bore, top dead centre, bottom dead centre; piston engine cycle, eg induction, compression, power, exhaust; what happens at each point in the cycle and why; value and ignition timing; definitions and operation; meaning of valve lead, valve lag, valve overlap

Mechanical construction of a piston engine: description, design, construction and function of pistons, connecting rods, crankshaft, inlet and exhaust valve mechanisms

4 **Understand operating principles of propellers**

Propeller: types and uses, eg two, three or four blades; parts, eg blade leading edge, hub, pitch change mechanism; basic operating principles, eg helical path, angle of attack equals blade angle minus helix angle; meaning of blade twist, blade cross-section

Pitch: uses and function of fixed and viable pitch propellers; control mechanism and relationship with engine power; safety devices, eg fine pitch stop, hydraulic pitch stop

Propeller operations: range of movement, eg reverse pitch, ground fine

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Identify the differences between petrol and diesel engines	M1 Compare the advantages and disadvantages of petrol and diesel engines	D1 Evaluate the benefits of different piston engine layouts
P2 Describe the use and design of the two-stroke engine		
P3 Describe the use and design of the rotary type engine		
P4 Describe the purpose of components in piston engine fuel systems	M2 Compare carburettor and injection fuel systems	D2 Evaluate the benefits and disadvantages of carburettor and injection fuel systems in aircraft
P5 Describe the purpose of components in piston engine oil systems		
P6 Describe the purpose of components in piston engine ignition systems		
P7 Describe the purpose of components in piston engine cooling systems	M3 Compare the advantages and disadvantages of air and fluid cooling systems	
P8 Describe power boosting systems		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9 Explain the operating cycle of piston engines		
P10 Describe different layouts of piston engines		
P11 Explain the function of each of the main components of a propeller and its control system	M4 Justify reasons for blade angle limiting stops on a propeller system	
P12 Explain the advantage of a constant speed variable pitch propeller system		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF. The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training.

This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet). The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit.

Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduce the basic operating principals of a piston engine cycle, its mechanical construction and various layouts.
Introduce the basic principles of a piston engine. Explain the principles of compression, combustion and linear force producing rotary movement. Explain the design principles. Explain piston configurations and layout, eg line-4, V6, flat-4.
Introduce the mechanical construction of a piston engine. Explain the description, design, construction and function of pistons, connecting rods, crankshaft, inlet and exhaust valve mechanisms.

Topic and suggested assignments, activities and assessment
Introduce the operating principles. Explain the terms, eg stroke, bore, top dead centre, bottom dead centre. Explain piston engine cycle, eg induction, compression, power, exhaust. Explain what happens at each point in the cycle and why. Explain value and ignition timing. Explain the definitions and operation, meaning of valve lead, valve lag and valve overlap.
Formative assessment of the basic operating principals of a piston engine cycle, its mechanical construction and various layouts.
Introduce the differences between petrol and diesel engines, four-stroke and two-stroke cycles and the operation of rotary type engines.
Introduce the principles of petrol and diesel engines. Explain how a diesel engine works. Explain differences between petrol and diesel engines, the benefits and disadvantages of petrel and diesel engines.
Introduce the 2-stroke engine. Explain uses and designs. Explain the operating cycle. Explain the benefits and disadvantages.
Introduce rotary type engines. Explain the uses, designs and operating method. Explain the benefits and disadvantages.
Formative assessment of differences between petrol and diesel engines, four-stroke and two-stroke cycles and the operation of rotary type engines.
Introduce the operation of petrol piston engine fuel, oil, ignition, cooling systems and power boosting systems and their system units.
Introduce the oil system. Explain the operation, distribution, pumps, filter and tank operation.

Topic and suggested assignments, activities and assessment
Introduce the carburettor and injection fuel systems. Explain the method of operation. Explain the parts of a simple carburettor, eg air intake and choke tube, main jet, float chamber and float mechanism, throttle valve. Explain why the size of fuel valve is important and for what purpose. Explain carburettor refinements and air to fuel ratio. Explain rich or lean mixtures. Explain the injection flow control. Explain the distribution and pumps, eg accelerator pump. Explain how and why a filter is used. Explain tank operation. Explain the problems of aircraft fuel system and how they are overcome.
Introduce the ignition system. Explain ignition system uses, operation and parts of coils, spark plugs, magneto, condensers, distributor and contact breakers electronic systems.
Introduce air and fluid cooling systems. Explain the types and properties of lubricants. Explain engine lubrication systems. Explain the types and use of oil pumps. Explain the types, uses and comparisons of air cooling and liquid cooling systems. Explain the advantages and disadvantages of different cooling systems.
Introduce power-boosting systems. Explain the types, uses and comparison of turbo and super-charging and other systems.
Formative assessment of the operation of petrol piston engine fuel, oil, ignition, cooling systems and power boosting systems and their system units.
Introduce the basic operating principles of a propeller and its control system.
Introduce the propeller. Explain the types and uses, eg two, three or four blades. Explain the parts, eg blade leading edge, hub, pitch change mechanism. Explain the basic operating principles, eg helical path, angle of attack equals blade angle minus helix angle. Explain the meaning of blade twist and blade cross-section.
Introduce pitch. Explain the uses and function of fixed and viable pitch propellers. Explain the control mechanism and relationship with engine power. Explain safety devices, eg fine pitch stop, hydraulic pitch stop.

Topic and suggested assignments, activities and assessment
Introduce propeller operations. Explain the range of movement, eg reverse pitch, ground fine.
Formative assessment of basic operating principles of a propeller and its control system.
Learners should undertake some practical exercises in then construction and deconstruction of engines and parts of engines.
Learners should visit an airfield or maintenance facility to see engines and propellers in a working environment.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 11: Principles of Jet Engine Propulsion

Unit code: F/503/2031

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

This unit enables learners to understand the basic operating principles of a jet engine cycle, gas turbine engine systems and operating principles of a propeller and control system. Learners will also gain knowledge about different types of jet engine.

Unit introduction

This unit provides the learner with an understanding of aircraft propulsion methods required at ATC Senior Cadet and Master Air Cadet level.

The unit provides the learner with a basic introduction to aircraft propulsion by considering the operating principles of jet engines and their associated operating systems. The learner also has the opportunity to consider the use of propellers, in relation to jet engines, their safety features and control systems.

Learning outcomes

On completion of this unit a learner should:

1 Know operating principles of a jet engine cycle and its relevant systems

2 Know types of jet engine

3 Understand operating principles of gas turbine engine systems

Unit content

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1 **Know operating principles of a jet engine cycle and its relevant systems**

Basic method of operation: principle of the gas turbine engine, eg action and reaction

Mechanical arrangement: layout of a jet engine; main jet engine sections, eg intake, compressor, combustor, turbine, exhaust

Compressor: function, eg draws air, compresses and delivers; effect of air pressure, eg improves efficiency; types eg centrifugal, axial; variation in axial compressor, eg convergent annular duct; stages; reason and function

Combustion chamber: construction, eg flame tube or ring of tubes; purpose eg most efficient combustion, maximum heat energy, greatest expansion of gases; burners and purpose, eg vaporise fuel; igniters; purpose, eg initiate combustion

Turbine: construction, eg rotating assembly, spool; stages, eg alternate rotating and stationary aerofoil section blades; function, eg absorb energy to keep rotating in turbojet

2 **Know types of jet engine**

Main types of jet engines: aircraft use and operating principles of jet engines (turbojet, turbofan, turboprop, turboshaft)

Jet engine variations: design; function; aircraft use and operating principles of vectored thrust; geared and variable pitch fans; liftjets; ramjets

3 **Understand operating principles of gas turbine engine systems**

Systems: design; function and operating principles of hydro-mechanical and electronically controlled fuel systems; oil system; ignition system; cooling systems; tanks; pump types and filters

Jet engine cycle: basic operating principles, eg 4 stages of the cycle; basic pressure temperature and velocity changes

Additional gas turbine engine systems: basic operating principles of thrust augmentation systems; reheat and main components; various types of thrust reverser systems; pressure; temperature and velocities at different points within the system

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Identify main sections of jet engines		
P2 Explain the jet engine cycle		
P3 Describe the function of the components of gas turbine engine systems		
P4 Describe main components of jet engine fuel systems	M1 Explain function of main components in the jet engine fuel system	D1 Evaluate hydro-mechanical and electronic controlled jet engine fuel systems
P5 Identify turbo-jet engines	M2 Compare types of jet engine in terms of design and use	D2 Evaluate the advantages and disadvantages of different jet engines
P6 Describe the difference between turbo-prop and turbo-shaft engines		
P7 Describe the operation of the vectored thrust		
P8 Identify types of jet engine thrust augmentation systems	M3 Explain the effects of a failure of the internal cooling and sealing system	
P9 Identify components of jet engine reheat systems	M4 Explain the function of the components of reheat and thrust reverser systems	

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P10 Identify components of jet engine thrust reverser systems		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduce the basic operating principals of a jet engine cycle and its relevant fuel, oil, ignition and cooling systems.
Introduce the development of the jet engine. Explain the historical development of the jet engine, eg Sir Frank Whittle.
Introduce the basic method of operation of a jet engine. Explain the principle of the gas turbine engine, eg action and reaction.
Introduce the mechanical arrangement of a jet engine. Explain the layout of a jet engine. Explain the main jet engine sections, eg intake, compressor, combustor, turbine, exhaust.

Topic and suggested assignments, activities and assessment
Introduce the compressor. Explain the function of the compressor, eg draws air, compresses and delivers. Explain the effect of air pressure, eg improves efficiency. Explain the different types, eg centrifugal, axial. Explain variations in axial compressors, eg convergent annular duct. Explain the stages, reason and function.
Introduce the combustion chamber. Explain the construction, eg flame tube or ring of tubes. Explain the purpose, eg most efficient combustion, maximum heat energy, greatest expansion of gases. Explain the burners and purpose, eg vaporise fuel. Explain the igniters and purpose, eg initiate combustion.
Introduce the turbine. Explain the construction, eg rotating assembly, spool. Explain the stages, eg alternate rotating and stationary aerofoil section blades. Explain the function, eg absorb energy to keep rotating in turbojet.
Formative assessment of the basic operating principals of a jet engine cycle and its relevant fuel, oil, ignition and cooling systems.
Introduce the different types of jet engine.
Introduce the main types of jet engine. Explain the design, function, aircraft use and operating principles of turbojet, turbofan, turboprop, turboshaft.
Introduce jet engine variations. Explain the design, function, aircraft use and operating principles of vectored thrust, geared and variable pitch fans, liftjets, ramjets.
Formative assessment of the different types of jet engine.
Introduce the basic operating principals of gas turbine engine systems such as reheat and thrust reverser systems.
Introduce the systems. Explain the design, function and operating principles of hydro-mechanical and electronically controlled fuel systems, oil system, ignition system, cooling systems, tanks, pump types and filters.
Introduce the jet engine cycle. Explain the basic operating principals, eg four stages of the cycle, basic pressure temperature and velocity changes.

Topic and suggested assignments, activities and assessment
Introduce the additional gas turbine engine systems. Explain the basic operating principals of thrust augmentation systems, reheat and main components, various types of thrust reverser systems. Explain the pressure, temperature and velocities at different points within the system.
Formative assessment of the basic operating principals of gas turbine engine systems such as reheat and thrust reverser systems.
Learners should visit an aerospace museum, or online resource, to see for themselves the different type of jet engines and their applications.
Learners should visit an airfield or maintenance faculty to see engines and propellers in a working environment.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes

Unit 12: Development and Principles of Rocketry

Unit code: J/503/2032

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is for learners to gain knowledge and understanding of the development and principles of rocketry. Learners will develop an appreciation of the application, components, launch process and safety factors of modern rocketry.

Unit introduction

A rocket is a vehicle, missile or aircraft that is propelled by an engine that creates thrust from a high-speed exhaust. The history of rockets goes back to at least the 13th century, with rockets used for warfare and recreational displays. The widespread use of rockets for military, scientific and industrial use did not occur until the 20th century, when rocketry was the enabling technology of the space age, with man visiting the moon.

Rockets have a wide variety of uses; from fireworks for pleasure to the delivery of nuclear weapons; from ejection seats in aircraft to delivering communication satellites into orbit around the earth; from rocket-powered cars to emergency flares used to summon rescue.

This unit will examine the development and application of rocketry, in addition to the components and general principles of operation. It will also examine the safety factors necessary for the practical use of rockets for pleasure and recreation.

Learning outcomes

On completion of this unit a learner should:

1 Know the development of rocketry

2 Know application and components of modern rocketry

3 Understand principles of rocketry

4 Know the launch process and safety requirements for rocketry

Unit content

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1 **Know the development of rocketry**

Use of rockets in antiquity: history, eg origins, types, usage

Spread of rocket technology: technology, eg development of the rocket for war

Accuracy of early rockets: methods of achieving accuracy and stability, eg tube, spinning

Theories of interplanetary rocketry: early theory; developers of rocketry, eg Tsiolkovsky, Esnault-Pelterie, Goddard and Oberth

Modern rocketry: work of Robert Goddard; birth of rocket research organisations; development of rocketry in Germany 1920-1945; creation of the rocket-based weapons arms race; non-military use of rockets from 1945 for communications and space exploration

2 **Know application and components of modern rocketry**

Uses of rockets: different uses, eg military, science and research, communication, spaceflight, rescue, hobby, sport, entertainment

Types of rocket vehicle configurations: models; missiles; space rockets; rocket cars; rocket planes; rocket sleds; rocket trains; rocket torpedoes; rocket powder jet packs; rapid escape systems; ejection seats and launch escape systems; rescue systems; Breeches buoy; emergency flares

Components: propellant tank; rocket engine; nozzle; directional stabilization; structure; navigation systems; other components, eg wings, wheels

Rocket engine types: physical; chemical; electrical; solar; beam; nuclear

Propellants: gas; solid; liquid; hybrid; steam; solar thermal; nuclear thermal; pressurised water; pressurised cold gas; uses of each type of propellant

3 **Understand principles of rocketry**

Principle methods of operation: theory of operation; calculation of net thrust; specific impulse; rocket's performance; nozzle designs (under expanded, ambient, over expanded); mass ratios; benefit of high mass ratio and thrust thrust-to-weight ratio; mass ratios of various rocket vehicles; thrust-to-weight ratio; Newton's Third Law of Motion

Staging: use of staging and examples; types of staging (serial, parallel)

Energy efficiency: energy density of rocket propellant; efficiency of propellant system related to rocket vehicle speed; propulsive efficiency; overall energy efficiency equation

Use of the Apogee Kick Motor: method of achieving geostationary orbit

4 **Know the launch process and safety requirements for rocketry**

Safety: safety code of the UK Rocketry Association; specific safety requirements for rockets, motors, igniters, launch site, flying, recovery

Launch: launch preparation timeline; launch sequence

Flight phases: boost; coast; ejection; descent; landing

Model rockets and motors: parts, eg body tube, fins, nosecone, launch lug, shock cord, parachute; motor types and igniters, eg motor case, de Laval nozzle, burn sequence, impulse, thrust, delay

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Describe significant developments in the history of rocketry		
P2 Describe uses and types of rocket vehicles	M1 Explain the theory for rocket propulsion in relation to Newton's Third Law of Motion	
P3 List main components of a rocket vehicle		
P4 List uses of different types of rocket propellant	M2 Compare take-off mass to final mass of a range of rocket vehicles	D1 Evaluate which rocket propellant will achieve highest mass ratio
P5 Describe the principle methods of operation of a rocket	M3 Explain why acceleration of a rocket increases with time when the thrust remains the same	
P6 Explain types and uses of rocket staging		
P7 Describe factors which affect the energy efficiency of rocket propulsion systems	M4 Explain the use of nozzles to control combustion efficiency	
P8 Explain the use of apogee kick motors		
P9 Identify safety requirements from the UK Rocketry Association's safety code		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P10 Explain the launch and flight phases of a rocket		
P11 Describe the parts of a model rocket and motor		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduce the development of rocketry.
Explain the use of rockets in antiquity. Explain the history of rocketry including origins, types and usage.
Explain the spread of rocket technology and the development of the rocket for war.
Explain the accuracy of early rockets. Explain the methods of achieving accuracy and stability, eg tube, spinning.
Introduce the theories of interplanetary rocketry. Explain the early theory. Identify the developers of rocketry and their role, including Tsiolkovsky, Esnault-Pelterie, Goddard and Oberth.

Topic and suggested assignments, activities and assessment
Introduce modern rocketry. Explain the work of Robert Goddard. Explain the birth of rocket research organisations. Explain the development of rocketry in Germany 1920-1945. Explain the creation of the rocket-based weapons arms race. Explain the non-military use of rockets from 1945 for communications and space exploration.
Formative assessment of the development of rocketry.
Introduce the application and components of modern rocketry.
Explain the uses of rockets. Explain the different uses, inducing military, science and research, communication, spaceflight, rescue, hobby, sport, entertainment.
Introduce types of rocket vehicle configurations. Explain how the use of each of type of rocket is achieved, including models, missiles, space rockets, rocket cars, rocket planes, rocket sleds, rocket trains, rocket torpedoes, rocket powder jet packs, rapid escape systems, ejection seats and launch escape systems, rescue systems, Breeches buoy and emergency flares.
Introduce rocket engine types. Explain how each of the rocket engine types work, including physical, chemical, electrical, solar, beam and nuclear.
Introduce the propellants. Explain the uses of each type of propellant gas, including solid, liquid, hybrid, steam, solar thermal, nuclear thermal, pressurised water and pressurised cold gas.
Introduce the components. Explain the types and uses of components, including propellant tank, rocket engine, nozzle, directional stabilisation, structure, navigation systems, other components, wings and wheels.
Formative assessment of the application and components of modern rocketry.
Introduce the principles of rocketry.

Topic and suggested assignments, activities and assessment
Introduce the operational methods. Explain the theory of operation. Explain the calculation of net thrust. Explain specific impulse. Describe a rocket's performance, nozzle designs, under expanded, ambient, over-expanded. Explain the mass ratios, benefit of high mass ratio and thrust thrust-to-weight ratio. Explain the compare mass ratios of various rocket vehicles.
Introduce staging. Explain the use of staging and examples. Explain the types of staging, serial and parallel.
Introduce the principles of acceleration. Explain what is meant by the thrust-to-weight ratio. Explain Newton's Third Law of Motion.
Introduce energy efficiency. Explain the energy density of rocket propellant. Explain the efficiency of propellant system related to rocket vehicle speed and propulsive efficiency. Explain the overall energy efficiency equation.
Introduce geostationary orbit. Explain the method of achieving geostationary orbit. Explain the use of the Apogee Kick Motor.
Formative assessment of the principles of rocketry.
Introduce the launch process and safety factors.
Introduce the principles of the launch. Explain the launch preparation timeline. Explain the launch sequence.
Explain the flight phases, including boost, coast, ejection, descent and landing.
Introduce the principles of safety. Explain the safety code of the UK Rocketry Association. Explain the specific safety requirements for rockets, motors, igniters, launch site, flying and recovery.

Topic and suggested assignments, activities and assessment
Explain the types and uses of model rockets and motors. Explain the parts, including body tube, fins, nosecone, launch lug, shock cord and parachute. Explain motor types and igniters, including motor case, de Laval nozzle, burn sequence, impulse, thrust and delay.
Formative assessment of the launch process and safety factors.
Learner should construct a simple rocket (eg a water rocket), launch the rocket and evaluate the result.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 13: Principles of Airframes for Air Cadets

Unit code: L/503/2033

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to give learners knowledge of the principles or airframes for Air Cadets. This includes: main components of airframe structures, techniques and tools used in airframe manufacture and basic principles of hydraulics and pneumatics.

Unit introduction

The unit explores the principles of airframe design and their key features. It considers aspects of engineering including materials, structural elements, methods of construction and manufacturing technology. The unit also develops an awareness of hydraulic and pneumatic systems.

The unit enables the learner to gain knowledge of the various influences that affect the shape and performance of an airframe. The unit also provides a basic introduction to the principles of hydraulics and pneumatics and their application within the airframe.

Learning outcomes

On completion of this unit a learner should:

1 Know main components of airframe structures

2 Know techniques and tools used in airframe manufacture

3 Know principles of hydraulics and pneumatics

Unit content

1 **Know main components of airframe structures**

Design concepts: main components of an airframe

Fuselage: shape; configurations; stretching and sections; forces on the fuselage; pressure vessel

Wing and tailplane: functions; wing loading and forces; design considerations, eg sweep back, swing wings and delta wings; aspect ratio; flying wings; wing spar design; tailplane; fin and foreplane design

Undercarriage: types of undercarriage layout eg tail sitter, tricycle, large aircraft configurations; coping with the landing forces; stowing undercarriage and related systems

2 **Know techniques and tools used in airframe manufacture**

Engineering concepts: cantilever; lightening the structure; nose wheels and nose wheel steering; jokey wheel units; variations of wheel unit arrangement and distribution of loads; oleo leg types, eg pneumatic and oil compression; undercarriage retraction systems; safety systems; braking systems; structural loads and forces; squashing; bending; tearing; pulling and twisting; types of structure elements, eg struts, ties, beams and webs

Methods of airframe construction : types of fuselage construction, eg welded steel truss, true monocoque, semi-monocoque, reinforced shell; windows; door types, eg passenger cabin, cargo hold; methods of wing construction, eg stressed skin, machined skin, fabric covered; front and rear spars; ribs; leading and trailing edges; other wing functions eg undercarriage attachment

Materials: materials utilised in airframe construction, eg aluminium and magnesium alloys, steel and steel alloys, titanium and titanium alloys, plastics and composites; material advantages and disadvantages

Material removal and tooling: boring; broaching; drilling; electrical discharge machining; grinding, eg centreless, creep feed, disk; use of laser technology; lathe; milling; plasma cutting; turning; water jet cutting

Material forming techniques: bending; die–forming; extrusion; forging; presses; casting

Other techniques: design concepts (material design factors and properties, strength to weight ratio); composites (application of composite technology in airframe construction, design considerations, repair of damage); additive processes (rapid prototyping, eg fused deposition modelling, laminated object manufacturing, selective laser sintering, stereo lithography); controls/software (CAD/CAM, computer integrated manufacturing, numerical control, eg computer, direct, distributed); plastics technology (moulding, eg blow, injection, co-injection, compression, die, extrusion, thermoforming, curing)

3 **Know principles of hydraulics and pneumatics**

Scientific principles: practical application of Pascal's law; multiplication of forces and

Design features: basic hydraulic and pneumatic systems; system components, eg fluid, air line, fluid line, reservoir, gear and vane pumps, piston pumps, selector valves, actuators

Engineering features: layout of the hydraulic and pneumatic systems; use of hydraulic systems in the airframe

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Identify main components of an airframe structure	M1 Explain the function of the main components of an airframe structure	
P2 Outline engineering concepts relating to airframe structural design	M2 Explain the difference between the forces acting on an airframe structure and the structural elements employed in the design	D1 Evaluate airframe loads and the structural elements utilised to overcome these loads
P3 Identify methods of airframe construction		
P4 Describe components of a fuselage		
P5 Describe components of a tailplane structure		
P6 Describe components of a wing structure		
P7 Describe materials used in an airframe structure	M3 Explain advantages and disadvantages of materials employed within the airframe structure	D2 Evaluate tools and techniques utilised when constructing an airframe structure
P8 Describe tools and techniques used in airframe manufacture		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9 Describe principles of hydraulics and pneumatics	M4 Explain operation of airframe hydraulic systems and benefits of utilising this technology	
P10 Identify features of hydraulics and pneumatic systems		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduction to airframes unit content and outline assessment methods.
Main components of an aircraft, including discussion on what constitutes a 'main' component. Use of models to show various parts of the aircraft. Structural loads and forces encountered by an airframe. Types of structural elements used in an airframe, using everyday items as examples to show different types of structural elements. Use paper to show how design can influence and take advantage of the strength of materials.
Visit to air museum to look at full size aircraft to identify parts of the aircraft, and to look at various aircraft construction (restoration department etc). Use a small balsa wood glider to show construction methods – spar/ribs, frames/stringers etc.
Formative assessment of main components of an aircraft.

Topic and suggested assignments, activities and assessment
Introduction to manufacturing technology. Manufacturing tools used for material removal, including discussion on everyday tools and processes of material removal – saw, chisel, plane, file, sander etc. Techniques used in material forming, including discussion about material forming methods ie folding, bending, casting. Use of examples found in the home to reinforce learning. Techniques used in additive processes, including examples of rapid prototyping – most colleges will have small machines for stereo lithography etc. The use of computers in design and manufacturing, reinforced with a visit to local college to see examples of NC machines and CAD software. The use of plastics and composites in airframe structures, including examples of more accessible plastics designs – modern car panels, bumpers, sports cars such as F1 using carbon fibre. Use of composites in sports equipment ie golf, tennis, fishing etc.
Visit to local college or manufacturers of plastic components in the area. Search on the internet for composite uses etc.
Formative assessment of manufacturing technology.
Introduction to the design concepts as used in aircraft fuselages. Discussion on what could be contained in an aircraft fuselage, fuselage shape and configuration ie stretching of civil airliners and the differences in military aircraft. Forces acting on a fuselage. Types and methods of fuselage construction, including discussion of different types of construction through the history of aircraft i.e. welded truss, semi-monocoque etc. Types of doors and windows utilised.
Use of scale models to show different fuselage types – civil verses military. Visit to air museum.
Formative assessment of design concepts used in aircraft fuselages.
Introduction to the design concepts for wing and tailplane design. Discussion on what could be contained in an aircraft wing and design considerations – sweep back, swept wings, delta wings. Design of wing spars – difference between civil and military ie wing loading considerations. The definition of aspect ratio and how it relates to wing design. Types and methods of tailplane, fin and foreplane construction, including discussion of different types of construction through the history of aircraft i.e. fabric covered, stressed skin etc. An appreciation of underlying features such as spars, ribs, leading and trailing edges, as well as undercarriage attachment.

Topic and suggested assignments, activities and assessment
Use of scale models as well as the use of a balsa aircraft kit to reinforce where the structural components are used.
Formative assessment of design concepts for wing and tailplane design.
Introduction to the principles of hydraulics and pneumatics, including discussion on the main components of an aircraft hydraulic and pneumatic system. Pascal's law and the practical uses for Pascal's law. Discussion on more familiar uses of multiplication of forces ie car jack, car brakes etc. The use of hydraulic and pneumatic systems in an airframe.
Practical sessions showing hydraulics and / or pneumatics, eg demonstration of hydraulic car jack. A visit to a local fire station to see things like the 'Jaws of Life' etc. Build a demonstration system using different-sized syringes.
Formative assessment of hydraulics and pneumatics.
Introduction to the layout and types of undercarriages as used in airframes. The need for different layout depending on the size and weight of the aircraft. The understanding of the forces imposed on the undercarriage. How the undercarriage can be stowed, and looking at the associated systems. Design implications of nose wheel steering, jockey wheel units etc. Shock absorption – oleo leg types. Braking systems.
Use of scale models to show different undercarriage layouts – 'tail dragger', tricycle, etc. Visit aircraft museum to see different types of aircraft and the varied types and layouts of undercarriages.
Formative assessment of undercarriages used in airframes.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 14: Avionic and Aircraft Electrical Systems

Unit code: R/503/2034

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

This unit gives learners knowledge of the principles and features of avionic and aircraft electrical systems.

Unit introduction

This unit introduces learners to avionic and aircraft electrical systems as part of an integrated training programme at ATC Senior Cadet and Master Air Cadet level.

The unit explores basic electrical terminology, the international standard atmosphere and radio/radar concepts. The unit then introduces the learner to the fundamentals of aircraft electrical, communication, navigation, instrument and auto-flight systems.

Learning outcomes

On completion of this unit a learner should:

1 Understand electrical terminology and components in avionic systems

2 Know operating principles in aircraft communication and navigation

3 Know aircraft instruments and their principles of operation

4 Know components and functions of auto-flight systems

Unit content

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1 **Understand electrical terminology and components in avionic systems**

Electrical terminology: electrical units and the factors affecting them; units of charge; potential difference; electromotive force; current; resistance and voltage

AC and DC electrical generation: battery operation and installation; DC generators; AC generators

Distribution and control: AC and DC regulation and control; power distribution; paralleling; circuit protection

2 **Know operating principles in aircraft communication and navigation**

Radio wave propagation: 'line of sight' and 'over the horizon' propagation; frequency and frequency allocation; AM/FM modulation; pulsing

Receivers and transmitters: amplifiers; oscillators; modulators and detectors; superhetrodyne receivers

Airborne communication and navigation systems: VHF, HF and satellite communication systems, eg VHF Omni-Range (VOR), Automatic Direction Finder (ADF), Instrument Landing System (ILS), Distance Measuring Equipment (DME), Area Navigation (RNAV), Global Positioning System (GPS), Air Traffic Control Secondary Surveillance Radar (ATC/SSR), Traffic Collision Avoidance System (TCAS), Weather Radar, Radio Altimeter, Flight Management Systems (FMS), Emergency Locator Transmitter (ELT), Inertial Navigation

Antenna systems: directional and omni-directional antennae; transmission lines; co-axial and wave guides; aerial tuning

3 **Know aircraft instruments and their principles of operation**

International standard atmosphere: definitions and figures for pressure; density; temperature; gravity; lapse rate

Aircraft instruments: pitot-static systems, eg altimeter, vertical speed indicator, airspeed indicator, machmeter, air data computer; gyroscopic principles, eg attitude indicator, direction indicator, compass systems; other instruments, eg flight data recorder, electronic flight instrumentation system (EFIS), stall warning system

4 **Know components and functions of auto-flight systems**

Auto-flight system: roll, pitch and yaw channels; modes of operation, eg stability augmentation, interface with navigation aids; automatic landing modes, eg including approach, glideslope, land, take-off/go-around (TOGA)

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Describe how electrical terminology is used in aircraft systems		
P2 Identify the components in an aircraft AC and DC electrical system	M1 Explain function of each component in aircraft DC and AC electrical systems	D1 Evaluate the difference between AC and DC aircraft electrical systems and control techniques
P3 Describe distribution and control methods		
P4 Describe what is meant by radio wave propagation		
P5 Identify components of a receiver and transmitter		
P6 Identify airborne communication and navigation systems	M2 Compare the function of components in aircraft communication and navigation systems	
P7 Identify antenna systems		
P8 Describe the International Standard Atmosphere		
P9 Identify aircraft instruments		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P10 Describe operation of aircraft instruments	M3 Explain principles of operation of each component in a pitot-static system	
P11 Identify components of an auto-flight system	M4 Describe modes of operation of auto-flight systems	D2 Evaluate how navigation systems and auto-flight interface to enable auto-flight and auto-land

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduction to avionics and aircraft electrical systems unit content and outline assessment methods.
Introduce the electrical terminology.
Look at electrical units and the factors that affect them, using examples to illustrate. Examine units of charge and potential difference. Discuss electromotive force, its effects and examples. Current, resistance and voltage, with practical examples.
Formative assessment of electrical terminology.
Introduce the components in avionic systems. Visit a museum or airfield to examine avionic systems within aircraft.
Examine AC and DC electrical generation. Types of battery operation and installation with examples. DC and AC generators, their design and function. Learners to research examples and feedback outcomes to the group.

Topic and suggested assignments, activities and assessment
Principles of distribution and control. Examine types of AC and DC regulation and control. Power distribution. Paralleling. Circuit protection. Learners to look at various examples of different types of distribution and control.
Formative assessment of avionic systems.
Introduce the operating principles of aircraft communication and navigation systems. View Services Sound and Vision Corporation videos on aircraft communication and navigation systems in use. Visit a museum or airfield to examine aircraft communication and navigation systems in aircraft and in practical use or demonstration.
Examine the principles of radio wave propagation, including 'line of sight' and 'over the horizon' propagation. Discuss frequency and frequency allocation. AM/FM modulation and pulsing. Learners research examples and feed-back examples to the group.
Examine antenna systems. Look in at directional and omni-directional antennae and their use. Transmission lines, co-axial and wave guides, and aerial tuning, all with examples.
Introduce receivers and transmitters. Look in detail at amplifiers, oscillators, modulators, detectors and superhetrodyne receivers, with learners researching examples and uses.
Introduce airborne communication and navigation systems. Examine VHF, HF and satellite communication systems, with the learners researching possible uses of each system.
Formative assessment of airborne communication and navigation systems.
Introduce aircraft instruments and their principles of operation. Visit a museum or airfield to examine airborne communication and navigation systems in aircraft and in practical use or demonstration. Practical experience of computerised flight simulation.
Introduce the principle of the International Standard Atmosphere. Identify the definitions and figures for pressure, density, temperature, gravity and lapse rate.

Topic and suggested assignments, activities and assessment
Introduce aircraft instruments. Examine pitot-static systems and identify uses. Examine gyroscopic principles and identify uses. Examine other instruments and identify uses.
Formative assessment of aircraft instruments and their principles of operation.
Introduce the components and functions of an auto-flight system. Visit a museum or airfield to examine the components and functions of an auto-flight system in aircraft and in practical use or demonstration. Practical experience of computerised flight simulation.
Examine the principles of an auto-flight system. Roll, pitch and yaw channels. Modes of operation, including stability augmentation, interface with navigation aids and automatic landing modes. Learners should relate these principles to practical examples they have experienced.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 15: Military Aircraft Systems

Unit code: Y/503/2035

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to enable learners to gain knowledge of military aircraft systems, types, use, capability and limitations and advantages/disadvantages of air-launched weapons.

Unit introduction

In this unit the learner explores the systems used by modern military aircraft, principally those of the Royal Air Force, but including types in use by other British and foreign armed forces. It provides the learner with knowledge of military aircraft systems.

The unit explores the principles of the design of air-launched weapon and their key features. It considers aspects of engineering including materials, structural elements, safety features and the interaction with the aircraft on which they are carried. The unit develops an awareness of the context in which these systems are operated to understand the reasons behind their design.

Learning outcomes

On completion of this unit a learner should:

1 Know types of air-launched weapons carried by modern aircraft

2 Know use, capability and limitations of air-launched weapons

3 Know how air-launched weapons work as systems and interact with the aircraft on which they are carried

4 Know advantages and disadvantages of guided and unguided weapons

Unit content

1 **Know types of air-launched weapons carried by modern aircraft**

Air-to-air weapons: guided missiles, eg Meteor, AMRAAM, ASRAAM, Sidewinder (AIM-9L) and Sky Flash

Air-to-ground weapons: guided missiles, eg Storm Shadow, Hellfire, Brimstone, ALARM, Maverick; freefall bombs eg 500lb, 1000lb and 2000lb; guided bombs eg Paveway 2, Paveway 3, Paveway 4, JDAM; guns and rockets, eg M134 Minigun, Mauser 27mm, CRV-7

Air-to-surface weapons: guided missile eg Harpoon; Torpedo, eg Sting Ray

2 **Know use, capability and limitations of air-launched weapons**

Air-to-air missiles: types of target; direction and range to target; method of steering missile towards target; updating target information in flight; overcoming defensive measures; effectively disabling the target

Air-to-ground weapons: types of target; locating the target; method of steering towards the target; updating target information in flight; overcoming defensive measures and effectively disabling the target

3 **Know how air-launched weapons work as systems and interact with the aircraft on which they are carried**

Safety: importance of safety mechanisms; how safety mechanisms are used to ensure the hazard to the launch aircraft is minimised

Parts of systems: target audience systems, eg seeker, guidance unit, navigation system; fuse and warhead; actuation system; propulsion system; airframe; release mechanisms, eg rail launchers, ejection release units; version markings seeker; guidance unit; navigation system; fuse and warhead; actuation system; propulsion system and airframe; rail launchers, eg BOL-304, LAU-7; ejection release units; version markings

4 **Know advantages and disadvantages of guided and unguided weapons**

Advantages and disadvantages of unguided weapons: cost; range; accuracy; effectiveness; anti-weapon defensive strategy and its effectiveness

Advantages and disadvantages of guided weapons: cost; range; accuracy; effectiveness; anti-weapon defensive strategy and its effectiveness

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Identify types of air-launched weapons used by military aircraft		
P2 Describe capability and limitations of air-to-air missiles	M1 Compare capability and effectiveness of types of weapons that perform the same role	D1 Evaluate compromises that are necessary in the design and development of weapons
P3 Describe capability and limitations of air-to-ground missiles		
P4 Identify type of target that each air-launch weapon is designed for		
P5 Identify main parts of an air-launched weapon	M2 Explain markings used to differentiate between capabilities of different versions of the same weapon	
P6 Identify safety mechanisms used to protect the launch aircraft	M3 Explain methods and processes used to ensure a weapon remains safe when carried on an aircraft	
P7 Describe how an air-launched weapon is released from the aircraft and guided towards its target		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P8 List advantages and disadvantages of unguided weapons	M4 Compare the advantages of air-launched weapons to ground-launched weapons	D2 Evaluate benefits and disadvantages of guided and non-guided weapons in the delivery of success in an air campaign
P9 List advantages and disadvantages of guided weapons		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content, and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduction to military aircraft systems unit content and outline assessment methods.
Introduce the types of air-launched weapons carried by modern aircraft whether RAF or other British armed forces.
Introduce the types of air-to-air weapons. Explain the role and function of guided missiles, including Meteor, AMRAAM, ASRAAM, Sidewinder (AIM-9L) and Sky Flash.
Introduce the types of air-to-ground weapons. Explain the role and function of guided missiles, including Storm Shadow, Hellfire, Brimstone, ALARM and Maverick. Explain the role and function of freefall bombs, including 500lb, 1000lb and 2000lb bombs. Explain the role and function of guided bombs, including Paveway 2, Paveway 3, Paveway 4 and JDAM. Explain the role and function of guns and rockets, including M134 Minigun, Mauser 27mm and CRV-7.

Topic and suggested assignments, activities and assessment
Introduce air-to-surface weapons. Explain the role and function of guided missiles, eg Harpoon. Explain the role and function of torpedoes, eg Sting Ray.
Formative assessment of the types of air-launched weapons carried by modern aircraft whether RAF or other British armed forces.
Introduce the use, capability and limitations of air-launched weapons.
Introduce air-to-air missiles. Explain types of target. Explain direction and range of target principles. Explain the method of steering missile towards target. Explain the process for updating target information in flight. Explain overcoming defensive measures. Explain effectively disabling the target.
Introduce air-to-ground weapons. Explain the types of target. Explain how to locate the target. Explain the method of steering towards the target. Explain the process for updating target information in flight. Explain overcoming defensive measures. Explain effectively disabling the target.
Formative assessment of the use, capability and limitations of air-launched weapons.
Introduce how air-launched weapons work as systems in their own right and interact with the aircraft on which they are carried.
Introduce the parts of the different systems. Explain the part of the system, its role and function, including seeker, guidance unit, navigation system, fuse and warhead, actuation system, propulsion system and airframe.
Introduce carriage equipment. Explain the role and function of rail launchers, eg BOL-304, LAU-7. Explain the role and function of ejection release units. Explain weapon type and version markings
Introduce the safety aspects. Explain the importance of safety mechanisms. Explain how safety mechanisms are used to ensure that the hazard to the launch aircraft is minimised.

Topic and suggested assignments, activities and assessment
Formative assessment of how air-launched weapons work as systems in their own right and interact with the aircraft on which they are carried.
Introduce how weapons are used in the application of air power.
Explain the history related to weapons and air power. Explain the development of air-launched weapons.
Explain the capability. Explain the need for weapons with different capabilities.
Introduce range and accuracy. Explain the relationship between range and accuracy. Explain the need for weapons that have high accuracy.
Formative assessment of how weapons are used in the application of air power.
Introduce the advantages and disadvantages of guided and unguided weapons.
Explain the advantages and disadvantages of unguided weapons, including cost, range, accuracy, effectiveness, anti-weapon defensive strategy and its effectiveness.
Explain the advantages and disadvantages of guided weapons, including cost, range, accuracy, effectiveness, anti-weapon defensive strategy and its effectiveness.
Formative assessment of the advantages and disadvantages of guided and unguided weapons.
Learners should view videos of weapon use.
Learners should visit an aerospace museum, or an online resource, to view military aircraft weapons.
Learners should experiment with using various weapon types against a variety of targets on a flight simulator.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 16: Air Navigation for Air Cadets

Unit code: H/503/2037

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to provide learners with the understanding of air navigation. This unit introduces the calculations needed for air navigation, use of compass systems for air navigation and meteorological conditions that affect flying.

Unit introduction

The aim of this unit is to provide the learner with the understanding of air navigation that is necessary at Senior and Master Air Cadet level.

This unit provides the learner with an opportunity to explore the use of navigational techniques to determine speed, time travelled and relative velocities of aircraft. It provides an introduction to the terms of air triangle and a quick method to check the output of navigational computers, the 1-in-60 rule. Moreover, the learner will examine different types of compasses used in the aviation industry and the effects of weather on aircraft operations.

Learning outcomes

On completion of this unit a learner should:

1 Be able to carry out calculations to determine aircraft distance, speed and time travelled

2 Understand principles of vectors and triangle of velocities to establish aircraft's track and ground speed

3 Understand principles of the 1-in-60 rule relating to air navigation

4 Understand types and limitations of compass systems used for air navigation

5 Know the hazards that weather presents to aviation

Unit content

1 **Be able to carry out calculations to determine aircraft distance, speed and time travelled**

Measurement of distance: use of distance on nautical maps and charts; one minute of latitude and a nautical mile; nautical mile shown along each meridian; why scale along the parallels is not used; distances between the places on the same meridian

Measurement of aircraft speed: units of speed, eg nautical miles per hour or knots; method of measurement, eg air speed indicator, definition of dynamic pressure use of the pitot tube

Measurement of time: 24-hour clock; Greenwich Mean Time or Coordinated Universal Time; nautical miles per hour or knots

Calculation of time of flight in still air: distance, speed and time formula; manipulations of equations

2 **Understand principles of vectors and triangle of velocities to establish aircraft's track and ground speed**

Vectors and velocity: definitions, eg direction and speed is called velocity, velocity represented by a vector

Vector triangle: air triangle and its components, eg heading, true air speed, wind velocity, track, groundspeed, drift; computers, eg Dalton computer; examples and application of magic numbers, eg six-minute magic

3 **Understand principles of the 1-in-60 rule relating to air navigation**

1-in-60 rule: definitions, eg track required, track made good, revised track; rule, eg TMG 1 degree error from track is one mile off track after 60 miles; applications, eg halfway along track pinpoint; track error and closing angle

Aircraft flight: how wind affects flight

4 Understand types and limitations of compass systems used for air navigation

Magnetism: magnetic principles; earth's magnetic field

Direct indication compass: types, eg Silva; limitations and reasons, eg uses in aircraft; advantages, eg simple, reliable, cheap, lightweight, does not require power

Gyro magnetic compass: propose and basic principle, eg long-term accuracy of detector combined with short-term accuracy of a gyro; components, eg magnetic detector unit, gyroscope, error detector, controller, display; gyro errors

Other navigation systems: inertial navigation system; benefits, eg aligns to true north without need for variation; disadvantages; others, eg ring laser gyros or fibre optical gyros for inertial referencing system, global positioning systems

5 Know the hazards that weather presents to aviation

Weather hazards: definition of shallow fog and measurement, eg runway visual range; precipitation, eg rain, sleet, snow, hail; airborne hazards, eg thunderstorms, icing

Meteorological conditions: propose and uses of visual meteorological conditions; visual circuit; surface wind; wind component, eg headwinds, crosswinds, use of table

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Identify units used to measure distance, speed and time		
P2 Describe how measurements are made to determine aircraft speed, distance and time travelled	M1 Use techniques to determine aircraft speed, distance and time travelled	D1 Analyse the corrections needed to accurately measure aircraft speed, distance and time travelled
P3 Explain what is meant by 'vectors' and 'velocity' in aircraft navigation		
P4 Explain the components of the vector triangle	M2 Describe how the components of the vector triangle are interrelated	D2 Analyse an aircraft's track and ground speed from the principles of vectors and triangle of velocities
P5 Explain how to carry out calculations using a Dalton computer to establish aircraft's track and ground speed		
P6 Explain uses of the 1-in-60 rule	M3 Assess the error of an aircraft given certain criteria, using the principles of the 1-in-60 rule	
P7 Describe how wind affects aircraft flight		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P8 Describe types of navigation systems used in aircraft		
P9 Explain the working principle of magnetic compasses		
P10 Describe the use and components of a gyro magnetic compass		
P11 Describe limitations of aircraft compass systems		
P12 Identify weather hazards that affect navigation		
P13 Identify the meteorological conditions that affect aircraft operation	M4 Explain the meteorological conditions in which the various training aircraft can operate	

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduction to the basic navigation unit content and outline assessment methods.
Introduce to the calculations to determine aircraft distance, speed and time.
Introduce the measurement of distance. Explain the use of distance on nautical maps and charts. Explain the principle of one minute of latitude and a nautical mile. Explain principle of nautical miles shown along each meridian. Explain why scale along the parallels is not used. Explain the distances between the places on the same meridian.
Introduce the measurement of aircraft speed. Explain units of speed, eg nautical miles per hour or knots. Explain the method of measurement, eg air speed indicator, definition of dynamic pressure and the use of the pitot tube.

Topic and suggested assignments, activities and assessment
Introduce corrections. Explain the definitions of pressure error and instrument pressure. Explain how calibrated air speed is calculated. Explain how true air speed is calculated.
Introduce the principles of the measurement of time. Explain the 24-hour clock. Explain Greenwich Mean Time or Coordinated Universal Time. Explain nautical miles per hour or knots.
Introduce the calculation of time of flight in still air. Explain the distance, speed and time formula. Explain the manipulations of equations.
Formative assessment of calculations to determine aircraft distance, speed and time.
Introduce the principles of vectors and the triangle of velocities to establish an aircraft's track and ground speed.
Introduce vectors and velocity. Explain the definitions, eg direction and speed is called velocity and velocity represented by a vector.
Introduce the vector triangle. Explain the air triangle and its components, eg heading, true air speed, wind velocity, track, groundspeed and drift. Explain the associated computers, eg Dalton computer. Explain the examples and application of magic numbers, eg six-minute magic.
Formative assessment of the principles of vectors and the triangle of velocities to establish an aircraft's track and ground speed.
Introduce the principles of the 1-in-60 rule.
Explain how wind affects aircraft flight.
Introduce the 1-in-60 rule. Explain the definitions, eg track required, track made good and revised track. Explain the rule, eg TMG 1 degree error from track is one mile off track after 60 miles. Explain the applications, eg halfway along track pinpoint; track error and closing angle.
Formative assessment of the principles of the 1-in-60 rule.
Introduce the types of compass systems used for air navigation, how they work and their limitations.

Topic and suggested assignments, activities and assessment
Introduce magnetism. Explain magnetic principles. Explain the earth's magnetic field.
Introduce the direct indication compass. Explain the types, eg Silva. Explain the limitations and reasons, eg uses in aircraft. Explain the advantages, eg simple, reliable, cheap, lightweight, does not require power.
Introduce the gyro magnetic compass. Explain the propose and basic principle, eg long-term accuracy of detector combined with short-term accuracy of a gyro. Explain the components, eg magnetic detector unit, gyroscope, error detector, controller and display. Explain gyro errors.
Introduce other navigation systems. Explain the inertial navigation system and benefits, eg aligns to true north without need for variation and disadvantages. Explain others, eg ring laser gyros or fibre optical gyros for inertial referencing system and global positioning systems.
Formative assessment of the types of compass systems used for air navigation, how they work and their limitations.
Introduce the hazards that weather presents to aviation.
Introduce meteorological conditions. Explain the purpose and uses of visual meteorological conditions. Explain the visual circuit. Explain surface wind. Explain the wind component, eg headwinds, crosswinds, use of table.
Introduce weather hazards. Explain the definition of shallow fog and measurement, eg runway visual range. Explain precipitation, eg rain, sleet, snow, hail. Explain airborne hazards, eg thunderstorms, icing.
Formative assessment of the hazards that weather presents to aviation.
Learners should undertake a range of navigation exercises.
Learners should practice navigation principles on a flight simulator.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 17: Principles of Pilot Navigation

Unit code: K/503/2038

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to enable learners to understand pilot navigation, including flight-planning techniques and effects of weather on aviation.

Unit introduction

The aim of this unit is to provide the learner with the understanding of pilot navigation as required at ATC Senior Cadet and Master Air Cadet level.

This unit introduces the learner to the appropriate units of measurement, map and chart-work, and terms and techniques for air navigation. It allows the learner to explore the effects of weather on aviation from an in-flight perspective and introduces a range of forecasting information methods.

Learning outcomes

On completion of this unit a learner should:

1 Know the features of air navigation and navigational aids

2 Be able to use flight-planning techniques

3 Understand effects of weather on aviation

Unit content

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1 **Know the features of air navigation and navigational aids**

Units of measurement: International System of Units and International Civil Aviation Organisation alternatives, eg metres and nautical miles, hectopascals and millibar; measurement of vertical distance and speed, eg feet per minute; metrological units; aircraft weight and fuel, eg pounds or metric tonnes; fuel conversion; fuel weight to volume; use of specific gravity; pressure, eg air pressure varies with altitude

Position fixing: methods of visual fixing; radio aids, eg radio direction finder; use of radio beacons, eg VOR/DME and TACAN; astro-navigation, eg use of a sextant; radar navigation; advantages and disadvantages; long range fixing; active and passive systems, eg electric warfare systems, GPS

Map reading: limitations, eg speed of travel, weather; recognising unique features; use of maps and charts; map scales; timing marks; contact colour

2 **Be able to use flight-planning techniques**

Vector triangle: triangle of velocities, eg methods of calculation; information required, eg track, distance, forecast, height, air temperatures, indicated air speed, true air speed, variation; calculation, eg what heading aircraft must fly to counter wind effect and follow desired track over ground

Flight planning: use of pilot navigation log card; completing of pilot navigation log card with appropriate data for each leg of journey; fuel planning, eg reasons, methods; other information eg safety altitude; air traffic control flight plan

3 **Understand effects of weather on aviation**

Definitions: air; temperature and pressure, eg Boyle's law; water vapour, eg dew point

Vertical motion in air: how clouds are formed

Thunderstorms: hazards; icing; precipitation; turbulence; lightning and thunder; landing hazards; how thunderstorm are detected, eg radar

Measurement: isobars; high and low pressure, eg cyclones, anti-cyclones

Weather charts: uses; how there are interpreted

Weather forecasts: use of terminal aerodrome forecast and meteorological actual report; codes and uses, eg DZ drizzle, FG fog, FZ freezing, FZDZ light freezing drizzle

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Name units of measurement used in aviation		
P2 Identify methods used for position fixing in aviation	M1 Compare the effectiveness of position-fixing methods in different flying situations	
P3 Identify what features are useful for map reading in an aircraft at low level		
P4 Describe the limitations of visual map reading in an aircraft	M2 Compare benefits and limitations of visual map reading in an aircraft	
P5 Describe use of vector triangle in flight planning		
P6 Identify factors necessary for flight planning	M3 Explain purpose of calculating flight times and importance when working out the fuel load	D1 Justify the order in which navigation log card information is used for flight planning
P7 Describe how to calculate flight times using flight-planning techniques		
P8 Identify terms used for weather in aviation		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9 Identify reasons for vertical motion in air		
P10 Identify hazards caused by thunderstorms		
P11 Describe use of weather charts in aviation		
P12 Identify the types of weather forecasting used in aviation and the codes	M4 Describe the uses of weather-forecasting codes	D2 Assess weather conditions from actual weather forecasts and reports

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduction to the basic principles of pilot navigation unit content and outline assessment methods.
Introduce the basic features of air navigation and navigational aids.
Introduce the units of measurement. Explain the International System of Units and International Civil Aviation Organisation alternatives, eg metres and nautical miles, hectopascals and millibars, etc. Explain the measurement of vertical distance and speed, eg feet per minute. Explain metrological units, aircraft weight and fuel, eg pounds or metric tonnes. Explain fuel conversion, fuel weight to volume, use of specific gravity, pressure, eg air pressure varies with altitude.

Topic and suggested assignments, activities and assessment
Introduce position fixing. Explain the methods of visual fixing. Explain radio aids, eg radio direction finder. Explain VOR/DME and TACAN, eg use of radio beacons. Explain astro-navigation, eg use of a sextant. Explain radar navigation, advantages and disadvantages. Explain long-range fixing. Explain active and passive systems, eg electric warfare systems, GPS, etc.
Introduce aircraft map reading. Explain the limitations, eg speed of travel, weather. Explain who to recognise unique features. Explain the use of maps and charts. Explain map scales and timing marks. Explain the use of contact colour.
Formative assessment of the basic features of air navigation and navigational aids.
Introduce the techniques of flight planning.
Introduce the principle of the vector triangle. Explain the triangle of velocities, eg methods of calculation. Explain the information required, eg track, distance, forecast, height, air temperatures, indicated air speed, true air speed, variation. Explain the calculation, eg what heading aircraft must fly to counter wind effect and follow desired track over ground.
Introduce flight planning. Explain the use of the pilot navigation log card. Explain and demonstrate how to complete a pilot navigation log card with appropriate data for each leg of a journey. Explain fuel planning, eg reasons, methods. Explain what other information may be required, eg safety altitude. Explain the air traffic control flight plan.
Formative assessment of the techniques of flight planning.
Introduce the effects of weather on aviation.
Explain the definitions that relate to weather. Explain what air is. Explain temperature and pressure, eg Boyle's law. Explain water vapour, eg dew point.

Topic and suggested assignments, activities and assessment
Explain the principle of vertical motion in air. Explain how clouds are formed.
Explain the hazards, including icing, precipitation, turbulence, lightning and thunder and landing hazards. Explain how thunderstorm are detected, eg radar.
Introduce the methods of measurement. Explain isobars. Explain high and low pressure, eg cyclones and anti-cyclones.
Introduce weather charts. Explain and demonstrate the uses of weather charts. Explain how these are interpreted.
Introduce the principle of weather forecasts. Explain the use of terminal aerodrome forecast and meteorological actual report. Explain the codes and their uses, eg weather – DZ drizzle, FG fog, FZ freezing, FZDZ light freezing drizzle.
Formative assessment of the effects of weather on aviation.
Learner should practice calculating the triangle of velocity.
Learners should practice completing the pilot navigation log card.
Learner should put into practice pilot navigation principles on a flight simulator.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 18 Radio and Radar for Air Cadets

Unit code: A/503/2044

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to give learners knowledge of the principles of radio and radar, relating to aviation.

Unit introduction

The aim of this unit is to enable the learner with an understanding of radio, radar and equipment techniques required at ATC Senior Cadet and Master Air Cadet level.

The unit introduces the learner to the principles and equipment used in radar and radio communications. It allows the learner to explore the history and development of radar including the key terms, equipment and installation. The unit also introduces the types of ground radio and aids to navigation used in an airfield environment.

Further into the unit, the learner will go deeper into the subject by producing and evaluating basic radio and radar block diagrams.

Learning outcomes

On completion of this unit a learner should:

1 Know principles of radar and radio communications

2 Know how various types of radio and radar work

3 Know how ground radio and radar systems are used to aid air navigation

Unit content

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1 **Know principles of radar and radio communications**

Basic principles of radio and radar communications: definitions, eg frequency, amplitude, wavelength, velocity; relationship between frequency, wavelength and velocity, eg formula; principles of radio waves; sound waves; electromagnetic radiation/energy; radio signals; frequency modulation (FM) and amplitude modulation (AM); how wavelength affects efficient aerial length

Radio communications and radar equipment: basic AM transmitter; master oscillator; buffer amplifier; power amplifier; amplifier; frequency modulation (FM) discriminator; purpose of an aerial and how it works

Basic radio circuit: circuit diagrams, eg radio receivers, aerials, uses and parts of superheterodyne receivers, FM receivers

2 **Know how various types of radio and radar work**

Types of radar: types, eg primary, secondary; principle of primary radar, eg uses reflected energy; uses of primary radar, eg surveillance, early warning, navigation, ground mapping, guidance control, target detection and tracking, terrain following/avoidance, collision avoidance, altitude measurement; air traffic control

Radar block diagram: block circuit diagrams, eg primary, pulse-modulated and continuous radar; contents of diagrams, eg master timing unit, transmitter, aerial, transmit/receive switch, receiver, CRT indicator, timebase generator

Basic operation of primary radar: distance, speed and time formula; method of operation of pulse-modulated, eg echo principle, radar mile, pulse repetition frequency, peak power wave; continuous wave radar; Doppler effect and Doppler frequency shift

Basic operation of secondary radar: development and uses of identify friend or foe (IFF) and secondary surveillance radar (SSR); information obtained, eg aircraft height, direction, speed and type; advantages, eg no unwanted returns, increased range with less power, more information, use of wide bandwidth

Aerials: types and methods of operation, eg directed radiation beam

Display: types and methods of operation, eg cathode ray tube, plan position indicator, 3-D radar

Factors affecting radar system: noise; interference; clutter, target; aerial rotation; pulse repetition frequency

3 **Know how ground radio and radar systems are used to aid air navigation**

Ground radio and radar systems aid air navigation: types of ground radio systems; communication systems available on airfields, eg IFF/SSR radar, precision approach radar, primary radar, TACAN (tactical air navigation), instrument landing system, precision approach radar, digital resolution direction finding; components and principle of operation of each type

Types and uses of ground radio and airfield communication equipment: mascot minicoms; RAF fixed telephone system; satellite communications; UK ADGE; STCICS; components and principle of operation of each type

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Outline principles of radio communications and radio signals	M1 Describe the principle of electromagnetic radiation/energy	
P2 Describe how a radio and radar aerial works		
P3 Identify the components of radio and radar equipment	M2 Describe the components of AM transmitters	D1 Analyse a block diagram of AM transmitters
P4 Identity the components of a basic radio circuit		
P5 Identify types of radar and their uses		
P6 Identify the components of a radar system	M3 Describe the function of the components of a radar system	D2 Analyse a block circuit diagram of a radar system
P7 Outline the basic operation of primary and secondary radar	M4 Describe how primary, pulse-modulated and continuous radar works	
P8 Describe types of display used by radar systems		
P9 Identify factors that affect radar systems		
P10 Outline types of ground radio and radar systems available on airfields		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P11 Describe how ground radio and radar systems aid air navigation		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets) will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduce the principles of radar and radio communications.
Introduce the basic principles of radio and radar communications. Explain the definitions, eg frequency, amplitude, wavelength, velocity. Explain the relationship between frequency, wavelength and velocity, eg formula. Explain the principles of radio waves and sound waves. Explain electromagnetic radiation/energy. Explain the principle of radio signals. Explain frequency modulation (FM) and amplitude modulation (AM). Explain how wavelength affects efficient aerial length.

Topic and suggested assignments, activities and assessment
Introduce radio communications and radar equipment. Explain the basic AM transmitter. Explain the master oscillator and how it operates. Explain the buffer amplifier and how it operates. Explain the power amplifier and how it operates. Explain the amplifier and how it operates. Explain the frequency modulation (FM) discriminator and how it operates. Explain the purpose of an aerial and how it works.
Introduce the basic radio circuit. Explain circuit diagrams of radio receivers and aerials. Explain the uses and parts of superheterodyne receivers. Explain FM receivers.
Formative assessment of the principles of radar and radio communications.
Introduce how various types of radio and radar work.
Introduce the development of radar. Explain the early history, eg radio detection and finding.
Introduce the types of radar. Explain the types of radar, eg primary and secondary. Explain the principle of primary radar, eg uses reflected energy. Explain the uses of primary radar, eg surveillance, early warning, navigation, ground mapping, guidance control, target detection and tracking, terrain following/avoidance, collision avoidance and altitude measurement, air traffic control.
Introduce the basic operation of primary radar. Explain the distance, speed and time formula. Explain the method of operation of pulse-modulated radar, eg echo principle, radar mile, pulse repetition frequency, peak power wave, continuous wave radar. Explain the Doppler effect and Doppler frequency shift.
Introduce the basic operation of secondary radar. Explain the development and uses of identify friend or foe (IFF) and secondary surveillance radar (SSR). Explain the information obtained, eg aircraft height, direction, speed and type. Explain the advantages, eg no unwanted returns, increased range with less power, more information, use of wide bandwidth.
Aerials: types and methods of operation, eg directed radiation beam.

Topic and suggested assignments, activities and assessment
Introduce the display. Explain the types and methods of operation, eg cathode ray tube, plan position indicator, 3-D radar.
Introduce the factors affecting radar system. Explain what is meant by noise, interference, clutter, target, aerial rotation, pulse repetition frequency and how they affect a radar system.
Introduce the radar block diagram. Explain radar block diagrams, eg primary, pulse-modulated and continuous radar. Explain the contents of diagrams, eg master timing unit, transmitter, aerial, transmit/receive switch, receiver, CRT indicator, timebase generator.
Formative assessment of how various types of radio and radar work.
Introduce how ground radio and radar systems aid air navigation.
Explain the types of ground radio systems. Explain the communication systems available on airfields, eg IFF/SSR radar, precision approach radar, primary radar, TACAN (tactical air navigation), instrument landing system, precision approach radar, digital resolution direction finding. Explain the components and principle of operation of each type.
Introduce the types and uses of ground radio and airfield communication equipment. Explain mascot minicoms, RAF fixed telephone system, satellite communications, UK ADGE and STCICS. Explain the components and principle of operation of each type.
Formative assessment of how ground radio and radar systems aid air navigation.
Learners should use the air traffic control simulator to experience the practical application of radio and radar systems.
Learners should visit an operational airfield to view airfield radio and radio systems in use.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Unit 19: Satellite and Data Communication for Air Cadets

Unit code: F/503/2045

Level 2: BTEC Specialist

Credit value: 5

Guided learning hours: 40

Unit aim

The aim of this unit is to give learners knowledge of satellite and data communication systems and networks for Air Cadets.

Unit introduction

This unit gives learners knowledge of satellite and data communication systems and networks that are required at ATC Senior and Master Air Cadet level.

This unit introduces the principles and equipment used in satellite and data communication. It explores the types, orbits and roles and construction of satellites, and describes the basic function of a Global Positioning System. The unit also develops an understanding of types of data communications networks and mobile communication.

Learning outcomes

On completion of this unit a learner should:

1 Know main types and roles of satellites and principles of earth orbit

2 Know components and principles of a Global Positioning System

3 Know principles of data communication

4 Know types and roles of mobile communication

Unit content

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1 **Know main types and roles of satellites and principles of earth orbit**

Orbit: definition; types, eg low earth orbit, medium earth orbit, geostationary earth orbit; functions; orbit slots; space junk; how satellites stay in orbit

Uses of satellites, their uses and who uses them: astronomy; communication; navigation; reconnaissance; remote sensing; search and rescue; space exploration; weather stations

Phases: launch phase; orbit injection phase; perigee; transfer; apogee

Station keeping: definition; disturbing forces (what they are and their outcome); control mechanism and how it operates, eg ejection of hydrazine gas; lifespan of process

Satellite components and uses: configurations of satellite housing; reasons for determining the housing, eg stabilisation system; three-axis stabilised satellites; design features, eg solar array, reaction control thrusters, apogee kick motor nozzle cone, hydrazine propellant tanks, communications antennae; types of power sources, eg high performance batteries, solar cells; advantages of each type, eg solar are lightweight, resilient, efficiency; disadvantages of each type, eg solar does not work during eclipses; ways of overcoming disadvantages; purpose of antenna systems, eg receive and transmit telecommunications signals and tracking, telemetry and command; consequences, eg no command function satellite could drift out of control; purpose and method of operation of command and control system; transponder operation, typical output, number of transponders used typically on satellites

2 **Know components and principles of a Global Positioning System**

How GPS works: method of measurement, eg measurements for time, position and distance; method of calculation, eg receiver distance from satellite in time; standard, eg World Geodetic System 1984 (WGS84)

Components: main parts and their uses, eg space segment, user segment, control segment

Constellation of satellites: GPS satellite orbits; timing, eg atomic clock; method of operation and measurement; calculation of latitude, longitude and altitude; benefits of using four or more satellites

Ground stations: GPS control segment, eg master control station, unstaffed monitoring stations, large ground antenna station; method of operation, eg role of monitoring stations, adjustment control

GPS in the military: how military GPS works and why

GPS in everyday life: non-military uses in the public services, eg police, fire, medical; uses in mapping, eg mapmaking, surveying, construction, mining; vehicle tracking, eg private cars, fleet vehicles, public transportation, delivery trucks, courier services; moving map GPS displays; balloons, eg to monitor holes in the ozone layer; buoys, eg tracking tides, oil spills; scientific research, eg archaeologists, biologists, explorers; entertainment, leisure and other person applications, eg boating, hill walking, keeping track of children, managing the location of parolees

3 Know principles of data communication

Protocols: uses and methods; transfer of data: method of transfer; preservation of data during transfer; network security

Types of network: fixed wire and wireless; personal area networks; local area networks; wide area networks; internetwork; worldwide web; intranet; extranet; wireless networks; wi-fi

Computer network servers: uses of methods, eg server farms

4 Know types and roles of mobile communication

Design concepts: main components of a mobile communication network, eg mobile device

Application: mobile phones; mobile data devices; internet; worldwide web

Bluetooth: definition; method of operation and security, eg 2.4 GHz band, no licence or subscription, 128-bit encryption and PIN code; operating range by class, eg 100 metres for Class 1; electronic devices that can supported

Wi-fi: definition, eg wireless fidelity; uses, eg computers, mobile phone and PDAs wirelessly communicating; methods of operation; hotspots; voice over internet protocol

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Describe the principles of earth orbit		
P2 Identify uses of satellites	M1 Comment on advantages and disadvantages of using satellites	
P3 Identify phases that a satellite undergoes		
P4 Describe how station keeping is managed		
P5 Identify use of the main components of a satellite	M2 Describe use of power system components in a satellite	D1 Analyse benefits and disadvantages of satellite power systems
P6 Describe how a Global Positioning System works		
P7 Identify components of a Global Positioning System	M3 Describe function of components of a Global Positioning System	D2 Evaluate function of a Global Positioning System
P8 Describe the application of a constellation of satellites for Global Positioning		
P9 Identify types of Global Positioning System ground stations		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P10 Identify uses of Global Positioning Systems in the military and everyday life		
P11 Describe protocols used for data communication		
P12 Identify types of data networks	M4 Explain uses of data networks	
P13 Describe use of data network servers		
P14 Identify main components of a mobile communications network		
P15 Identify applications of mobile communications	M5 Describe how mobile communication devices affect society	
P16 Describe the definition and use of Bluetooth and wi-fi		

Essential guidance for tutors

Delivery

This unit has been designed to be delivered as part of an integrated training programme for the Air Training Corps (ATC) or Combined Cadet Force (CCF – Royal Air Force section) and to follow the respective syllabus of training for the ATC and CCF.

The delivery of the units that make up the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Aviation Studies for Air Cadets will support and be integral to the general cadet training. This training will provide the learner with progression from First Class Cadet, Leading Cadet and Senior Cadet (and for the ATC syllabus – Master Air Cadet).

The delivery of each unit will follow the structure laid down by the joint ATC/CCF Air Cadet Publications (ACP), published by the RAF to support and guide the syllabus for each unit. Each ACP provides a structured learning programme that will aid the delivery of the unit content, and materials that can be used for formative assessment of learning.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way of planning the delivery and assessment of this unit.

Topic and suggested assignments, activities and assessment
Introduction to unit and programme of assignments.
Introduce the main types of satellite and the principles of earth orbit.
Introduce the topic of satellites. Explain the history of the development of satellites. Explain the definition of a satellite.
Introduce orbits. Explain the definition. Explain the types, including low earth orbit, medium earth orbit, geostationary earth orbit. Explain the functions, orbit slots, space junk and how satellites stay in orbit.
Introduce the launch process. Explain the launch phase, orbit injection phase; perigee, transfer and apogee.
Introduce satellite communications basics. Explain the use of earth stations. Explain the satellite footprint. Explain the transmission systems and methods, including uplink, downlink.

Topic and suggested assignments, activities and assessment
Explain the types of satellite, their uses and who uses them, including astronomy, communication, navigation, reconnaissance, remote sensing, search and rescue, space exploration and weather stations.
Formative assessment of the main types of satellites and the principles of earth orbit.
Introduce the main components of a satellite.
Introduce satellite housing. Explain configurations of the satellite housing. Explain the reasons for determining the housing, including stabilisation system. Explain the principle of three axis stabilised satellites. Explain the design features, including solar array, reaction control thrusters, apogee kick motor nozzle cone, hydrazine propellant tanks, communications antennae.
Introduce the power system. Explain the types of power sources, including high performance batteries and solar cells. Explain the advantages of each type of system, eg solar are lightweight, resilient, efficient. Explain the disadvantages of each type, eg solar does not work during eclipses. Explain the ways of overcoming disadvantages.
Introduce the antenna system. Explain the purpose, eg receive and transmit telecommunications signals and tracking, telemetry and command. Explain system priority, reasons and consequences, eg no command function, satellite could drift out of control.
Introduce the command and control system. Explain the purpose and method of operation.
Introduce the principle of station keeping. Explain the definition. Explain the disturbing forces, what they are and their outcome. Explain the control mechanism and how it operates, eg ejection of hydrazine gas. Explain the lifespan of process.
Introduce transponders. Explain the definition. Explain the means of operation and the typical output. Explain the number of transponders used typically on satellites.
Formative assessment of the main components of a satellite.
Introduce the basic principles and components of a Global Positioning System.

Topic and suggested assignments, activities and assessment
Explain the history of Global Positioning Systems. Explain the basic method of operation.
Introduce the components of Global Positioning Systems. Explain the main parts and their uses, including space segment, user segment and control segment.
Introduce the principle of the constellation of satellites. Explain GPS satellite orbits. Explain timing, including the atomic clock; method of operation and measurement. Explain the calculation of latitude, longitude and altitude. Explain the benefits of using four or more satellites.
Introduce receivers. Explain the uses and where used, including aircraft, ships, tanks, submarines, cars, trunks and personal mobile phones. Explain the method of operation.
Introduce the principle of ground stations. Explain the GPS control segment, including master control station, unstaffed monitoring stations, large ground antenna station. Explain the method of operation, including the role of monitoring stations and adjustment control.
Introduce how GPS works. Explain the method of measurement, including measurements for time, position and distance. Explain the method of calculation, eg receiver distance from satellite in time. Explain the standard applied to GPS, eg World Geodetic System 1984 (WGS84).
Introduce GPS in the military. Explain how military GPS works and why.
Introduce the GPS in everyday life. Explain and demonstrate moving map GPS displays. Explain the non-military uses in the public services, eg police, fire, medical. Explain the uses in mapping, eg map making, surveying, construction, mining. Explain vehicle tracking, eg private cars, fleet vehicles, public transportation, delivery trucks, courier services. Explain GPS use in balloons, eg to monitor holes in the ozone layer. Explain GPS use in buoys, eg tracking tides, oil spills. Explain GPS use in scientific research, eg archaeologists, biologists, explorers. Explain GPS use in entertainment, leisure and other person applications, eg boating, hill walking, keeping track of children, managing the location of parolees.

Topic and suggested assignments, activities and assessment
Formative assessment of the basic principles and components of a Global Positioning System.
Introduce the principles of data communication.
Introduce types and roles of mobile communication. Explain transfer of data and the method of transfer. Explain the preservation of data during transfer.
Introduce the protocols of data communication. Explain the uses and methods of use.
Introduce types of networks. Explain personal area networks, local area networks, wide area networks, internetwork, world wideweb, intranet, extranet, wireless networks and wi-fi.
Introduce network security. Explain the uses and methods of use.
Introduce the principle of computer network servers. Explain the methods of use, eg server farms.
Formative assessment of the principles of data communication.
Introduce the basic principles of mobile communication.
Introduce the design concepts of mobile communication. Explain the main components of a mobile communication network, eg mobile device.
Introduce the scientific concepts of mobile communication. Explain the applications of mobile phones, mobile data devices, internet and worldwide web.
Introduce Bluetooth. Explain the definitions. Explain the method of operation and security, eg 2.4 GHz band, no licence or subscription, 128-bit encryption and PIN code. Explain the operating range by class, eg 100 metres for Class 1. Explain what the electronic devices are that can be supported.
Introduce wi-fi. Explain the definition, eg wireless fidelity. Explain the uses, eg computers, mobile phone and PDAs wirelessly communicating. Explain the methods of operation. Explain the principle of hotspots. Explain voice over internet protocol.

Topic and suggested assignments, activities and assessment
Formative assessment of the basic principles of mobile communication.
Review of unit and programme of assignments.

Assessment

The unit is assessed by the centre and will be subject to external verification by Pearson.

Achievement of the assessment and grading criteria should be evidenced through contextualised, vocationally related experiences, with tasks specifically designed with the assessment and grading criteria in mind. This unit can be assessed through learners collating a portfolio of evidence. Centres should devise their own assignments and are encouraged to use a variety of assessment methods to help motivate learners. This can include: project work, reports, presentations, question papers, observations of practical activity.

Signed witness testimonies and observation records must be retained for verification purposes.

Further information and useful publications

To get in touch with us visit our 'Contact us' pages:

- Edexcel, BTEC and Pearson Work Based Learning contact details: qualifications.pearson.com/en/support/contact-us.html
- books, software and online resources for UK schools and colleges: www.pearsonschoolsandfecolleges.co.uk

Key publications

- Adjustments for candidates with disabilities and learning difficulties, Access and Arrangements and Reasonable Adjustments, General and Vocational qualifications (Joint Council for Qualifications (JCQ))
- Supplementary guidance for reasonable adjustments and special consideration in vocational internally assessed units (Pearson)
- General and Vocational qualifications, Suspected Malpractice in Examination and Assessments: Policies and Procedures (JCQ)
- Equality Policy (Pearson)
- Recognition of Prior Learning Policy and Process (Pearson)
- UK Information Manual (Pearson)
- Pearson Edexcel NVQs, SVQs and competence-based qualifications – Delivery Requirements and Quality Assurance Guidance (Pearson)

All of these publications are available on our website: qualifications.pearson.com

Further information and publications on the delivery and quality assurance of NVQ/Competence-based qualifications are available at our website on the Delivering BTEC pages. Our publications catalogue lists all the material available to support our qualifications. To access the catalogue and order publications, please go to the resources page of our website.

Professional development and training

Pearson supports UK and international customers with training related to Pearson BTEC qualifications. This support is available through a choice of training options offered in our published training directory or through customised training at your centre.

The support we offer focuses on a range of issues including:

- planning for the delivery of a new programme
- planning for assessment and grading
- developing effective assignments
- building your team and teamwork skills
- developing student-centred learning and teaching approaches
- building functional skills into your programme
- building-in effective and efficient quality assurance systems.

The national programme of training we offer can be viewed on our website (qualifications.pearson.com). You can request customised training through the website or by contacting one of our advisers in the Training from Pearson team via Customer Services to discuss your training needs.

Contact us

We have a dedicated Account Support team, across the UK, to give you more personalised support and advice.

To contact your Account Specialist:

Email: wblcustomerservices@pearson.com
Telephone: 0844 576 0045

If you are new to Pearson and would like to become an approved centre, please contact us by:

Email: wbl@pearson.com
Telephone: 0844 576 0045

Annexe A

Mapping to Level 2 functional skills

Skill	Unit number																		
ICT – Use ICT systems	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system used																			✓
Manage information storage to enable efficient retrieval	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Follow and understand the need for safety and security practices																			✓
ICT – Find and select information	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Skill	Unit number																		
ICT – Develop, present and communicate information	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bring together information to suit content and purpose	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Present information in ways that are fit for purpose and audience	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists																			✓

Skill	Unit number																		
Mathematics	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Identify the situation or problem and the mathematical methods needed to tackle it												✓	✓			✓			
Select and apply a range of skills to find solutions																✓			

Skill	Unit number																		
English	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Annexe B

Examples of calculation of qualification grade above pass grade

Pearson will automatically calculate the qualification grade for your learners when your learner unit grades are submitted.

The generic examples below demonstrate how the qualification grade above pass is calculated using the following two tables which are also shown in the section earlier in the specification *Calculation of the qualification grades above pass grade*.

Points available for credits achieved at different levels and unit grades

The table below shows the **number of points scored per credit** at the unit level and grade.

Unit level	Points per credit		
	Pass	Merit	Distinction
Level 1	3	4	5
Level 2	**5**	**6**	**7**
Level 3	7	8	9

Learners who achieve the correct number of points within the ranges shown in the 'qualification grade' table below will achieve the qualification merit or distinction or distinction* grade.

Qualification grade

Qualification	Points range above pass grade		
	Merit	Distinction	Distinction*
Pearson BTEC Level 2 Certificate	85–94	95–99	100 and above
Pearson BTEC Level 2 Extended Certificate	170–189	190–199	200 and above
Pearson BTEC Level 2 Diploma	340–379	380–399	400 and above

Example 1

Achievement of pass qualification grade

A learner completing a 15-credit Pearson BTEC Level 2 Certificate achieves the credit required to gain a pass qualification grade and does not achieve the points to gain a merit grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Pass	5	5 × 5 = 25
Unit 2	2	5	Pass	5	5 × 5 = 25
Unit 3	2	5	Merit	6	5 × 6 = 30
Qualification grade totals		**15**	**Pass**		**80**

Example 2

Achievement of merit qualification grade

A learner completing a 15-credit Pearson BTEC Level 2 Certificate achieves the points required to gain a merit qualification grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Pass	5	5 × 5 = 25
Unit 2	2	5	Merit	6	5 × 6 = 30
Unit 3	2	5	Merit	6	5 × 6 = 30
Qualification grade totals		**15**	**Merit**		**85**

Example 3

Achievement of distinction qualification grade

A learner completing a 15-credit Pearson BTEC Level 2 Certificate achieves the points required to gain a distinction qualification grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Merit	6	5 × 6 = 30
Unit 2	2	5	Merit	6	5 × 6 = 30
Unit 3	2	5	Distinction	7	5 × 7 = 35
Qualification grade totals		**15**	**Distinction**		**95**

Example 4

Achievement of merit qualification grade

A learner completing a 30-credit Pearson BTEC Level 2 Extended Certificate achieves the points required to gain a merit qualification grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Merit	6	5 × 6 = 30
Unit 2	2	5	Pass	5	5 × 5 = 25
Unit 3	2	5	Distinction	7	5 × 7 = 35
Unit 6	2	10	Pass	5	10 × 5 = 50
Unit 8	3	5	Pass	7	5 × 7 = 35
Qualification grade totals		**30**	**Merit**		**175**

Example 5

Achievement of merit qualification grade

A learner completing a 60-credit Pearson BTEC Level 2 Diploma achieves the points required to gain a merit qualification grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Merit	6	5 × 6 = 30
Unit 2	2	5	Pass	5	5 × 5 = 25
Unit 3	2	5	Distinction	7	5 × 7 = 35
Unit 6	2	10	Merit	6	10 × 6 = 60
Unit 9	1	5	Merit	4	5 × 4 = 20
Unit 10	2	10	Distinction	7	10 × 7 = 70
Unit 11	2	10	Merit	6	10 × 6 = 60
Unit 14	2	10	Merit	6	10 × 6 = 60
Qualification grade totals		**60**	**Merit**		**360**

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For more information on Edexcel and BTEC qualifications please visit our website: qualifications.pearson.com