City & Guilds Level 2 Diploma in Aircraft Engineering (2675-23)

Version 1.2 (September 2024)

Qualification Handbook

Qualification at a glance

Subject area	Engineering
City & Guilds number	2675
Age group approved	16-18, 19+
Entry requirements	City & Guilds does not set a minimum requirement for entry to this qualification. The apprenticeship framework suggests the following: As a guide, the Engineering Manufacturing Framework is suitable for applicants who have five GCSEs grades D to E in English, Maths and Science.
Assessment	Assignment, Multiple Choice test, Written exam
Grading	Pass/Fail
Approvals	Full approval required
Support materials	Example assessments
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	City & Guilds qualification number	Regulatory reference number	GLH	TQT
City & Guilds Level 2 Diploma in Aircraft Engineering	2675-23	600/3409/9	340	400

Version and date	Change detail	Section
1.0 September 2011	Initial version	All
1.1 September 2017	Added TQT details. Deleted QCF	Qualification at a glance and Structure Throughout
1.2 September 2024	Handbook reviewed and updated to the new template Update on the Civil Aviation Authority (CAA) replacing all European Union Aviation Safety Agency (EASA) regulations	Throughout Throughout

Contents

1 Introduction

This document tells you what you need to do to deliver the qualification

Area	Description
Who is the qualification for?	For candidates who want to develop a comprehensive understanding of the aerospace industry and flight. This qualification is especially valuable for learners who work, or want to work, in the aeronautical engineering sector across a range of roles and career routes
What does the qualification cover?	Allows candidates to learn, develop and practice the knowledge required for employment and/or career progression in the aeronautical engineering sector.
What opportunities for progression are there?	Further opportunities for candidates include: • Level 2 NVQ Diploma in Aeronautical Engineering (City & Guilds 1789)* • Level 3 Diploma in Aircraft Engineering (City & Guilds 2675) • Level 3 Certificate/Diploma in Aircraft Manufacturing (City & Guilds 4597)* • Level 3 Diploma in Survival Equipment (City & Guilds 5412)*
Who did we develop the qualification with?	n/a
Is it part of an apprenticeship framework or initiative?	This qualification is recognised as a technical certificate in the intermediate engineering apprenticeship frameworks.

* This qualification has been withdrawn and is no longer available for new candidate registrations. For more details regarding this, please contact City & Guilds directly.

Structure

To achieve the City & Guilds Level 2 Diploma in Aircraft Engineering (2675-23) learners must achieve 40 credits from the mandatory units. Learners can also achieve 5 credits from the elective unit however these credits will not count toward the minimum required for the qualification:

City & Guilds unit number	Unit title	Credit value	GLH
Mandatory units:			
Learners must achieve all **five** mandatory units.			
003	Fundamentals of aircraft materials and hardware	11	90
035	Human factors in aviation	5	40
101	Fundamentals of electrics and theory of flight	5	40
102	Fundamentals of airframe construction and systems	11	100
215	Aviation mathematics and science for technicians	8	70
Elective unit:			

Learners can also achieve the elective unit, however these credits will not count toward the minimum required for the qualification.

005	Fundamentals of aerodynamics	5	40

Total Qualification Time (TQT)

Total Qualification Time (TQT) is the number of notional hours which represents an estimate of the total amount of time that could reasonably be expected for a learner to demonstrate the achievement of the level of attainment necessary for the award of a qualification.

TQT comprises of the following two elements:

1) the number of hours that an awarding organisation has assigned to a qualification for guided learning
2) an estimate of the number of hours a learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by – but, unlike guided learning, not under the immediate guidance or supervision of – a lecturer, supervisor, tutor or other appropriate provider of education or training.

Title and level	GLH	TQT
City & Guilds Level 2 Diploma in Aircraft Engineering	340	400

2 Centre requirements

Approval

Full approval

To offer this qualification, new centres will need to gain both centre and qualification approval. Please refer to the document **Centre Approval Process: Quality Assurance Standards** for further information.

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

Resource requirements

Physical resources and site agreements

Centres can use specially designated areas to assess, for example, the installation of specialised electrical systems, alignment and setting up of electric motors and driven devices (pumps, compressors, and generators). The equipment, systems and machinery must meet industrial standards and be capable of being used under normal working conditions, for example electric motors must have a method of applying sufficient power and not be connected up to show movement.

Please note that to gather the requisite evidence, access to flight worthy aircraft is required on a regular basis.

Centre staffing

Staff delivering these qualifications must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area(s) for which they are delivering training and/or have experience of providing training (this knowledge must be to the same level as the training being delivered)
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Continuing professional development (CPD)

Centres are expected to support their staff in ensuring that their knowledge remains current of the occupational area and of best practice in delivery, mentoring, training, assessment and quality assurance, and that it takes account of any national or legislative developments.

Quality assurance

Approved centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications. Quality assurance includes initial centre approval, qualification approval and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance. All external quality assurance processes reflect the minimum requirements for verified and moderated assessments, as detailed in the Centre Assessment Standards Scrutiny (CASS), section H2 of Ofqual's General Conditions. For more information on both CASS and City and Guilds Quality Assurance processes visit: the What is CASS? and Quality Assurance Standards documents on the City & Guilds website.

Standards and rigorous quality assurance are maintained by the use of:

- Internal quality assurance
- City & Guilds external quality assurance.

In order to carry out the quality assurance role, Internal Quality Assurers must

- have appropriate teaching and vocational knowledge and expertise
- have experience in quality management/internal quality assurance
- hold or be working towards an appropriate teaching/training/assessing qualification
- be familiar with the occupation and technical content covered within the qualification.

External quality assurance for the qualification will be provided by City & Guilds EQA process. EQAs are appointed by City & Guilds to approve centres, and to monitor the assessment and internal quality assurance carried out by centres. External quality assurance is carried out to ensure that assessment is valid and reliable, and that there is good assessment practice in centres.

The role of the EQA is to:

- provide advice and support to centre staff
- ensure the quality and consistency of assessments and marking/grading within and between centres by the use of systematic sampling
- provide feedback to centres and to City & Guilds.

Learner entry requirements

City & Guilds does not set entry requirements for this qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualification successfully.

Age restrictions

This qualification is approved for learners aged 16 or above.

Access arrangements and reasonable adjustments

City & Guilds has considered the design of this qualification and its assessments in order to best support accessibility and inclusion for all learners. We understand however that individuals have diverse learning needs and may require reasonable adjustments to fully participate. Reasonable adjustments, such as additional time or alternative formats, may be provided to accommodate learners with disabilities and support fair access to assessment.

Access arrangements are adjustments that allow candidates with disabilities, special educational needs, and temporary injuries to access the assessment and demonstrate their skills and knowledge without changing the demands of the assessment. These arrangements must be made before assessment takes place.

Equality legislation requires City & Guilds to make reasonable adjustments where a disabled person would be at a substantial disadvantage in undertaking an assessment.

It is the responsibility of the centre to ensure at the start of a programme of learning that candidates will be able to access the requirements of the qualification.

Please refer to the Joint Council for Qualifications (JCQ) access arrangements and reasonable adjustments and access arrangements - when and how applications need to be made to City & Guilds. For more information documents are available on the City & Guilds website.

3 Delivering the qualification

Initial assessment and induction

An initial assessment of each learner should be made before the start of their programme to identify:

- if the learner has any specific training needs
- support and guidance they may need when working towards their qualification
- any units they have already completed or credit they have accumulated which is relevant to the qualification
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the learner fully understands the requirements of the qualification, their responsibilities as a learner and the responsibilities of the centre. This information can be recorded on a learning contract.

Inclusion and diversity

City & Guilds is committed to improving inclusion and diversity within the way we work and how we deliver our purpose which is to help people and organisations develop the skills they need for growth.

More information and guidance to support centres in supporting inclusion and diversity through the delivery of City & Guilds qualifications can be found here:

Inclusion and diversity | City & Guilds (cityandguilds.com)

Sustainability

City & Guilds are committed to net zero. Our ambition is to reduce our carbon emissions by at least 50% before 2030 and develop environmentally responsible operations to achieve net zero by 2040 or sooner if we can. City & Guilds is committed to supporting qualifications that support our customers to consider sustainability and their environmental footprint.

More information and guidance to support centres in developing sustainable practices through the delivery of City & Guilds qualifications can be found here:

Our Pathway to Net Zero | City & Guilds (cityandguilds.com)

Centres should consider their own carbon footprint when delivering this qualification and consider reasonable and practical ways of delivering this qualification with sustainability in mind. This could include:

- reviewing purchasing and procurement processes (such as buying in bulk to reduce the amount of travel time and energy, considering and investing in the use of components that can be reused, instead of the use of disposable or single use consumables)

- reusing components wherever possible
- waste procedures (ensuring that waste is minimised, recycling of components is in place wherever possible)
- minimising water use and considering options for reuse/salvage as part of plumbing activities wherever possible.

Support materials

The following resources are available for these qualifications:

Description	How to access
Centre devised guidance: • Centre guidance • Grading guidance criteria	www.cityandguilds.com
Centre devised forms	www.cityandguilds.com
Assessor instructions	www.cityandguilds.com

4 Assessment

Assessment of the qualification

Candidates must:

- successfully complete the following assessments for each unit

Assessment types			
Unit	**Title**	**Assessment method**	**Where to obtain assessment materials**
Mandatory units			
003	Fundamentals of Aircraft Materials and Hardware	External Examination	**Contact City and Guilds**
035	Human Factors in aviation	Online multiple-choice	**www.cityandguilds.com**
101	Fundamentals of electrics and theory of flight	Online multiple-choice	**www.cityandguilds.com**
102	Fundamentals of airframe construction and systems	Assignment	**www.cityandguilds.com**
215	Aviation mathematics and science for technicians	Online multiple-choice	**www.cityandguilds.com**
Elective unit			
005	Fundamentals of aerodynamics	Online multiple-choice	**www.cityandguilds.com**

Assessment strategy

City & Guilds has written the following assessments/assignments to use with this qualification:

- On-line multiple-choice test
- live assignments that can be downloaded from the City & Guilds website
- sample assignments that can be downloaded from the City & Guilds website.

Unit 003 Fundamentals of Aircraft Materials and Hardware is externally assessed by the Civil Aviation Authority (CAA).

Online multiple-choice assessments

The online multiple-choice assessments for this qualification will be in the form of a question with three options to choose from (a, b, c) and calculators are **not** permitted. This is to bring it in line with the CAA exams and the expectation from industry that candidates can do basic mathematics (including long division) without a calculator. Please refer to the 2675-001 sample questions to understand the level of maths required of candidates – this will be available to download from the City & Guilds website.

Online multiple-choice tests are externally set, automatically marked exams, scheduled and delivered by the centre under invigilated conditions

Assignment

Assignment short answer question tests are externally set by City & Guilds, scheduled and delivered by the centre under invigilated conditions. Assessments are marked by the centre using the marking guide provided in the relevant assessment materials which are available to download from www.cityandguilds.com. All assessment materials must be held securely by centres and not made available to candidates. All assessment materials must be held securely by centres and not made available to candidates.

Assessments should be scheduled when the candidate is prepared and ready to be assessed and invigilated in line with City & Guild's invigilation policy. At the end of an assessment, candidates should not be permitted to take any materials away with them. Centres must have arrangements in place to store and handle assessment and marking materials securely at all times.

Recognition of prior learning (RPL)

Recognition of prior learning means using a person's previous experience or qualifications which have already been achieved to contribute to a new qualification.

Without evidence of formal qualifications, candidates must demonstrate adequate prior knowledge and experience to ensure they have the potential to gain the qualification. It is recognised that learners come from a wealth of applicable backgrounds and in these cases, it is recommended that the centre assess learner competence against their claims.

Test specifications

The way the knowledge is covered by each test is laid out in the table(s) below:

Graded: Pass/Fail

Unit 035 Human Factors in Aviation

Test 1	Duration: 60 minutes		
Unit 035	**Outcome**	**Number of questions**	**Percentage %**
	01 Understand why human factors are important in aviation	2	5
	02 Know features of human performance	6	15
	03 Know aspects of social psychology	6	15
	04 Know personal factors that affect human performance	6	15
	05 Know physical aspects of working environments that affect human performance	5	12.5
	06 Know categories of task that can affect human performance	5	12.5
	07 Understand communication in the workplace	3	7.5
	08 Understand how human error occurs	3	7.5
	09 Know hazards and risks in aeronautical engineering environments	4	10
	Total	40	100%

Unit 101 Fundamentals of electrics and theory of flight

Test 2	Duration: 60 minutes		
Unit 101	**Outcome**	**Number of questions**	**Percentage %**

	01 Understand electrical concepts	11	27.5
	02 Know about direct current power sources and machines	7	17.5
	03 Know the principles of alternating current	3	7.5
	04 Know about aircraft electrical devices and data transmission	4	10
	05 Know the forces acting on an aircraft in flight	8	20
	06 Know about aircraft stability and control	7	17.5
	Total	40	100

Unit 102 Fundamentals of airframe construction and systems

Test 3	**Duration: 60 minutes**		
Unit 102	**Outcome**	**Number of questions**	**Percentage %**
	01 Know the concepts of airframe structures and components	3	15
	02 Understand the operation of aircraft hydraulic power systems	3	15
	03 Understand the operation of aircraft flight control systems	3	15
	04 Understand the operation of aircraft landing gear systems	2	10
	05 Understand the operation of aircraft ice and rain protection systems	2	10
	06 Understand the operation of aircraft oxygen and air systems	5	25
	07 Know aircraft interior fittings and systems	2	10
	Total	20	100

Unit 215 Aviation mathematics and science for technicians

Test 5	Duration: 105 minutes		
Unit 215	**Outcome**	**Number of questions**	**Percentage %**
	01 Be able to use principles of arithmetic	8	11
	02 Be able to use SI, Imperial and US customary units	7	10
	03 Be able to manipulate algebraic expressions and formulae using standard techniques	7	10
	04 Be able to calculate physical properties of common two and three dimensional shapes	5	7
	05 Be able to use graphs to determine values and solve engineering problems	6	9
	06 Understand the nature of matter	9	13
	07 Understand principles of statics	9	13
	08 Understand principles of linear, angular and oscillating motion related to aircraft in flight	8	11
	09 Understand principles of dynamics related to aircraft in flight	7	10
	10 Understand principles of fluid motion related to aircraft in flight.	4	6
	Total	70	100

5 Units

Structure of the units

These units each have the following:

- City & Guilds reference number
- title
- level
- guided learning hours (GLH)
- credit value
- unit aim
- assessment type
- learning outcomes, which are comprised of a number of assessment criteria
- range statements
- supporting information
- relationship to NOS/mapping to occupational/apprenticeship standards.

Guidance for delivery of the units

This qualification comprises a number of **units**. A unit describes what is expected of a competent person in particular aspects of their job.

Each **unit** is divided into **learning outcomes** which describe in further detail the skills and knowledge that a candidate should possess.

Each **learning outcome** has a set of **assessment criteria** (performance and knowledge and understanding) which specify the desired criteria that must be satisfied before an individual can be said to have performed to the agreed standard.

Range statements define the breadth or scope of a learning outcome and its assessment criteria by setting out the various circumstances in which they are to be applied.

Supporting information provides guidance of the evidence requirement for the unit and specific guidance on delivery and range statements. Centres are advised to review this information carefully before delivering the unit.

Unit 003 Fundamentals of aircraft materials and hardware

Level:	2
Credit value:	11
GLH:	90
Relationship to NOS:	This unit is linked to the Aeronautical Engineering Level 3 NOS Units 013, 144 etc
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	The aim of the Unit is to provide learners with a detailed understanding of aircraft materials and hardware. The Unit covers the complete knowledge requirement for CAA Part-66 Module 6 for A Category licences.

Learning outcome

The learner will:

LO1 Know the properties of aircraft ferrous materials

Assessment criteria

The learner can:

AC1.1 describe the basic characteristics, properties and identification of ferrous materials
AC1.2 describe heat treatment and applications of alloy steels.

Range

List 1

Eg: Alloying elements, including; Carbon, Chromium, Nickel, Vanadium, Molybdenum, Manganese, Silicon

Properties eg: density, strength, elasticity, ductility, malleability, toughness, hardness, brittleness, creep and fatigue resistance, work hardening, corrosion resistance, hot and cold performance

Identification markings on stock material

List 2

Annealing

Tempering
Quench Hardening
Normalising
Surface hardening
Including: Carburising, Nitriding, Flame hardening, Induction hardening

Learning outcome

The learner will:

LO2 Know the properties of aircraft non-ferrous materials

Assessment criteria

The learner can:

AC2.1 describe characteristics, properties and identification of nonferrous metals used in aircraft
AC2.2 describe heat treatment and applications of non-ferrous materials.

Range

List 1

Eg:
Common alloying elements - all of: copper, magnesium silicon, zinc
Properties eg: density, strength, elasticity, ductility, malleability, toughness, hardness, brittleness, creep and fatigue resistance, work
hardening, corrosion resistance, hot and cold performance
Advanced alloys eg: titanium and aluminium/lithium alloys
Identification marks on stock material

List 2

Annealing
Solution treatment
Precipitation hardening

Learning outcome

The learner will:

LO3 Know the properties of composite and other non-metallic materials

Assessment criteria

The learner can:

AC3.1 describe characteristics, properties and identification of composite and other non-metallic materials
AC3.2 describe characteristics, properties and identification of sealants and bonding agents
AC3.3 describe detection of typical defects/deterioration in composite material
AC3.4 explain typical repair techniques for composite materials
AC3.5 explain the preservation and maintenance of non-metallic materials.

Range

List 1
Fibres (eg: glass, carbon, boron, aramid)
Typical resins
Sandwich structures
Plastics
Polymers (eg thermoplastics, thermosetting, elastomers)
Sandwich construction
Adhesives and glues

List 2
Eg:
Polyurethane
Silicones
Thread locking compound
Resins
Glues

List 3
Eg: cracking, warping, splitting, de-bonding, delamination, Barely Visible Impact Damage (BVID)

List 4
Pre-impregnated layup (Prepreg)
Wet layup
Fibre orientation
Autoclave
Vacuum bag
Typical repair tools
Safety precautions

List 5
Protective treatments
Inspection

Learning outcome

The learner will:

LO4 Know wood and fabric airframe construction

Assessment criteria

The learner can:

AC4.1 describe construction methods for wooden airframe structures
AC4.2 describe characteristics and properties of the types of wood and glue used in aeroplanes
AC4.3 describe methods of detecting defects in wooden structures
AC4.4 describe methods of repairing wooden structures
AC4.5 describe characteristics, properties and types of fabric used in aeroplanes
AC4.6 describe inspection methods for fabrics
AC4.7 describe the common defects found in fabrics
AC4.8 describe common methods of repairing fabric coverings.

Range

List 1
Eg: structural members, fabric or plywood skin, type of joints, general direction of grain, reinforcement, use of glues, screws and other fasteners.

List 2
Wood: type of wood used eg: spruce

List 3
Eg: visual inspection joint testing, measurement

List 4
Eg: splicing, scarf joint, reinforcement, replacement, patching (scarf, splayed, oval, plug)

List 5
Eg: cotton, linen, Dacron, fibre glass
Classification of fabrics, stitching and lacing, anti-tear tape

List 6
Eg: visual inspection, fabric punch tester; tensile testing, slackness, peeling of re-enforcing fabric from plywood panels,

List 7
Tears, deterioration of fabric due to: humidity, extremes of temperature, chemical action, fungal growth, erosion, brittleness

List 8
Eg: small tears – sew together and dope a pinked patch on top; larger tear – sewn in patch repairs; un-sewn doped-on patch repairs; panel replacement

Learning outcome

The learner will:

LO5 Understand corrosion in aircraft materials

Assessment criteria

The learner can:

AC5.1 describe the chemical fundamentals of corrosion
AC5.2 describe the causes and formation of corrosion
AC5.3 describe the types of corrosion and their identification
AC5.4 explain which materials are susceptible to corrosion.

Range

List 1
Direct chemical action
Galvanic action process

List 2
Environment
Wear
Stress
Microbiological action

List 3
Surface, pitting, stress, fatigue, Intergranular, fretting, crevice, exfoliation, filiform

List 4
Steels
Aluminium alloys
Magnesium alloys
Copper
Silver

Learning outcome

The learner will:

LO6 Understand aircraft fasteners

Assessment criteria

The learner can:

AC6.1 explain the nomenclature of screw threads
AC6.2 explain thread systems
AC6.3 explain the specification of aircraft bolts
AC6.4 describe typical nuts, screws, studs and locking devices used on aircraft
AC6.5 describe typical rivet systems.

Range

List 1
Crest, form, root, thread angle, pitch, lead, major and minor diameters, depth, threads per inch single and multi-start threads, right and left hand threads

List 2
Eg: ACME. square, buttress, vee threads, BSF, BSW, BA, Unified, ISO metric

List 3

Eg:
Hexagon head
Cap bolts
Slotted head
High shear bolts
Twelve point head

List 4
Machine screws, studs, washers, plain nuts, thin nuts, slotted nuts, castellated nuts, self-locking nuts, washers, typical thread locking devices, locking wire, tab and spring washers locking plates, quick release fasteners, keys, circlips, cotter pins

List 5
Overview of: solid and blind rivets, countersunk and snap head rivets describe heat treatment
Typical riveting tools

Learning outcome

The learner will:

LO7 Know aircraft pipes, unions and fittings

Assessment criteria

The learner can:

AC7.1 describe aircraft pipes and connectors
AC7.2 describe unions for hydraulic, fuel, pneumatic and oxygen systems

Range

List 1
ICAO pipeline symbols
Pipeline construction
Pipe material
Eg – Aluminium alloy, stainless steel, Tungum (bronze copper alloy)
Hose material
Eg: – Plastic, metal, rubber

List 2
Flared couplings
Flareless couplings
British metric swaged pipe couplings
American Flareless couplings
Arsaero pipe couplings
Swaged end couplings
Cryogenic pipe couplings
Gamah couplings
Sliding couplings
Quick release connectors
V-flange couplings
Typical pipeline clamping

Learning outcome

The learner will:

LO8 know aircraft bearings

Assessment criteria

The learner can:

AC8.1 describe the purpose of bearings
AC8.2 describe types of bearing and their construction
AC8.3 describe bearing loads and their application.

Range

List 1
Reduce friction and wear
Component alignment

List 2
Including: plain, roller, taper roller, needle roller, ball, thrust
Materials
Lubrication
Construction

List 3
Eg:
Axial
Radial
Bending (perpendicular to axis)
Pre-loading
Typical aircraft applications

Learning outcome

The learner will:

LO9 Know aircraft transmission systems and control cable mechanisms

Assessment criteria

The learner can:

AC9.1 describe gears systems, ratios and their application
AC9.2 describe belts and pulleys, chains and sprockets
AC9.3 describe types of control cable and mechanisms
AC9.4 describe pulleys and cable system components
AC9.5 describe bowden cables
AC9.6 describe flexible control systems.

Range

List 1
Eg:
Spur gears
Helical gears
Bevel gears
Worm gears
Rack and pinion
Application of gears
Driver gear
Driven gear
Idler gears
Gear ratio
Shaft drives
Spline drives

List 2
Overview of:
Drive belts and pulleys
Screw jacks
Sprockets
Typical applications
Chains

List 3
Overview of:
Cable materials
Typical cable end fittings
Typical turnbuckles
Control stops
Typical rigging and maintenance procedures

List 4
Pulleys
Cable tensioning
Tensiometer

List 5
Overview of:
Cable material
Conduit
Typical end fittings
Adjustment
Pull system only

List 6
Overview of:
Teleflex
Conduit
Core cable
Adjustment
Push/Pull systems

Learning outcome

The learner will:

LO10 know aircraft electrical cables and connectors

Assessment criteria

The learner can:

AC10.1 describe cable types, construction and characteristics
AC10.2 describe high tension and co-axial cables
AC10.3 explain the process of crimping
AC10.4 describe aircraft connector types.

Range

List 1
Overview of eg: signal cable, power cable, data cable, screened, shielded fibre optic

List 2
Overview of eg: purpose, construction, connectors

List 3
Eg: security and reliability of connection, ease of fitment
Process eg: types of tool, pre-use inspection, go/no-go gauges, preparation of cable, selection of termination, crimping action, postcrimp inspection.

List 4
Overview of: pins, plugs, sockets, insulators, current and voltage rating, coupling, identification codes

Unit 003 Fundamentals of aircraft materials and hardware

Supporting information

Unit guidance

The UK Civil Aviation Authority (CAA) has replaced the European Union Aviation Safety Agency (EASA) regulations with its own legislative and licencing requirements. This includes the Part-66 licensing scheme for aircraft maintenance personnel.

This unit covers Part 66 Basic Knowledge Requirements Module 6 – Aircraft Materials and Hardware.

The CAA is the governing body for all matters related to aircraft maintenance licensing in the UK, they all come under the jurisdiction of the CAA. It is therefore essential to refer to the official CAA documentation for the most accurate and up-to-date information, and for precise technical details.

Unit 035 Human factors in aviation

Level:	3
Credit value:	5
GLH:	40
Relationship to NOS:	This unit is linked to the Aeronautical Engineering Level 2 NOS Unit 001 and Level 3 NOS Unit 003
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	The aim of this unit is to give the learner a comprehensive knowledge of human factors within the aircraft industry to assist them in living and working safely. It is a mandatory subject within the industry. The unit covers the complete syllabus of CAA Module 9 for Category B 1 and B2 licences.

Learning outcome

The learner will:

LO1 Understand why human factors are important in aviation

Assessment criteria

The learner can:

AC1.1 explain the term 'human factors' 1
AC1.2 explain why Human Factors is important in the aeronautical engineering workplace
AC1.3 explain categories of Human Factor that are important to aeronautical engineering staff.

Range

List 1
Meaning of the term and how it is used in aviation
SHEL Model, 'Murphy's Law', anthropometry

List 2
Eg:
Safety of employees, passengers, people on the ground etc

Safety of assets (eg: aircraft, equipment etc)
Long-term health of employees
Efficiency of the organisation

List 3
Eg:
Working environment
Work patterns
Social habits
Work load
Communication
Employee health

Learning outcome

The learner will:

LO2 Understand features and limitations of human performance

Assessment criteria

The learner can:

AC2.1 explain how images are seen and interpreted by humans
AC2.2 explain how sounds are heard and interpreted by humans
AC2.3 explain limitations of human memory
AC2.4 describe factors that affect mental attention span
AC2.5 describe how variations in an individual's sight and hearing can affect their behaviour
AC2.6 explain how working in challenging environments presents risks to airworthiness.

Range

List 1
To include:
Main parts of the eye
How each part of the eye reacts to light
Rods and cones
Seeing in high and low light
Peripheral vision
Interpretation by the brain

List 2:
To include:
Main parts of the ear
Vulnerable parts of the ear
Effect of noise – percussive, prolonged high intensity, varying pitch
Noise Induced Hearing Loss (NIHL)
Legal requirements for hearing protection

Correct protection for frequency range

List 3
Simple explanation eg:
Time from exposure to information
Form that information is in (audio, visual, words, pictures etc.)
Fatigue
Age
Complexity of information
Artificial stimulants/depressants
Types (iconic, echoic, episodic, symantic)

List 4
Eg:
Overconfidence
Boredom
Fatigue
Complexity of information
Artificial stimulants/depressants

List 5
Individually and i combination (such as in older people)
Sight eg:
Long and short sight
Optical illusion including the strobe effect
Persistence
Moving from light area to work in the dark
Optimum lighting for typical tasks
Long and short sight
Use of spectacles and magnifiers
Hearing eg:
High and low tone deafness
Tinnitus
Hearing damage, poor communication
Social isolation (at work and at home)

List 6
At height and in confined spaces eg:
Claustrophobia
Fear of heights
Limited access/egress to a large space
Confined space
Specific tasks (eg: inspections on fuselage crown or in equipment bays)
Low concentration
Rushing the task
Cutting corners
Poor vision

Learning outcome

The learner will:

LO3 Understand aspects of social psychology

Assessment criteria

The learner can:

AC3.1 explain areas of individual and group responsibility in aircraft engineering environments
AC3.2 explain motivation and de-motivation
AC3.3 explain 'peer pressure'
AC3.4 explain company culture
AC3.5 explain the concepts of team working
AC3.6 identify the primary responsibilities of engineering managers and supervisors
AC3.7 discuss the basic concept of leadership.

Range

List 1
Outline of a typical organisation (must include maintenance)
Typical roles and responsibilities
Individuals and groups or teams
Individual responsibility when working alone and within a team
Group or team responsibilities
Overview of group and inter-group dynamics (eg: rivalry, polarisation, 'social loafing')

List 2
Overview of:
Fulfilling individual needs
Maslow's Hierarchy of Needs
Individual motivation
Motivation by management
Characteristics of motivation and de-motivation
How they can be affected by internal and external factors eg:
Management decisions
Personal situation

List 3
Eg:
Conformity and non-conformity
Pressure from co-workers, not management
Advice and pressure from more experienced colleagues to adopt
particular work practices
How it can affect performance of maintenance tasks

List 4
Overview of different types of culture (eg: safety, organisational, shift, team, social etc.)
More detailed knowledge of safety culture and the individual
How company culture can compromise best working practices

List 5
What is a team?
Advantages and disadvantages of team working
Team identity
Working with other teams
Ownership of tasks
Communication
Co-operation
Mutual support

List 6
Difference between management and supervisor roles
What should an employee expect from a supervisor? (e.g. motivation, support, guidance etc.)
Engineering organisations (eg:part145, military maintenance organisation)

List 7
What is a leader?
The basic characteristics of a leader.
How and when any individual might provide leadership eg:
Passing on knowledge and experience to colleagues
Organising and directing group tasks

Inspection and reporting on the work of others

Learning outcome

The learner will:

LO4 Understand personal factors that affect human performance

Assessment criteria

The learner can:

AC4.1 explain effects of personal health and fitness on work performance
AC4.2 identify types of stress
AC4.3 explain effects of setting time deadlines on individual work performance
AC4.4 explain the concept of work overload and underload
AC4.5 explain the effects of shift work on sleep and fatigue
AC4.6 explain the effects of alcohol, medication and substance abuse
AC4.7 explain the personal legal obligations of individuals in the aviation industry

Range

List 1

Legal requirement for individual physical and mental fitness while at work
Types of medical condition that might affect work eg:
Minor illness (eg: cold, 'flu, sickness etc.)
Major physical illness (eg: heart attack, stroke, cancer etc.)
Mental illness (eg: depression etc.)
Minor physical injury (eg: sprained wrist, pulled muscle, cramp etc.)
Major physical injury (eg: broken bones, lacerations etc.)
Effects of toxins and other substances (eg: carbon monoxide, alcohol, drugs etc.)
Gradual deterioration in physical condition

List 2
Define 'stress' (eustress, distress, acute stress, chronic stress, hypo stress, hyper stress)
Sources:
Home (eg: family illness, divorce etc.)
Work (organisational, task related)
Types:
Acute and chronic stress
Signs of stress (physical, health, behaviour, cognitive, other)
Explain how stress can affect individual performance at work

List 3
Actual, perceived and self-imposed deadlines
Effects of time pressure and deadlines
Managing time pressure and deadlines

List 4
Definition of work overload and underload
Results of work overload and underload
Factors determining workload
Workload management

List 5
What is sleep?
Five stages of sleep
Circadian rhythms
Fatigue (causes, symptoms)
Advantages and disadvantages of shift work
Working at night
Types of shift pattern

List 6
Effects of alcohol
Removal of alcohol from the blood
Effects while fatigued, hungry or combined with medication
Types, effects, short and long term consequences of abuse of:
Alcohol
Prescription medication
Over-the-counter medication
Illegal drugs
Effects on individual work performance

List 7
Eg:
Alcohol limits and legal requirements for aircraft engineers
CAP 562/AN47
Transport legislation/AN45
Health and Safety legislation

Learning outcome

The learner will:

LO5 Understand how physical aspects of the working environment affect human performance

Assessment criteria

The learner can:

AC5.1 explain effects of noise on individuals and groups
AC5.2 explain effects of fumes on individual performance
AC5.3 explain effects of varying illumination on an individual performance
AC5.4 explain effects of variations in climate on an individual performance
AC5.5 explain effects of exposure to constant motion and vibration while working
AC5.6 explain effects of layout of a working environment on individual performance.

Range

List 1
Eg effects on:
Concentration
Communication

List 2
Eg effects on:
Concentration
Communication
Longer term effects
Safe oxygen levels

List 3
Eg:
Ability to see detail
Moving between areas of different illumination, including well-lit hangar and night flight line
Strobe effect and propellers

List 4
Eg:
Cold/wet, warm/dry, hot/humid environments

List 5
Eg:
Working at height on scissor platforms and cherry picker
Unsteady platforms
Use of rotating or percussive tools
Vibration White Finger (VWF)

List 6
Eg:
The three components of a working environment
Layout
Cleanliness
Ease of movement between work areas
Lighting, noise, atmosphere, temperature etc

Social environmentTasks, tools and information

Learning outcome

The learner will:

LO6 understand how categories of tasks can affect human performance

Assessment criteria

The learner can:

AC6.1 explain the importance of planning the execution of a task
AC6.2 explain effects of physically demanding work on individual performance
AC6.3 explain effects of repetitive tasks on individual performance
AC6.4 explain aspects of visual inspection
AC6.5 explain aspects of working on complex systems.

Range

List 1
Eg:
Defining the task
Defining the resources
Personal skills and proficiency
Information

List 2
Eg:
Health and physical condition, effects of ageing
Work environment
Physical effort
Effects of ageing

List 3
Eg:
Ignoring manuals, job cards etc.
Complacency
Making assumptions

List 4
Eg:
Importance of good eyesight
Knowledge of the inspection area
Illumination
Concentration
Systematic search

List 5
Eg:
Simple system: transparent to the engineer
Complex system: opaque to the engineer
Clear understanding of the purpose of the system
System-specific training
Pooling of knowledge and skills
Clear and comprehensive information and guidance

Learning outcome

The learner will:

LO7 understand communication in the workplace

Assessment criteria

The learner can:

AC7.1 explain the importance of good communication in the workplace
AC7.2 explain the importance of accurate work logging
AC7.3 explain modes of communication between individuals and teams
AC7.4 explain the importance of maintaining individual professional currency
AC7.5 explain the importance of information dissemination.

Range

List 1
Within and between groups eg:
Prevention of accidents
Maintaining good working relations
Organisational efficiency

List 2
Eg:
Formal work logging
Shift logging
Shift handover
Task staging
Duplicate
Inspection
Stage sheets/check

List 3
Eg:
Verbal
Written
Body language
Workplace social culture
Communication between all levels of an organisation

List 4
Eg:
Refresher training
Reading briefing material
Notices and amendments to maintenance procedures
Reading professional journals
Undertaking up-skilling and further licence training.

Learning outcome

The learner will:

LO8 understand the causes of human error

Assessment criteria

The learner can:

AC8.1 explain the error models and theories used in aeronautical engineering
AC8.2 explain types of error that occur during work on aircraft
AC8.3 describe the error-incident-accident chain
AC8.4 describe methods of managing and avoiding errors.

Range

List 1
Eg

Induced
Variable
Reversible/irreversible
Slips, lapses and mistakes
The ‘Swiss Cheese Model’

List 2
Eg:
Complacency
Environmental capture
Rule-based errors
Violations
Individual practices and habits
Errors associated with visual inspection
Latent/active errors

List 3
Eg:
Self discipline
Safety Management System
Anonymous and blame-free reporting
Training
Logging and analysis

Learning outcome

The learner will:

LO9 understand the human factors aspects of aircraft incidents

Assessment criteria

The learner can:

AC9.1 analyse an incident report to extract information
AC9.2 identify a sequence of events from a narrative report
AC9.3 identify human factors contributing to an incident
AC9.4 draw conclusions from incident data.

Range

List 1
Using extracts from an actual report or a realistic example
Filter out irrelevant detail

List 2
How, why, when where, who
Use presentation aids such as flow diagrams

Identify what should have been done

List 3
Analyse the information and identify contributing factors
Including where possible:
Personal behaviour
Environmental conditions
Management
Organisational culture
Using eg:
MEDA
MEMS

List 4
Including where necessary, brief details of:
Environment
Personal issues
Organisation
Nature and mix of allocated tasks
Recommendations for preventative action

Learning outcome

The learner will:

LO10 understand risk assessments in aeronautical engineering environments

Assessment criteria

The learner can:

AC10.1 define the terms associated with risk assessment
AC10.2 describe the five steps to risk assessment
AC10.3 describe the associated risks for workplace hazards
AC10.4 describe conclusions from risk assessments
AC10.5 explain how to manage workplace emergencies.

Range

List 1
Hazard
Risk
Severity
Likelihood (probability)

List 2
1 - Identify hazards
2 - Decide who might be harmed and how

3 - Evaluate risks and decide on precautions
4 - Record findings and implement them
5 - Review and update

List 3
Step 2

List 4
Steps 2&3
Recommend ways of eliminating or reducing to an acceptable level, a range of identified risks

List 5
Steps 3&4 eg:
Reduce the likelihood of them happening
Management of workplace emergency situations such as fire, spillage, personal injury etc

Unit 035 Human factors in aviation

Supporting information

Unit guidance

The UK Civil Aviation Authority (CAA) has replaced the European Union Aviation Safety Agency (EASA) regulations with its own legislative and licencing requirements. This includes the Part-66 licensing scheme for aircraft maintenance personnel.

This unit covers Part 66 Basic Knowledge Requirements Module 9 – Human Factors.

The teaching of the knowledge content of this unit should be referenced to the latest Civil Aviation Authority (CAA) publication, or its military equivalents. The City & Guilds online multiple-choice examination is based on this content.

The CAA is the governing body for all matters related to aircraft maintenance licensing in the UK, they all come under the jurisdiction of the CAA. It is therefore essential to refer to the official CAA documentation for the most accurate and up-to-date information and precise technical details on the topic area.

Unit 101 Fundamentals of electrics and theory of flight

Level:	2
Credit value:	5
GLH:	40
Relationship to NOS:	This unit is linked to the Aeronautical Engineering Level 2 NOS Units 7 and 8
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	The aim of this unit is to give learners a solid grounding in basic electrical theory and aerodynamics to enable further aeronautical engineering studies.

Learning outcome

The learner will:

LO1 Understand electrical concepts

Assessment criteria

The learner can:

AC1.1 explain the difference between a conductor and an insulator
AC1.2 explain static electricity and conduction
AC1.3 explain the build-up of static charge on an aircraft surface
AC1.4 explain electrical terms
AC1.5 perform calculations involving Ohm's Law
AC1.6 identify series, parallel and series-parallel circuits
AC1.7 calculate current division through series and parallel stages in a network
AC1.8 calculate voltage drop across series and parallel stages in a network
AC1.9 describe ways in which electricity can be produced
AC1.10 explain the purpose of a capacitor
AC1.11describe the construction of a capacitor
AC1.12 explain the operation of a capacitor.

Range

List 1
Basic electron theory:
Structure and distribution of electrical charges within atoms, molecules, ions and compounds
Molecular structure of conductors, semi-conductors and insulators

List 2
Basic explanation of:
Static electricity and distribution of electrical charges
Electrostatic laws of attraction and repulsion
Units of charge
Coulomb's Law
Conduction of electricity in solids, liquids and gases, and in a vacuum

List 3
Basic explanation of static build-up
Describe how to prevent static build-up eg:
Conductive tyres
Static wick dischargers

List 4
Basic explanation of:
Potential Difference
Electromotive force
Voltage
Current
Resistance
Conductance
Charge
Conventional current flow
Electron flow

List 5
Basic explanation of:
Light
Heat
Friction
Pressure
Chemical action
Magnetism
Motion

List 6
Visual identification
Simple calculations for resistance

List 7

dc circuits with varying resistances in combinations

List 8
Explain in simple terms and do calculations:
Eg: basic Kirchoff calculations

List 9
In simple terms:
Heat
Light
Friction
Pressure
Chemical action
Magnetism
Motion

List 10
Charge storage
Smoothing
Emergency Power
DC block
Resonant circuits

List 11
Construction of different types of capacitor
Role played by:
Conductors
Dielectric
Permittivity
Area

List 12
Charge/discharge cycle
Relationship between Q, C & V
Time constant

Learning outcome

The learner will:

LO2 Know about direct current power sources and machines

Assessment criteria

The learner can:

AC2.1 describe the chemical action of primary and secondary cells
AC2.2 explain the connection of cells are connected in series and in parallel
AC2.3 explain the internal resistance of a battery

AC2.4 explain properties of magnetic materials
AC2.5 describe the magnetic field of a bar magnet
AC2.6 describe differences in the magnetic characteristics of soft and hard iron
AC2.7 describe uses of magnetic materials
AC2.8 describe the interaction of a current-carrying conductors and magnetic fields
AC2.9 explain the production of an EMF by the interaction of a permanent magnet with a coil
AC2.10 identify the key components of dc generators
AC2.11 identify the key components of dc motors.

Range

List 1
Construction and basic chemical action
Dry cells
Lead acid cells
Nickel-Cadmium cells
Other alkaline cells

List 2
How and why eg: greater voltage, greater power etc

List 3
Basic explanation of internal resistance
Effect on battery performance

List 4
Eg:
Hard
Soft

List 5
Using sketches:
Flux lines
Direction
Density

List 6
Basic differences:
Hysteresis loop
Remanence
Coercive field
Relative Permeability
Demagnetisation quadrant

List 7
Common uses of:

Permanent magnets
Magnetic shielding
Electromagnet formers

List 8
In simple terms for a single conductor and one field:
Direction of current and effect on field direction
Strength of current and effect on field strength

List 9
Define electromagnetic induction
Effect of:
number of coils
relative speed and direction of movement

List 10
Including the arrangement of eg:
Armature
Magnets
Commutator
Brushes

List 11
Including the arrangement of eg:
Armature
Magnets
Commutator
Brushes

Learning outcome

The learner will:

LO3 Know the principles of alternating current know the principles of alternating current

Assessment criteria

The learner can:

AC3.1 explain the term ‘alternating current’
AC3.2 describe commonly used terms related to alternating current
AC3.3 identify the key components of a simple single-phase ac generator
AC3.4 explain the difference between single-phase and 3-phase waveforms.

Range

List 1
Describe and sketch its waveform Include:

Position of coil to magnetic field
Direction of flow on graph axis

List 2
Cycle
Periodic time
Peak value
Peak-to-peak value
Magnitude or amplitude
Frequency
Average value
RMS value
Phase

List 3
Including the arrangement of eg:
Armature
Magnets
Commutator
Brushes

List 4
Including phase angle – Φ

Learning outcome

The learner will:

LO4 Know about aircraft electrical devices and data transmission

Assessment criteria

The learner can:

AC4.1 describe thermocouples
AC4.2 describe the operation of a photo-cell
AC4.3 describe the operation variable resistors
AC4.4 explain why data buses are used in aircraft
AC4.5 explain how light can be transmitted down a fibre optic cable
AC4.6 compare the properties of fibre optic data transmission to electrical wire propagation.

Range

List 1
Basic description of the construction, operation and use:
Materials
Construction

Operation

List 2
Basic description of construction and operation

List 3
Operation and application of:
Potentiometer
Rheostat
Common uses in aircraft

List 4
Basic description
Include redundancy
Include weight saving, the need for a complex controller

List 6
Basic description:
Encode
Transmit (including internal reflection)
Boost
De-code

List 7
Information at a basic level:
Advantages of optical fibre eg:
Faster
More secure
More simultaneous signals
Disadvantages of optical fibre eg:
Greater cost
Less robust

More signals lost if damaged

Learning outcome

The learner will:

LO5 Know the forces acting on an aircraft in flight

Assessment criteria

The learner can:

AC5.1 describe the forces acting on an aircraft in flight
AC5.2 describe the effects of streamlining an object in an airflow
AC5.3 explain how lift is produced
AC5.4 explain how a stall occurs
AC5.5 explain aerodynamic terms

AC5.6 explain the importance of the speed of sound to high-speed aircraft
AC5.7 state the meaning of terms related to high speed flight
AC5.8 describe problems that can occur when an aircraft approaches the speed of sound
AC5.9 explain design features peculiar to high-speed aircraft.

Range

List 1
Basic description of the forces including relationship to one another
Lift
Weight
Thrust
Drag

List 2
In simple terms:
Define streamlining
Briefly explain (for subsonic) eg:
Reduction of compression shockwaves
Reduction in drag

List 3
In simple terms including:
Application of simple Bernoulli's theorem to an aerofoil (dynamic and static pressure)

List 4
Basic explanation of the development of a stall in a simple aerofoil

List 5
In simple terms:
Aerofoil
Chord line
Camber line
Angle of attack
Centre of pressure
Centre of gravity

List 6
Basic explanation
Include how speed of sound can vary with height, air density, etc

List 7
Speed of sound
Subsonic flight
Transonic flight
Supersonic flight
Mach number
MCrit

List 8
Basic explanation of eg:
Shockwave
Buffet
Increased drag
Control reversal
Tuck-under

List 9
Eg simple design features of:
Wings
Fuselage
Engine intakes
Control surfaces

Learning outcome

The learner will:

LO6 Know about aircraft stability and control

Assessment criteria

The learner can:

AC6.1 describe the movement of an aircraft about its three axes
AC6.2 explain the term ‘equilibrium’
AC6.3 describe the relationship between lift, weight, thrust and drag in straight and level flight
AC6.4 explain the term ‘static stability’
AC6.5 explain the static stability requirements vary between different aircraft types
AC6.6 describe the design features that contribute to stability
AC6.7 explain what ‘control’ is with reference to conventional aircraft
AC6.8 explain ‘instinctive control’
AC6.9 explain the principles of balancing control surfaces
AC6.10 explain the purpose of lift augmentation devices
AC6.11 describe how lift augmentation devices work.

Range

List 1
Primary effects of control movement about 3 principle axes:
Pitch, roll, yaw

List 2
Basic explanation using force vectors

List 3

Describe the two couples:
Lift/weight – vertical
Thrust/drag – horizontal
Explain how the couples interact in flight

List 4
Including its main types, with reference to aircraft in flight:
Active and Passive
Lateral
Longitudinal
Directional

List 5
Eg:
Transport aircraft
Light aircraft
Combat aircraft

List 6
Lateral
Longitudinal
Directional

List 7
Simple definition of control in an aircraft context
Describe the function of basic control surfaces:
Ailerons
Elevator
Rudder
Describe how pilot's controls relate to basic control surfaces

List 8
Including how control surfaces affect aircraft attitude
Simple explanation of instinctive control
Primary effects of controls:
Roll, pitch, and yaw
Simple explanation of secondary roll and yaw

List 9
Including the reason for balancing:
Describe how 'flutter' can occur
Give typical examples describing the purpose and basic methods of:
Mass balance
Aerodynamic balance

List 10
Define 'lift augmentation'
Explain the basics of why lift needs augmentation under certain flight conditions eg:
(Short) take-off and landing

Slow speed flight
High altitude take-off/landing

List 11
Basic aerodynamic principles involved
Simplified purpose and operation of:
Flaps
Slats and slots
Vortex generators
Boundary layer control

Unit 101 Fundamentals of electrics and theory of flight

Supporting information

Unit guidance

This unit provides a basic knowledge of parts of the syllabus for the CAA part 66 Category 'A' Licensed Aircraft Maintenance Engineer and provides a useful platform for training learners who wish to work as un-licensed aircraft mechanics. It also provides a lead-in to the more demanding Level 3 courses where the same subject matter is dealt with in much more depth.

Subjects are meant to be taught at a basic level to give the learner a comprehensive overview of the way in which modern aircraft are designed to operate. Basic principles should be taught in an aircraft context, and teaching of specific systems should be done using actual aircraft, parts of aircraft or comprehensive multi-media material.

Unit 102 Fundamentals of airframe construction and systems

Level:	2
Credit value:	11
GLH:	100
Relationship to NOS:	This unit is linked to the Level 2 Aeronautical Engineering NOS Unit 2
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	To provide learners with a basic understanding of airframe construction and their associated systems.

Learning outcome

The learner will:

LO1 Know the concepts of airframe structures and components

Assessment criteria

The learner can:

AC1.1 explain the need for structural strength
AC1.2 describe the construction methods used for airframe and major components
AC1.3 describe the construction and operation of door, exit and seating systems.

Range

List 1
Overview of general concepts:
Airworthiness
Structural classification: primary secondary and tertiary
Basic fail-safe, safe life and damage tolerance concepts
Zone and station identification
Simple stress and strain eg:

Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue
Drains and ventilation
System installation provision
Lightning strike provision
Aircraft bonding

List 2
Simple description of:
Stressed skin fuselage
Formers
Longerons
Bulkheads
Frames
Floor structure
Anti-corrosion protection
Main component attachment points eg:
Wing/ empennage/tail unit, flying controls, engine attachments, landing gear
Construction of major components eg:
Wing/empennage, flying controls, engine nacelles, firewalls, engine mounts
Riveting systems
Methods of surface protection eg: chromating, anodising, painting
Simple composite construction methods
Alignment and symmetry checks

List 3
E.g. doors, emergency exits, windows, windscreens, safety devices
Materials
Construction
Fitment to aircraft
Pressurisation and sealing
Seat installation and restraint systems
Cargo loading and securing systems

Learning outcome

The learner will:

LO2 Understand the operation of aircraft hydraulic power systems

Assessment criteria

The learner can:

AC2.1 describe aircraft hydraulic power systems
AC2.2 describe the properties of hydraulic fluids
AC2.3 describe in simple terms the indication and warning system used in a hydraulic system.

Range

List 1
Basic layout and function of a typical system eg:
Hydraulic components
E.g. reservoir, pumps (electric, mechanical, pneumatic), filters, jacks and actuators, control valves, accumulators, pipelines,
Emergency pressure generation
Pressure control
Power distribution
Interface with other hydraulically powered systems

List 2
Eg:
Low compressibility
Low freezing point
Lubrication
Low foaming
Good heat transfer
Compatibility with seals
Compatibility with other fluids

List 3
Eg:
Pressure switches
Pressure transducers
Warning panel indication
Attention-getters

Learning outcome

The learner will:

LO3 Understand the operation of aircraft flight control systems

Assessment criteria

The learner can:

AC3.1 describe the primary flying controls used on aircraft
AC3.2 describe in secondary flying controls used on aircraft
AC3.3 describe methods of moving flying controls.

Range

List 1
Eg:
Ailerons – roll

Elevators – pitch
Rudder – yaw
All moving tailplane – pitch
Canards– pitch and roll
Foreplanes – pitch

List 2
Lift dump
Spoilers – increase/decrease lift, roll
Flaps/slats – increase lift
Airbrakes – increase drag
Trim control
Active load control
Artificial feel
Yaw damper
Mach trim
Rudder limiter
Gust lock systems
Stall warning and protection

List 3
In simple terms:
Manual
Hydraulic
Pneumatic
Electric
Fly-by-wire
Balance and rigging

Learning outcome

The learner will:

LO4 Understand the operation of aircraft landing gear systems

Assessment criteria

The learner can:

AC4.1 describe aircraft landing gear systems
AC4.2 describe landing gear retraction and extension systems
AC4.3 describe landing gear shock absorber and damping systems
AC4.4 describe landing gear wheels, tyres and brakes
AC4.5 describe how anti-skid and auto-braking work
AC4.6 describe nosewheel steering systems.

Range

List 1
Simple description of the construction and general layout of typical systems
Materials eg: Aluminium forgings, steels, magnesium alloys
Components
Layout
Attachments
Up-locks
Down-locks
Ground locks

List 2
Simple description of the construction and general layout of typical systems
Normal and emergency
Operating sequence

List 3
Simple description of the construction and general layout of typical systems
Shock absorber and damping
Materials and fluids used

List 4
Simple description of the construction and general layout of typical systems
Wheels: materials, basic design
Tyres: types of tyre, examples of what tyre ratings mean
Brakes: general layout, operation

List 5
Simple description of the construction and general layout of typical systems
Antiskid: when needed, how it operates
Autobraking: when it is used, different settings

List 6
Simple description of the construction and general layout of typical systems
Why it is needed
How steering is powered
How steering is controlled
Self-centering

Learning outcome

The learner will:

LO5 Understand the operation of aircraft ice and rain protection systems

Assessment criteria

The learner can:

AC5.1 describe how ice can form on aircraft
AC5.2 describe de-icing and anti icing systems
AC5.3 describe rain protection systems.

Range

List 1
How ice forms
Classification of ice
Effect on airflow
Detection

List 2
Difference between de-icing and anti-icing
Methods eg:
Electrical
Hot air
Pneumatic
Chemical
Probe and drain heating

List 3
Rain repellent materials
Wiper systems
Blower systems

Learning outcome

The learner will:

LO6 Understand the operation of aircraft oxygen and air systems

Assessment criteria

The learner can:

AC6.1 describe aircraft oxygen systems
AC6.2 describe safety precautions for working with oxygen systems
AC6.3 describe the sources of aircraft air supplies
AC6.4 describe aircraft air conditioning systems
AC6.5 describe aircraft pressurisation systems.

Range

List 1
Simple description of the construction and general layout of typical systems
Normal and emergency
Oxygen storage: Gaseous and liquid
On board oxygen generators
Supply system
Pipelines
Portable supplies

List 2
Eg:
Fire
Oils and greases
High pressures
Very low temperatures (liquid oxygen – LOX)
High temperatures (chemical generators)

List 3
Simple description of the construction and general layout of typical systems
Engine bleed
APU
Compressor
Ground test rig
Ducts

List 4
Simple description of the construction and general layout of typical systems
Purpose
Air cycle and vapour cycle machines
Flow control
Temperature control
Humidity control
Distribution system

List 5
Simple description of the construction and general layout of typical systems
Pressure control valves
Safety valves
Discharge valves
Cabin door and cockpit sealing
Indication and warning systems

Learning outcome

The learner will:

LO7 Know aircraft interior fittings and systems

Assessment criteria

The learner can:

AC7.1 describe examples of the layout aircraft passenger cabins
AC7.2 describe air cargo handling systems
AC7.3 describe aircraft water/waste systems.

Range

List 1
Overview of:
Galleys
Toilets
Crew seats
Passenger seats
Ceiling, walls, and partitions
Cabin decor
Cabin furnishing & installation
Overhead lockers
Emergency equipment
Fire and smoke detection
Cabin communication and entertainment
Airstairs

List 2
Container stowage
Dangerous cargo
Loading systems e.g.: conveyer, rollers, fork lift
Conveyor
Rollers
Restraint systems
Fire and smoke detection

List 3
Purpose
Water and waste system layout
Toilet system layout, flushing and servicing
Corrosion aspects

Unit 102 Fundamentals of airframe construction and systems

Supporting information

Unit guidance

The UK Civil Aviation Authority (CAA) has replaced the European Union Aviation Safety Agency (EASA) regulations with its own legislative and licencing requirements. This includes the Part-66 licensing scheme for aircraft maintenance personnel.

This unit covers Part 66 Basic Knowledge Requirements Module 11 – Structures and Systems for category A1 and A3 licences.

The CAA is the governing body for all matters related to aircraft maintenance licensing in the UK, they all come under the jurisdiction of the CAA. It is therefore essential to refer to the official CAA documentation for the most accurate and up-to-date information, and for precise technical details.

Unit 215 Aviation mathematics and science for technicians

Level:	3
Credit value:	8
GLH:	70
Relationship to NOS:	This unit is linked to the Aeronautical Engineering Level 3 NOS Units 155, 177 etc
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	To provide learners with a basic understanding of airframe construction and their associated systems.

Learning outcome

The learner will:

LO1 Be able to use principles of arithmetic

Assessment criteria

The learner can:

AC1.1define arithmetical terms
AC1.2 use standard operators on arithmetical expressions
AC1.3 calculate the LCM and HCF of arithmetical expressions
AC1.4 use basic operators on fractions
AC1.5 convert between fraction, decimal and percentage values
AC1.6 simplify fractions by cancelling
AC1.7 distinguish between ratio and proportion
AC1.8 calculate percentage values for common engineering variables
AC1.9 calculate by manipulating simple arithmetic ratios
AC1.10 distinguish between direct and inverse proportion
AC1.11calculate the constant of proportionality for arithmetical expressions.
AC1.12 define types of decimal values
AC1.13 distinguish between ‘significant figures’ and ‘decimal places’
AC1.14 convert numbers to standard form

AC1.15 manipulate arithmetic expressions in standard form
AC1.16 estimate values for expressions involving decimal values.

Range

List 1
Including: positive, negative and real numbers

List 2
Add, subtract, multiply, divide
A range of first-degree expressions in an aeronautical context

List 3
Expressions with at least four component values

List 4
Basic rules of fractions
Proper and improper fractions

List 5
Standard fractions found in engineering (eg: imperial sizes)
Non-standard ‘awkward’ fractions
Proper and improper fractions

List 6
Suitable proper and improper fractions

List 7
Nil

List 8
Eg:
Engine thrust
Voltage variation
Fuel tank contents

List 9
Nil

List 10
Nil

List 11
Nil

List 12
Recurring
Terminating
Non-terminating

List 13
Definitions and examples

List 14
Nil

List 15
Using more complex expressions than in '2.' with all basic operators

List 16
Rules of estimation
Practice with and without calculator
The implications of erroneous estimation in an engineering context

---

Learning outcome

The learner will:

LO2 Be able to use SI, imperial and us customary units

Assessment criteria

The learner can:

AC2.1 define the base SI units of measurement
AC2.2 define the base Imperial units of measurement
AC2.3 convert base and derived units between Imperial, US Customary and SI units
AC2.4 calculate derived unit conversion factors using base units
AC2.5 explain the terms 'relative error' and 'absolute error'
AC2.6 apply error arithmetic to experimental data
AC2.7 convert aircraft fuel loads between US Customary, Imperial and SI units
AC2.8 convert system pressures between Imperial and SI units
AC2.9 extract data from analogue and digital system gauges.

Range

List 1
Metre, kilogram, second, ampere, Kelvin, Pascal, Newton Joule
Names and symbols for preferred prefixes:
Giga G), mega (M), kilo (k), nano (n), pico (p)
Include their typical uses

List 2
Foot (ft), pound (lb), minute (min), Fahrenheit (F)
Include their typical uses

List 3
All those commonly used in engineering

With and without a calculator
Derived SI units eg: Hertz, Newton, Pascal, Joule, Watt, Volt, Ohm, °Celsius, Kelvin
Compound derived units eg:
Metres per second
Newton metre
Relevant US Imperial measures eg: US gallons
Imperial: feet, inches, yards, pounds (lb), Imp gallons,

List 4
Using both arithmetical means and standard reference tables/graphs/calculators
For Imperial and SI systems

List 5
Explanation of the definition
Using suitable examples from engineering

List 6
Relevant to engineering
Tolerance

List 7
Pounds, kilograms, litres, imperial gallons, US gallons
Explain the reasons for doing this accurately

List 8
Eg:
Pascal
Bar
Atmosphere
Psi
Nm-2
Explain the reasons for doing this accurately

Note: Simulation in the form of representative drawings or photographs of relevant gauges can be used when real equipment is not available

List 9
Using common scales eg: pounds, kilograms, litres, US gallons
aircraft and refueler fuel gauges
aircraft system pressure gauges
ground support system pressure gauges

List 10
Eg: oxygen, nitrogen, air, fuel

List 11
Eg: oxygen, nitrogen, air, fuel

Learning outcome

The learner will:

LO3 Be able to manipulate algebraic expressions and formulae using standard techniques

Assessment criteria

The learner can:

AC3.1 factorise algebraic expressions
AC3.2 define ‘algebraic expression’, ‘equation’ and ‘identity’
AC3.3 simplify expressions containing brackets, powers and roots
AC3.4 solve simultaneous equations
AC3.5 solve second degree equations
AC3.6 evaluate aeronautical and scientific formulae by substituting data
AC3.7 use formulae to obtain engineering and scientific data.

Range

List 1
By grouping and extracting common factors

List 2
Basic definitions with examples

List 3
Using BODMAS
Including nested brackets
Indices and powers
Negative and fractional indices

List 4
Simple equations using basic methods

List 5
With one unknown

List 6
Eg:
Gas laws
Aircraft weighing
Aircraft loading (C of G etc)

List 7
Eg:
specific gravity
Pressure

Learning outcome

The learner will:

LO4 Be able to calculate physical properties of common two and three dimensional shapes

Assessment criteria

The learner can:

AC4.1 define the components of a circle
AC4.2 solve problems related to dimensions of a circle
AC4.3 create geometrical constructions
AC4.4 use coordinate systems
AC4.5 use formulae to calculate dimensions of plane figures
AC4.6 use formulae to calculate surface area and volume of common solids.

Range

List 1
Radius
Diameter
Circumference
Arc
Chord

List 2
Radius
Diameter
Circumference

List 3
Simple constructions on paper eg:
Triangle
Square
Rectangle
Parallelogram
Circle

List 4
Rectangular
Polar

List 5
Using:
sine, cosine and tangent relationships
Triangle

Square
Rectangle
Parallelogram

List 6
Cube
Cylinder
Cone
Sphere

Learning outcome

The learner will:

LO5 Be able to use graphs to determine values and solve engineering problems

Assessment criteria

The learner can:

AC5.1 select scales and origins for graph axes
AC5.2 extract values from graphs
AC5.3 extrapolate linear graphs to determine x and y intercepts
AC5.4 determine y, x, m and c from linear equations and graphs
AC5.5 solve graphically pairs of simultaneous equations
AC5.6 recognise graphical representations of sine and cosine waveforms
AC5.7 determine data values from graphs and tables
AC5.8 apply graphical techniques to the solution of engineering problems.

Range

List 1
By examining experimental data using various origins

List 2
Including interpolate between known points

List 3
Extrapolate graph trends

List 4
Graphically and by calculation

List 5
First order equations

List 6
Recognise peak values and phase difference

List 7
Pressure
Density
Relative density
Temperature

List 8
Eg:
ICAO tables
Take-off performance graphs
Fuel data

Learning outcome

The learner will:

LO6 Understand the nature of matter

Assessment criteria

The learner can:

AC6.1 explain the kinetic theory of matter
AC6.2 identify common engineering chemical elements by name and symbol
AC6.3 explain the three basic states of matter and the changes of state of common substances
AC6.4 explain the three main bonds at molecular level
AC6.5 describe the nature of molecules found in metals and non-metals
AC6.6 explain the difference between heat and temperature
AC6.7 explain the relationship between the common temperature scales
AC6.8 convert temperature values between the common temperature scales
AC6.9 use the ISA tables to derive specific values.

Range

List 1
Explanation including:
Random motion of particles
Brownian motion
Gas properties of pressure, temperature and volume
Conduction, Convection, Radiation, Adiabetic compression

List 2
Eg carbon, iron, aluminium, copper

List 3
Solid, liquid, gas

Include all state changes: solid > liquid > gas >liquid > gas
Basic explanation of latent heat
Common features of state changes such as the expansion of water when frozen.

List 4
Metallic
Ionic
Covalent
Relative strengths of each bond
Reasons for forming each type

List 5
Materials used in aircraft eg:
Steel
Aluminium alloys
Plastics
Conductors
Insulators

List 6
Engineering explanation using aircraft related examples

List 7
Kelvin
Degrees Fahrenheit
Degrees Celsius

List 8
Kelvin
Degrees Fahrenheit
Degrees Celsius

List 9
Eg:
Altitude
Temperature
Density

Learning outcome

The learner will:

LO7 Understand principles of statics

Assessment criteria

The learner can:

AC7.1 identify forces represented graphically as vectors

AC7.2 explain the concept of equilibrium
AC7.3 define the meaning of ‘the moment of a force about a point’
AC7.4 define centre of gravity
AC7.5 solve problems involving straight levers, bell cranks and aircraft loading
AC7.6 solve problems graphically using the ‘triangle of forces’ theorem
AC7.7 solve problems graphically using the ‘parallelogram of forces’ theorem
AC7.8 define pressure and its units
AC7.9 explain the difference between gauge pressure and absolute pressure
AC7.10 solve problems involving atmospheric, gauge and absolute pressures
AC7.11 calculate pressures in liquids using basic physical measurement.

Range

List 1
Define ‘vector’
Draw vector lines to represent forces in a system

List 2
With respect to mechanical systems

List 3
Basic principle of moments

List 4
Explain the meaning
Examples of position in common objects including aircraft

List 5
Relate problems to aircraft eg:
Bell crank on control cables
Aircraft balance about main undercarriage on the ground
Aircraft loading to adjust C of G

List 6
Including some aircraft-related problems

List 7
Including some aircraft-related problems

List 8
The atmosphere
Free liquids and gases
Constrained liquids and gases
Stress and strain of materials
Gas laws (Boyle’s Charles)

List 9

Aircraft-related examples

List 10
Aircraft related

List 11
Measuring height
Applying ρp = þ gh

Learning outcome

The learner will:

LO8 Understand principles of linear, angular and oscillating motion related to aircraft in flight

Assessment criteria

The learner can:

AC8.1 define speed, velocity and acceleration
AC8.2 state Newton's Laws of Motion
AC8.3 explain the relationships F = ma and W = mg
AC8.4 define the equations of linear motion for constant acceleration
AC8.5 solve problems related to an aircraft in flight
AC8.6 define basic terms for angular motion
AC8.7 define terms for oscillating motion
AC8.8 explain simple harmonic motion in terms of mass-spring and simple pendulum systems
AC8.9 calculate the natural frequency of small oscillations in a pendulum.

Range

List 1
Including acceleration due to gravity and its approximate value

List 2
In standard form
Include aircraft-related examples

List 3
Including aircraft-related examples

List 4
s= ut + ½ at2
v = u + at
v2 = u2 + 2as

List 5
Using:

Newton’s Laws of Motion
Linear motion equations

List 6
Centripetal acceleration
Centrifugal force
Angular velocity
Calculations

List 7
For elastic systems:
Free vibration
Simple harmonic motion
Forced vibration
Resonance
Time period
Cycle
Frequency
Amplitude

List 8
Applying definitions in (7.)

List 9
Using the simplified version of the pendulum formula for small oscillations

Learning outcome

The learner will:

LO9 Understand principles of dynamics related to aircraft in flight

Assessment criteria

The learner can:

AC9.1 define terms relating to simple machines
AC9.2 solve problems involving simple machines
AC9.3 explain terms related to gyroscopic motion
AC9.4 define work and power
AC9.5 define common forms of energy
AC9.6 explain the concept of the conservation of energy
AC9.7 solve simple problems involving potential and kinetic energy
AC9.8 explain terms related to friction
AC9.9 solve simple problems involving friction affecting objects on horizontal surfaces.

Range

List 1
Velocity ratio
Mechanical advantage
Efficiency

List 2
Related to aircraft where possible:
Relationship between pressure, force and area
Pulley systems
Worm and wheel
Levers
Gears
Screw jack
Efficiency

List 3
Momentum
Inertia
Rigidity
Precession
Gimbal Lock, Degrees of freedom

List 4
Calculations

List 5
Potential
Kinetic
Heat
Electrical
Chemical

List 6
Eg: ‘energy can neither be created nor destroyed, but only converted from one form to another’

List 7
Related to aircraft where possible:

List 8
Static friction
Dynamic friction
Coefficient of friction
Reaction
Normal force

List 9
Applying definitions in 8

Learning outcome

The learner will:

LO10 Understand principles of fluid motion related to aircraft in flight

Assessment criteria

The learner can:

AC10.1 explain density and relative density (specific gravity)
AC10.2 solve simple problems involving changing altitude
AC10.3 explain viscosity
AC10.4 describe the effects of streamlining on the properties of air over an aerofoil surface
AC10.5 explain Bernoulli's Principle for a non-viscous fluid
AC10.6 explain the relationship between Bernoulli's principle, a venturi and lift on an aerofoil.

Range

List 1
Including practical examples eg: fuel

List 2
Changes with altitude of air properties:
Density
Pressure
Temperature

List 3
In terms of:
Resistance to fluid flow
Shear stresses close to the system boundary

List 4
Velocity of the air
Resistance of the air

List 5
Eg: potential energy, kinetic energy and pressure energy remain constant in the streamline

List 6
Simplified explanation

Unit 215 Aviation mathematics and science for technicians

Supporting information

Unit guidance

The UK Civil Aviation Authority (CAA) has replaced the European Union Aviation Safety Agency (EASA) regulations with its own legislative and licencing requirements. This includes the Part-66 licensing scheme for aircraft maintenance personnel.

This unit covers Part 66 Basic Knowledge Requirements Module 1 – Mathematics and Module 2 – Physics, for Category A Licences but is taught to the depth for Category B1. B1 syllabus paragraphs not covered are:

- 1.2b – Logarithms (only)
- 2.3b – Thermodynamics
- – Optics (Light)
- – Wave Motion and Sound

The teaching of the knowledge content of this unit should be referenced to the latest Civil Aviation Authority (CAA) publication, or its military equivalents. The City & Guilds online multiple-choice examination is based on this content.

The CAA is the governing body for all matters related to aircraft maintenance licensing in the UK, they all come under the jurisdiction of the CAA. It is therefore essential to refer to the official CAA documentation for the most accurate and up-to-date information and precise technical details on the topic area.

Unit 005 Fundamentals of aerodynamics

Level:	2
Credit value:	5
GLH:	40
Relationship to NOS:	This unit is linked to the Aeronautical Engineering Level 2 NOS Units 006, 007
Endorsement by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	To give the learner a working knowledge of aircraft aerodynamics and control to as a basis for further study. It covers the complete syllabus for the CAA Part-66 Module 8 for the category A licences.

Learning outcome

The learner will:

LO1 Know the basic properties of the earth's atmosphere

Assessment criteria

The learner can:

AC1.1 describe the basic nature and composition of the Earth's atmosphere
AC1.2 describe the main layers of the Earth's atmosphere
AC1.3 use the basic gas laws make calculations
AC1.4 describe the use of the International Standard Atmosphere (ISA) in aviation.

Range

List 1
Air composition
Temperature
Pressure
Density
Position on the Earth's surface
Climatic conditions

List 2
Including the region of constant temperature (with altitude)

List 3
Quoting values at sea level in SI and Imperial units:
Pressure: psi, Nm-2, bar, millibar, hectopascal
Density: kgm-2
Temperature: °C, Kelvin, °F

Learning outcome

The learner will:

LO2 Understand the nature of airflow around aerodynamic bodies

Assessment criteria

The learner can:

AC2.1 describe the main properties of airflow
AC2.2 describe how air flows around an aerodynamic body
AC2.3 explain how an aerofoil stalls and the effect a stall has on an aircraft in flight
AC2.4 describe the main characteristics of symmetrical and cambered aerofoils
AC2.5 describe how the airflow around aerofoils changes with angle of attack and velocity
AC2.6 explain how lift and drag affect aircraft performance
AC2.7 explain qualitatively how lift and drag can vary
AC2.8 explain how a high lift device alters the flow characteristics of an aerofoil
AC2.9 explain how the total drag of an aircraft is generated
AC2.10 describe common methods of drag reduction.

Range

List 1
Eg:
Compressible
Viscosity
Changed by temperature, solid objects etc

List 2
Related to different types of flow including:
Laminar, turbulent (boundary layer)
Free stream flow
Up and down wash
Vortices
Features including:
Stagnation point/region
Transition and separation points

List 3
Mechanism in terms of airflow

Effect in terms of passage through the air and degree of control available

List 4
Related to 2 and including:
Camber
Chord
Mean aerodynamic chord
Mean camber line
Angle of attack
Angle of incidence
Fineness ratio
Thickness to chord ratio (percentage)

List 5
Basic qualitative explanation:
With reference to Bernoulli's principle
Including resulting static pressure changes resulting from:
Changes in angle of attack, including around the stall
Velocity changes
Effects including changes in:
Lift
Drag

List 6
Simple explanation

List 7
Simple explanation:
Including, for both cambered and symmetrical aerofoils:
How the following change with angle of attack:
Lift coefficient
Drag coefficient
Lift/drag ratio

List 8
Eg:
Airflow separation
Changes in lift and drag coefficients

List 9
Including simple explanations of:
Induced drag
Pressure or form drag
Skin friction
Interference drag
Parasite drag

List 10
Eg:

Polished surfaces
Fairings
Special materials
Aerodynamic shape

Learning outcome

The learner will:

LO3 Know the characteristics of the basic wing planforms

Assessment criteria

The learner can:

AC3.1 describe the basic wing planforms and their typical applications
AC3.2 calculate dimensions for each basic wing planform
AC3.3 describe the airflow over each basic wing planform
AC3.4 describe the effect of ice, snow and frost build-up on the performance of aerofoils.

Range

List 1
Rectangular
Tapered
Swept
Delta

List 2
Span
Aspect ratio
Taper ratio
Gross wing area
Wash in
Wash out

List 3
Using simple diagrams:
In normal flight
At or near the stall

List 4
Eg:
Change of shape
Increase in weight
Variation in thickness

Learning outcome

The learner will:

LO4 Understand basic aircraft control using primary control surfaces

Assessment criteria

The learner can:

AC4.1 explain the relationship between the four main forces acting on an aircraft
AC4.2 explain the meaning of 'aircraft control'
AC4.3 describe the operation and effect of the primary aircraft control surfaces
AC4.4 explain the term 'flight envelope'
AC4.5 describe typical aircraft performance in different phases of flight
AC4.6 describe how turning flight is related to the stall
AC4.7 describe how turning flight changes the loading on an airframe
AC4.8 explain the influence of load factor on aerodynamic performance.

Range

List 1
Lift
Drag
Thrust
Weight
Balancing effect of the tailplane

List 2
Any accepted definition

List 3
Elevator
Aileron
Rudder

List 4
Define the term flight envelope
Simple qualitative explanation of the limits and their dependency on values such as Mach number
Simple qualitative explanation why an aircraft may be unable to recover from a stall at Mach numbers close to 1 at high operating altitude (the so-called 'coffin corner')

List 5
Straight and level flight
Climb
Descent
Glide

Turn

List 6
Simple aerodynamic explanation
Spins

List 7
Simple explanation including the effect on structural defects

List 8.
Define Load Factor
Simple qualitative explanation of its effect on lift generated and how changes alter the aircraft's flight characteristics

Learning outcome

The learner will:

LO5 Understand the nature of aircraft stability

Assessment criteria

The learner can:

AC5.1 explain the nature of aircraft flight stability
AC5.2 relate the three aircraft axes to different types of stability
AC5.3 explain the differences between statically stable, unstable and neutral aircraft
AC5.4 describe major components on an aircraft that affect stability in flight
AC5.5 describe typical methods of enhancing stability.

Range

List 1
Eg:
Active stability
Passive stability

List 2
Eg:
Pitch stability eg:
Short period pitch oscillation
Long period pitch oscillations (Phugoid)
Lateral stability eg:
Dutch roll
Directional stability eg:
Weathercocking

List 3
Definitions and examples of:
Static or positive stability
Negative stability (unstable)
Zero stability (neutral)

List 4
Eg:
Position and size of vertical stabiliser(s)
Shape and mounting of the wings (eg: anhedral/dihedral, aspect ratio etc.)
Design of the tailplane

List 5
Eg:
Adjusting the centre of gravity
Design of lifting and control surfaces (eg: wings, canards, tailplane etc.)

Learning outcome

The learner will:

LO6 Know the purpose and operation of a range of secondary control surfaces

Assessment criteria

The learner can:

AC6.1 describe the secondary effects of roll and yaw and methods of overcoming them
AC6.2 describe the arrangement and operation of alternative and combined flying controls
AC6.3 describe the general flow characteristics of high lift devices
AC6.4 compare the performance of trailing edge high-lift devices
AC6.5 describe the aerodynamic problems caused by asymmetric flap operation
AC6.6 compare the performance of leading edge high-lift devices
AC6.7describe the purpose and operation of stall strips/wedges
AC6.8 describe common methods of boundary layer control
AC6.9 compare the operation of high drag devices.

Range

List 1
Simple description in terms of airflow over control surfaces:
Main issue is adverse yaw
Explain the effect of adverse yaw on roll rate
Ways of counteracting averse yaw eg:
Differential ailerons
Frise ailerons
Roll spoilers
Explain the secondary roll effect of applying rudder

Explain this is worse in V-tailed aircraft
Co-ordinated use of rudder and aileron
Rudder limiters

List 2
Simple explanation of: arrangement, operation and reasons for:
Spoilers
All-moving tailplane (slab/stabilator)
Tailerons
Canards
Elevons
Ruddervators
Flaperons

List 3
Using the example of eg: a trailing edge flap
Simple explanation to centre on:
Airflow changes on deployment eg:
Change in lift and drag coefficients
Airflow separation

List 4
Simple explanation of advantages, disadvantages with respect to aerodynamic effectiveness and operation:
Plain flap
Split flap
Slotted flap
Fowler flap

List 5
Explanation of asymmetric flap and how it happens
Description of the effect on aircraft attitude

List 6
Simple explanation of advantages, disadvantages with respect to aerodynamic effectiveness and operation:
Krueger flap
Leading edge droop
Slots
Slats

List 7
Reason
Position
How they operate

List 8
Eg:
Blown air

Suction

List 9
Including limitations in flight and on the ground
Spoilers
Lift dumpers
Speed brakes.

Error! Use the Home tab to apply H1 Unit to the text that you want to appear here.

Supporting information

Unit guidance

The UK Civil Aviation Authority (CAA) has replaced the European Union Aviation Safety Agency (EASA) regulations with its own legislative and licencing requirements. This includes the Part-66 licensing scheme for aircraft maintenance personnel.

This unit covers Part 66 Basic Knowledge Requirements Module 8 – Basic Aerodynamics for A Category licenses.

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Appendix 1 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centre Document Library** on **www.cityandguilds.com** or click on the links below:

Centre Handbook: Quality Assurance Standards

This document is for all approved centres and provides guidance to support their delivery of our qualifications. It includes information on:

- centre quality assurance criteria and monitoring activities
- administration and assessment systems
- centre-facing support teams at City & Guilds/ILM
- centre quality assurance roles and responsibilities.

The Centre Handbook should be used to ensure compliance with the terms and conditions of the centre contract.

Centre Assessment: Quality Assurance Standards

document sets out the minimum common quality assurance requirements for our regulated and non-regulated qualifications that feature centre-assessed components. Specific guidance will also be included in relevant qualification handbooks and/or assessment documentation.

It incorporates our expectations for centre internal quality assurance and the external quality assurance methods we use to ensure that assessment standards are met and upheld. It also details the range of sanctions that may be put in place when centres do not comply with our requirements or actions that will be taken to align centre marking/assessment to required standards. Additionally, it provides detailed guidance on the secure and valid administration of centre assessments.

Access arrangements: When and how applications need to be made to City & Guilds provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

The **Centre document library** also contains useful information on such things as:

- conducting examinations
- registering learners
- appeals and malpractice.

Useful contacts

Please visit the **Contact us** section of the City & Guilds website.

City & Guilds

For over 140 years, we have worked with people, organisations and economies to help them identify and develop the skills they need to thrive. We understand the life-changing link between skills development, social mobility, prosperity and success. Everything we do is focused on developing and delivering high-quality training, qualifications, assessments and credentials that lead to jobs and meet the changing needs of industry.

We partner with our customers to deliver work-based learning programmes that build competency to support better prospects for people, organisations and wider society. We create flexible learning pathways that support lifelong employability because we believe that people deserve the opportunity to (re)train and (re)learn again and again – gaining new skills at every stage of life, regardless of where they start.

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This Qualification Handbook however may contain references to historic information, such as former organisations, obsolete frameworks, codes or standards, or retired units and qualifications. This information is included for reference purposes only.

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