QUALIFICATION HANDBOOK

Level 2 Diploma in Aircraft Engineering (2675-23)

September 2017 Version 1.1

City & Guilds

Qualification at a glance

Subject area	**Aeronautical Engineering**
GLH	340
TQT	400
City & Guilds number	2675-23
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: Employers would be interested in candidates that: • Are keen and motivated to work in an engineering environment • Are willing to undertake a course of training both on-the-job and off-the-job and apply this learning in the workplace • Have previous work experience or employment in the sector • Have completed a 14 to 19 Diploma in Engineering or Manufacturing • Have completed a Young Apprenticeship in Engineering or other related area • Have GCSEs in English, Maths and Science • Have completed tests in basic numeracy, literacy and communication skills and have spatial awareness 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
Fast track	Available
Support materials	Centre handbook
Registration and certification	Consult the City & Guilds website for information

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

Version and date	Change detail	Section
1.1 September 2017	Added TQT details Deleted QCF	Qualification at a glance and Structure 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 practise the knowledge required for employment and/or career progression in the aeronautical engineering sector.
Is the qualification part of a framework or initiative?	This qualification is recognised as a technical certificate in the intermediate engineering apprenticeship frameworks.
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)

Structure

To achieve the **Level 2 Diploma in Aircraft Engineering**, 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.

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Mandatory			
R/503/0817	Unit 003	Fundamentals of aircraft materials and hardware	11
M/503/1263	Unit 035	Human factors in aviation	5
D/503/0898	Unit 101	Fundamentals of electrics and theory of flight	5
H/503/0899	Unit 102	Fundamentals of airframe construction and systems	11
D/503/1128	Unit 215	Aviation mathematics and science for technicians	8
Elective			
T/503/0857	Unit 005	Fundamentals of aerodynamics	5

Total Qualification Time

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a Learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and assessment.

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

2 Centre requirements

Approval

For Level 2, centres already delivering the Level 2 City & Guilds Certificate in Aeronautical Engineering (2597) will be automatically approved to run the Level 2 routes in this qualification.

For Level 2, centres already delivering the City & Guilds Certificate in aeronautical Engineering (2661) will be automatically approved to run this new qualification.

To offer this qualification, new centres will need to gain both centre and qualification approval. Please refer to the *Centre guide* and *Providing City & Guilds Qualifications* 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 within a centre 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

Centre staff must satisfy the requirements for occupational expertise for this qualification.

These requirements are as follows:

Staff should be technically competent in the areas for which they are delivering training and/ or should also have experience of providing training.

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.

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Assessors and internal verifiers

While the Assessor/Verifier (A/V) units are valued as qualifications for centre staff, they are not currently a requirement for the qualification.

Continuing professional development (CPD)

Centres must support their staff to ensure that they have current knowledge of the occupational area, that delivery, mentoring, training, assessment and verification

Verifier Requirements (internal and external)

Internal quality assurance (Internal Verification) must be carried out by competent Verifiers that as a minimum must hold the Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practices. Current and operational Internal Verifiers that hold internal verification units V1 or D34 will not be required to achieve the Level 4 Award as they are still appropriate for the verification requirements set out in this Unit Assessment Strategy. Verifiers must be familiar with, and preferably hold, either the nationally recognised Assessor units D32 and/or D33 or A1 and/or A2 or the Level 3 Award in Assessing Competence in the Work Environment.

External quality assurance **(External Verification)** must be carried out by competent External Verifiers that as a minimum must hold the Level 4 Award in the External Quality Assurance of Assessment Processes and Practices**.** Current and operational External Verifiers that hold external verification units V2 or D35 will not be required to achieve the Level 4 Award as they are still appropriate for the verification requirements set out in this Unit Assessment Strategy. Verifiers must be familiar with, and preferably hold, either the nationally recognised Assessor units D32 and/or D33 or A1 and/or A2 or the Level 3 Award in Assessing Competence in the Work Environment

External and Internal Verifiers will be expected to regularly review their skills, knowledge and understanding and where applicable undertake continuing professional development to ensure that they are carrying out workplace Quality Assurance (verification) of Assessment Processes and Practices to the most up to date National Occupational Standards (NOS) Verifiers, both Internal and External, will also be expected to be fully conversant with the terminology used in the NVQ units against which the assessments and verification are to be carried out, the appropriate Regulatory Body's systems and procedures and the relevant Awarding Organisation's documentation.

Candidate 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 so should have the opportunity to gather work based evidence.

The SEMTA Engineering Manufacture apprenticeship framework suggests that:

Employers would be interested in candidates that:

- Are keen and motivated to work in an engineering environment
- Are willing to undertake a course of training both on-the-job and off-the-job and apply this learning in the workplace
- Have previous work experience or employment in the sector
- Have completed a 14 to 19 Diploma in Engineering or Manufacturing
- Have completed a Young Apprenticeship in Engineering or other related area
- Have GCSEs in English, Maths and Science
- Have completed tests in basic numeracy, literacy and communication skills and have spatial awareness.

As a guide, the Engineering Manufacturing framework is suitable for applicants who have five GCSEs grades D to E in English, Maths and Science. The selection process on behalf of employers may include initial assessment where applicants will be asked if they have any qualifications or experience that can be accredited against the requirements of the apprenticeship. They may also be required to take tests in basic numeracy and literacy, communications skills and spatial awareness. There may also be an interview to ensure applicants have selected the right occupational sector and are motivated to become an apprentice, as undertaking an apprenticeship is a major commitment for both the individual and the employer.

Recognition of prior learning

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.

Age restrictions

There is no age restriction for this qualification unless this is a legal requirement of the process or the environment.

3 Delivering the qualification

Initial assessment and induction

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

- if the candidate 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 candidate fully understands the requirements of the qualification, their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

Support materials

The following resources are available for these qualifications:

Description	How to access
Centre devised forms	**www.cityandguilds.com**, 2675 qualification pages
Centre devised generic guidance: • Centre guidance • Generic grading criteria	**www.cityandguilds.com**, 2675 qualification pages
Guidance for producing centre devised tasks (specific guidance for each unit within a pathway)	**www.cityandguilds.com**, 2675 qualification pages
Example assignments (for selected units only)	**www.cityandguilds.com**, 2675 qualification pages

4 Assessment

Assessment of the qualification

This qualification is assessed by a combination of e-assessments (multiple choice tests) and centre devised assignments covering practical skills and underpinning knowledge. The table below provides details on the assessment methods for each unit.

Mandatory Units

City & Guilds unit number	Unit title	Assessment method
2675-003	Fundamentals of Aircraft Materials and Hardware	CAA
2675-035	Human Factors in aviation	e-assessment
2675-101	Fundamentals of electrics and theory of flight	e-assessment
2675-102	Fundamentals of airframe construction and systems	Short-answer
2675-215	Aviation mathematics and science for technicians	e-assessment

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.

Centre set assignments

Centres must refer to '*Developing assignments – guidance for centres*' and the associated assignment development forms which are available to download from **www.cityandguilds.com**.

Example assignments and specific assessment guidance for each unit is also available for this qualification and can be found on **http://www.cityandguilds.com**.

Approval process for centre set assignments

Centre set assignments must be approved by the external verifier before use. For each assignment, the *assignment sign off sheet* (AD3) must be completed and be made available to the EV for inspection.

Time constraints

Timings for e-assessments are indicated in the test specifications on page 12

The centre set and marked assignments will need to have some limits to the time available. The time available may be based on practicalities such as scheduling marking during the required period, but the time available must always be sufficient for candidates to tackle the task fairly, and candidates will be able to negotiate extra time in appropriate circumstances.

Test specifications

The way the knowledge is covered by each online test is laid out in the tables below:

Test 1: Unit 035 Human Factors in Aviation
Duration: 60 minutes

Outcome	Number of questions	%
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**

Test 2: Unit 101 Fundamentals of Electrics and Theory of Flight
Duration: 60 minutes

Outcome	Number of questions	%
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**

Test 3: Unit 102 Fundamentals of airframe construction and systems
Duration: 60 minutes

Outcome	Number of questions	%
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**

Test 5: Unit 215 Aviation mathematics and science for technicians
Duration: 105 minutes

Outcome	Number of questions	%
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

Availability of units

Below is a list of the learning outcomes for all the units. If you want to download a complete set of units, go to www.cityandguilds.com

Structure of units

These units each have the following:

- City & Guilds reference number
- unit accreditation number (UAN)
- title
- level
- credit value
- unit aim
- relationship to NOS, other qualifications and frameworks
- endorsement by a sector or other appropriate body
- information on assessment
- learning outcomes which are comprised of a number of assessment criteria
- notes for guidance

Unit 003 Fundamentals of aircraft materials and hardware

UAN:	**R/503/0817**
Level:	2
Credit value:	11
GLH:	90
Relationship to NOS:	This unit is endorsed by SEMTA.
Endorsement by a sector or regulatory body:	This unit is linked to the Aeronautical Engineering Level 3 NOS Units 013, 144 etc
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 EASA Part-66 Module 6 for A Category licences.

learning outcome
the learner will: 1. know the properties of aircraft ferrous materials
assessment criteria
the learner can: 1.1 describe the basic characteristics, properties and identification of ferrous materials 1.2 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: 2. know the properties of aircraft non-ferrous materials
assessment criteria
the learner can: 2.1 describe characteristics, properties and identification of non-ferrous metals used in aircraft 2.2 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: 3. know the properties of composite and other non-metallic materials
assessment criteria
the learner can: 3.1 describe characteristics, properties and identification of composite and other non-metallic materials 3.2 describe characteristics, properties and identification of sealants and bonding agents 3.3 describe detection of typical defects/deterioration in composite material 3.4 explain typical repair techniques for composite materials 3.5 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: 4. know wood and fabric airframe construction
assessment criteria
the learner can: 4.1 describe construction methods for wooden airframe structures 4.2 describe characteristics and properties of the types of wood and glue used in aeroplanes 4.3 describe methods of detecting defects in wooden structures 4.4 describe methods of repairing wooden structures 4.5 describe characteristics, properties and types of fabric used in aeroplanes 4.6 describe inspection methods for fabrics 4.7 describe the common defects found in fabrics 4.8 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 ply wood 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: 5. understand corrosion in aircraft materials
assessment criteria
the learner can: 5.1 describe the chemical fundamentals of corrosion 5.2 describe the causes and formation of corrosion 5.3 describe the types of corrosion and their identification 5.4 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: 6. understand aircraft fasteners
assessment criteria
the learner can: 6.1 explain the nomenclature of screw threads 6.2 explain thread systems 6.3 explain the specification of aircraft bolts 6.4 describe typical nuts, screws, studs and locking devices used on aircraft 6.5 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: 7. know aircraft pipes, unions and fittings
assessment criteria
the learner can: 7.1 describe aircraft pipes and connectors 7.2 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: 8. know aircraft bearings
assessment criteria
the learner can: 8.1 describe the purpose of bearings 8.2 describe types of bearing and their construction 8.3 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: 9. know aircraft transmission systems and control cable mechanisms
assessment criteria
the learner can: 9.1 describe gears systems, ratios and their application 9.2 describe belts and pulleys, chains and sprockets 9.3 describe types of control cable and mechanisms 9.4 describe pulleys and cable system components 9.5 describe bowden cables 9.6 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: 10. know aircraft electrical cables and connectors
assessment criteria
the learner can: 10.1 describe cable types, construction and characteristics 10.2 describe high tension and co-axial cables 10.3 explain the process of crimping 10.4 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, post-crimp 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

Guidance

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 6 – Aircraft Materials and Hardware. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the A category licences - are listed below with an abridged description of each level:

Level 1 – "A familiarisation with the principal elements of the subject"

Level 2 – "A general knowledge of the theoretical and practical aspects of the subject"

Level 3 – "A detailed knowledge of the theoretical and practical aspects of the subject"

Outcome 1: EASA Level 1
Outcome 2: EASA Level 1
Outcome 3: EASA Level 1
Outcome 4: EASA Level 2 (Except 1 and 2 - EASA Level 1)
Outcome 5: EASA Level 2 (Except 5 - EASA Level 1)
Outcome 6: EASA Level 2
Outcome 7: EASA Level 1
Outcome 8: EASA Level 1
Outcome 9: EASA Level 1
Outcome 10: EASA Level 1

Note: the above list equates to the EASA requirement for category A licences and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject

Unit 035 Human factors in aviation

UAN:	**M/503/1263**
Level:	3
Credit value:	5
GLH:	40
Relationship to NOS:	This unit is endorsed by SEMTA.
Endorsement by a sector or regulatory body:	This unit is linked to the Aeronautical Engineering Level 2 NOS Unit 001 and Level 3 NOS Unit 003
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 EASA Module 9 for Category B 1 and B2 licences.

Learning outcome
The learner will: 1. understand why human factors are important in aviation
Assessment criteria
The learner can: 1.1 explain the term 'human factors' 1.2 explain why Human Factors is important in the aeronautical engineering workplace 1.3 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: 2. understand features and limitations of human performance
Assessment criteria
The learner can: 2.1 explain how images are seen and interpreted by humans 2.2 explain how sounds are heard and interpreted by humans 2.3 explain limitations of human memory 2.4 describe factors that affect mental attention span 2.5 describe how variations in an individual's sight and hearing can affect their behaviour 2.6 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: 3. understand aspects of social psychology
Assessment criteria
The learner can: 3.1 explain areas of individual and group responsibility in aircraft engineering environments 3.2 explain motivation and de-motivation

3.3	explain 'peer pressure'
3.4	explain company culture
3.5	explain the concepts of team working
3.6	identify the primary responsibilities of engineering managers and supervisors
3.7	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: 4. understand personal factors that affect human performance
Assessment criteria
The learner can: 4.1 explain effects of personal health and fitness on work performance 4.2 identify types of stress 4.3 explain effects of setting time deadlines on individual work performance 4.4 explain the concept of work overload and underload 4.5 explain the effects of shift work on sleep and fatigue 4.6 explain the effects of alcohol, medication and substance abuse 4.7 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: 5. understand how physical aspects of the working environment affect human performance
Assessment criteria
The learner can: 5.1 explain effects of noise on individuals and groups 5.2 explain effects of fumes on individual performance 5.3 explain effects of varying illumination on an individual performance 5.4 explain effects of variations in climate on an individual performance 5.5 explain effects of exposure to constant motion and vibration while working 5.6 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 environment
Tasks, tools and information

Learning outcome
The learner will: 6. understand how categories of tasks can affect human performance
Assessment criteria
The learner can: 6.1 explain the importance of planning the execution of a task 6.2 explain effects of physically demanding work on individual performance 6.3 explain effects of repetitive tasks on individual performance 6.4 explain aspects of visual inspection 6.5 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: 7. understand communication in the workplace
Assessment criteria
The learner can: 7.1 explain the importance of good communication in the workplace 7.2 explain the importance of accurate work logging 7.3 explain modes of communication between individuals and teams 7.4 explain the importance of maintaining individual professional currency 7.5 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: 8. understand the causes of human error
Assessment criteria
The learner can: 8.1 explain the error models and theories used in aeronautical engineering 8.2 explain types of error that occur during work on aircraft 8.3 describe the error-incident-accident chain 8.4 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: 9. understand the human factors aspects of aircraft incidents
Assessment criteria
The learner can: 9.1 analyse an incident report to extract information 9.2 identify a sequence of events from a narrative report 9.3 identify human factors contributing to an incident 9.4 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: 10. understand risk assessments in aeronautical engineering environments
Assessment criteria
The learner can: 10.1 define the terms associated with risk assessment 10.2 describe the five steps to risk assessment 10.3 describe the associated risks for workplace hazards 10.4 describe conclusions from risk assessments 10.5 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

Guidance

The teaching of the knowledge content of this unit should be referenced to the Civil Aviation Authority (CAA) publication CAP715 or its military equivalents. The City & Guilds GOLA examination is based on the content of CAP 715.

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 9 – Human Factors. The equivalent EASA knowledge level indicators for each of the above outcomes are listed below with an abridged description of each level:

Level 1 – "A familiarisation with the principal elements of the subject"

Level 2 – "A general knowledge of the theoretical and practical aspects of the subject"

Level 3 – "A detailed knowledge of the theoretical and practical aspects of the subject"

Outcome 1: EASA Level 2
Outcome 2: EASA Level 2
Outcome 3: EASA Level 1
Outcome 4: EASA Level 2
Outcome 5: EASA Level 1
Outcome 6: EASA Level 1
Outcome 7: EASA Level 2
Outcome 8: EASA Level 2
Outcome 9: EASA Level 2
Outcome 10: EASA Level 2

Note: the above list equates to the EASA requirement for category B licences and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject.

Unit 101 Fundamentals of electrics and theory of flight

UAN:	**D/503/0898**
Level:	2
Credit value:	5
GLH:	40
Relationship to NOS:	This unit is endorsed by SEMTA.
Endorsement by a sector or regulatory body:	This unit is linked to the Aeronautical Engineering Level 2 NOS Units 7 and 8
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: 1. understand electrical concepts
Assessment criteria
The learner can: 1.1 explain the difference between a conductor and an insulator 1.2 explain static electricity and conduction 1.3 explain the build-up of static charge on an aircraft surface 1.4 explain electrical terms 1.5 perform calculations involving Ohm's Law 1.6 identify series, parallel and series-parallel circuits 1.7 calculate current division through series and parallel stages in a network 1.8 calculate voltage drop across series and parallel stages in a network 1.9 describe ways in which electricity can be produced 1.10 explain the purpose of a capacitor 1.11 describe the construction of a capacitor 1.12 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: 2. know about direct current power sources and machines
Assessment criteria
The learner can: 2.1 describe the chemical action of primary and secondary cells 2.2 explain the connection of cells are connected in series and in parallel 2.3 explain the internal resistance of a battery 2.4 explain properties of magnetic materials 2.5 describe the magnetic field of a bar magnet 2.6 describe differences in the magnetic characteristics of soft and hard iron 2.7 describe uses of magnetic materials 2.8 describe the interaction of a current-carrying conductors and magnetic fields 2.9 explain the production of an EMF by the interaction of a permanent magnet with a coil

2.10 identify the key components of dc generators 2.11 identify the key components of dc motors.

Range
List1 Construction and basic chemical action Dry cells Lead acid cells Nickel-Cadmium cells Other alkaline cells **List2** How and why eg: greater voltage, greater power etc **List3** 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: 3. know the principles of alternating current know the principles of alternating current
Assessment criteria
The learner can: 3.1 explain the term 'alternating current' 3.2 describe commonly used terms related to alternating current 3.3 identify the key components of a simple single-phase ac generator 3.4 explain the difference between single-phase and 3-phase waveforms.

Range
List1 Describe and sketch its waveform Include: Position of coil to magnetic field Direction of flow on graph axis **List2** Cycle Periodic time Peak value Peak-to-peak value Magnitude or amplitude Frequency Average value RMS value Phase

List3
Including the arrangement of eg:
Armature
Magnets
Commutator
Brushes

List4
Including phase angle – Φ

Learning outcome
The learner will: 4. know about aircraft electrical devices and data transmission
Assessment criteria
The learner can: 4.1 describe thermocouples 4.2 describe the operation of a photo-cell 4.3 describe the operation variable resistors 4.4 explain why data buses are used in aircraft 4.5 explain how light can be transmitted down a fibre optic cable 4.6 compare the properties of fibre optic data transmission to electrical wire propagation.

Range
List1 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: 5. know the forces acting on an aircraft in flight
Assessment criteria
The learner can: 5.1 describe the forces acting on an aircraft in flight 5.2 describe the effects of streamlining an object in an airflow 5.3 explain how lift is produced 5.4 explain how a stall occurs 5.5 explain aerodynamic terms 5.6 explain the importance of the speed of sound to high-speed aircraft 5.7 state the meaning of terms related to high speed flight 5.8 describe problems that can occur when an aircraft approaches the speed of sound 5.9 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: 6. know about aircraft stability and control
Assessment criteria
The learner can: 6.1 describe the movement of an aircraft about its three axes 6.2 explain the term 'equilibrium' 6.3 describe the relationship between lift, weight, thrust and drag in straight and level flight 6.4 explain the term 'static stability' 6.5 explain the static stability requirements vary between different aircraft types 6.6 describe the design features that contribute to stability 6.7 explain what 'control' is with reference to conventional aircraft 6.8 explain 'instinctive control' 6.9 explain the principles of balancing control surfaces 6.10 explain the purpose of lift augmentation devices 6.11 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

Guidance

This unit provides a basic knowledge of parts of the syllabus for the EASA 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

UAN:	**H/503/0899**
Level:	2
Credit value:	11
GLH:	100
Relationship to NOS:	This unit is endorsed by SEMTA.
Endorsement by a sector or regulatory body:	This unit is linked to the Level 2 Aeronautical Engineering NOS Unit 2
Aim:	To provide learners with a basic understanding of airframe construction and their associated systems.

Learning outcome
The learner will: 1. know the concepts of airframe structures and components
Assessment criteria
The learner can: 1.1 explain the need for structural strength 1.2 describe the construction methods used for airframe and major components 1.3 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: 2. understand the operation of aircraft hydraulic power systems
Assessment criteria
The learner can: 2.1 describe aircraft hydraulic power systems 2.2 describe the properties of hydraulic fluids 2.3 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: 3. understand the operation of aircraft flight control systems
Assessment criteria
The learner can: 3.1 describe the primary flying controls used on aircraft 3.2 describe in secondary flying controls used on aircraft 3.3 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: 4. understand the operation of aircraft landing gear systems
Assessment criteria
The learner can: 4.1 describe aircraft landing gear systems 4.2 describe landing gear retraction and extension systems 4.3 describe landing gear shock absorber and damping systems 4.4 describe landing gear wheels, tyres and brakes 4.5 describe how anti-skid and auto-braking work 4.6 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: 5. understand the operation of aircraft ice and rain protection systems
Assessment criteria
The learner can: 5.1 describe how ice can form on aircraft 5.2 describe de-icing and anti icing systems 5.3 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: 6. understand the operation of aircraft oxygen and air systems
Assessment criteria
The learner can: 6.1 describe aircraft oxygen systems 6.2 describe safety precautions for working with oxygen systems 6.3 describe the sources of aircraft air supplies 6.4 describe aircraft air conditioning systems 6.5 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: 7. know aircraft interior fittings and systems
Assessment criteria
The learner can: 7.1 describe examples of the layout aircraft passenger cabins 7.2 describe air cargo handling systems 7.3 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

Guidance

This unit contains part of the syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 11 – Structures and Systems (11.4, 7, 9, 11-13, 15, 17, 21) for category A1 and A3 licences. The equivalent EASA knowledge level indicators for each of the above outcomes are listed below with an abridged description of each level:

Level 1 – "A familiarisation with the principal elements of the subject"

Level 2 – "A general knowledge of the theoretical and practical aspects of the subject"

Level 3 – "A detailed knowledge of the theoretical and practical aspects of the subject"

Outcome 1: EASA Level 1 (except 1. – EASA Level 2)

Outcome 2: EASA Level 1

Outcome 3: EASA Level 1

Outcome 4: EASA Level 2

Outcome 5: EASA Level 1

Outcome 6: EASA Level 1

Outcome 7: EASA Level 1

Note: the above list equates to the EASA requirement for category A1 and A3 licences and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject

Unit 215 Aviation mathematics and science for technicians

UAN:	**R/503/0980**
Level:	3
Credit value:	8
GLH:	70
Relationship to NOS:	This unit is endorsed by SEMTA.
Endorsement by a sector or regulatory body:	This unit is linked to the Aeronautical Engineering Level 3 NOS Units 155, 177 etc
Aim:	This unit aims to give the learner the maths and science knowledge in an aviation context to allow further study of aircraft manufacturing and maintenance practices.

Learning outcome
The learner will: 1. be able to use principles of arithmetic
Assessment criteria
The learner can: 1.1 define arithmetical terms 1.2 use standard operators on arithmetical expressions 1.3 calculate the LCM and HCF of arithmetical expressions 1.4 use basic operators on fractions 1.5 convert between fraction, decimal and percentage values 1.6 simplify fractions by cancelling 1.7 distinguish between ratio and proportion 1.8 calculate percentage values for common engineering variables 1.9 calculate by manipulating simple arithmetic ratios 1.10 distinguish between direct and inverse proportion 1.11 calculate the constant of proportionality for arithmetical expressions. 1.12 define types of decimal values 1.13 distinguish between ‘significant figures’ and ‘decimal places’ 1.14 convert numbers to standard form 1.15 manipulate arithmetic expressions in standard form 1.16 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: 2. be able to use SI, imperial and us customary units
Assessment criteria
The learner can: 2.1 define the base SI units of measurement 2.2 define the base Imperial units of measurement 2.3 convert base and derived units between Imperial, US Customary and SI units 2.4 calculate derived unit conversion factors using base units 2.5 explain the terms 'relative error' and 'absolute error' 2.6 apply error arithmetic to experimental data 2.7 convert aircraft fuel loads between US Customary, Imperial and SI units 2.8 convert system pressures between Imperial and SI units 2.9 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: 3. be able to manipulate algebraic expressions and formulae using standard techniques
Assessment criteria
The learner can:

3.1 factorise algebraic expressions 3.2 define 'algebraic expression', 'equation' and 'identity' 3.3 simplify expressions containing brackets, powers and roots 3.4 solve simultaneous equations 3.5 solve second degree equations 3.6 evaluate aeronautical and scientific formulae by substituting data 3.7 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 Temperature and heat

Learning outcome
The learner will: 4. be able to calculate physical properties of common two and three dimensional shapes
Assessment criteria
The learner can: 4.1 define the components of a circle 4.2 solve problems related to dimensions of a circle

4.3 create geometrical constructions
4.4 use coordinate systems
4.5 use formulae to calculate dimensions of plane figures
4.6 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: 5. be able to use graphs to determine values and solve engineering problems
Assessment criteria
The learner can: 5.1 select scales and origins for graph axes 5.2 extract values from graphs 5.3 extrapolate linear graphs to determine x and y intercepts 5.4 determine y, x, m and c from linear equations and graphs 5.5 solve graphically pairs of simultaneous equations 5.6 recognise graphical representations of sine and cosine waveforms 5.7 determine data values from graphs and tables 5.8 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: 6. understand the nature of matter
Assessment criteria
The learner can: 6.1 explain the kinetic theory of matter 6.2 identify common engineering chemical elements by name and symbol 6.3 explain the three basic states of matter and the changes of state of common substances 6.4 explain the three main bonds at molecular level 6.5 describe the nature of molecules found in metals and non-metals 6.6 explain the difference between heat and temperature 6.7 explain the relationship between the common temperature scales 6.8 convert temperature values between the common temperature scales 6.9 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: 7. understand principles of statics
Assessment criteria
The learner can: 7.1 identify forces represented graphically as vectors 7.2 explain the concept of equilibrium 7.3 define the meaning of 'the moment of a force about a point' 7.4 define centre of gravity 7.5 solve problems involving straight levers, bell cranks and aircraft loading 7.6 solve problems graphically using the 'triangle of forces' theorem 7.7 solve problems graphically using the 'parallelogram of forces' theorem 7.8 define pressure and its units 7.9 explain the difference between gauge pressure and absolute pressure 7.10 solve problems involving atmospheric, gauge and absolute pressures 7.11 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: 8. understand principles of linear, angular and oscillating motion related to aircraft in flight
Assessment criteria
The learner can: 8.1 define speed, velocity and acceleration 8.2 state Newton's Laws of Motion 8.3 explain the relationships F = ma and W = mg 8.4 define the equations of linear motion for constant acceleration

8.5 solve problems related to an aircraft in flight
8.6 define basic terms for angular motion
8.7 define terms for oscillating motion
8.8 explain simple harmonic motion in terms of mass-spring and simple pendulum systems
8.9 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: 9. understand principles of dynamics related to aircraft in flight
Assessment criteria
The learner can: 9.1 define terms relating to simple machines 9.2 solve problems involving simple machines 9.3 explain terms related to gyroscopic motion 9.4 define work and power 9.5 define common forms of energy 9.6 explain the concept of the conservation of energy 9.7 solve simple problems involving potential and kinetic energy 9.8 explain terms related to friction 9.9 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: 10. understand principles of fluid motion related to aircraft in flight
Assessment criteria
The learner can: 10.1 explain density and relative density (specific gravity) 10.2 solve simple problems involving changing altitude 10.3 explain viscosity 10.4 describe the effects of streamlining on the properties of air over an aerofoil surface 10.5 explain Bernoulli's Principle for a non-viscous fluid 10.6 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

Guidance

This unit contains the complete syllabus of EASA 2042/2003 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 equivalent EASA knowledge level indicators for each of the above outcomes are listed below with an abridged description of each level:

Level 1 – "A familiarisation with the principal elements of the subject"

Level 2 – "A general knowledge of the theoretical and practical aspects of the subject"

Level 3 – "A detailed knowledge of the theoretical and practical aspects of the subject"

Outcome 1: EASA Level 2
Outcome 2: EASA Level 2
Outcome 3: EASA Level 2 (3.1-3) EASA Level 2 (3.4-7)
Outcome 4: EASA Level 2 (except – EASA Level 1)
Outcome 5: EASA Level 2
Outcome 6: EASA Level 1 (except 6.6-8 – EASA Level 2)
Outcome 7: EASA Level 2
Outcome 8: EASA Level 2
Outcome 9: EASA Level 2
Outcome 10: EASA Level 2

Note: the above list equates to the EASA requirement for category B licences and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject.

Unit 005 Fundamentals of aerodynamics

UAN:	**T/503/0857**
Level:	2
Credit value:	5
GLH:	40
Relationship to NOS:	This unit is linked to the Aeronautical Engineering Level 2 NOS Units 006, 007
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by SEMTA
Aim:	This unit aims 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 EASA Part-66 Module 8 for the category A licences.

Learning outcome
The learner will: 1. know the basic properties of the earth's atmosphere
Assessment criteria
The learner can: 1.1 describe the basic nature and composition of the Earth's atmosphere 1.2 describe the main layers of the Earth's atmosphere 1.3 use the basic gas laws make calculations 1.4 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: 2. understand the nature of airflow around aerodynamic bodies
Assessment criteria
The learner can: 2.1 describe the main properties of airflow 2.2 describe how air flows around an aerodynamic body 2.3 explain how an aerofoil stalls and the effect a stall has on an aircraft in flight 2.4 describe the main characteristics of symmetrical and cambered aerofoils 2.5 describe how the airflow around aerofoils changes with angle of attack and velocity 2.6 explain how lift and drag affect aircraft performance 2.7 explain qualitatively how lift and drag can vary 2.8 explain how a high lift device alters the flow characteristics of an aerofoil 2.9 explain how the total drag of an aircraft is generated 2.10 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: 3. know the characteristics of the basic wing planforms
Assessment criteria
The learner can: 3.1 describe the basic wing planforms and their typical applications 3.2 calculate dimensions for each basic wing planform 3.3 describe the airflow over each basic wing planform 3.4 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: 4. understand basic aircraft control using primary control surfaces
Assessment criteria
The learner can: 4.1 explain the relationship between the four main forces acting on an aircraft 4.2 explain the meaning of 'aircraft control' 4.3 describe the operation and effect of the primary aircraft control surfaces

4.4	explain the term ‘flight envelope’
4.5	describe typical aircraft performance in different phases of flight
4.6	describe how turning flight is related to the stall
4.7	describe how turning flight changes the loading on an airframe
4.8	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: 5. understand the nature of aircraft stability
Assessment criteria
The learner can: 5.1 explain the nature of aircraft flight stability 5.2 relate the three aircraft axes to different types of stability 5.3 explain the differences between statically stable, unstable and neutral aircraft 5.4 describe major components on an aircraft that affect stability in flight 5.5 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: 6. know the purpose and operation of a range of secondary control surfaces
Assessment criteria
The learner can: 6.1 describe the secondary effects of roll and yaw and methods of overcoming them 6.2 describe the arrangement and operation of alternative and combined flying controls 6.3 describe the general flow characteristics of high lift devices 6.4 compare the performance of trailing edge high-lift devices 6.5 describe the aerodynamic problems caused by asymmetric flap operation 6.6 compare the performance of leading edge high-lift devices 6.7 describe the purpose and operation of stall strips/wedges 6.8 describe common methods of boundary layer control 6.9 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.

Unit 005 Fundamentals of aerodynamics

Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 8 – Basic Aerodynamics for A Category licenses. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the A category - are listed below with an abridged description of each level:

Level 1 – "A familiarisation with the principal elements of the subject"

Level 2 – "A general knowledge of the theoretical and practical aspects of the subject"

Level 3 – "A detailed knowledge of the theoretical and practical aspects of the subject"

Outcome 1: EASA Level 1
Outcome 2: EASA Level 1
Outcome 3: EASA Level 1
Outcome 4: EASA Level 1
Outcome 5: EASA Level 1
Outcome 6: EASA Level 1

Note: the above list equates to the EASA requirement for category A licences and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject.

Appendix 1 Relationships to other qualifications

Literacy, language, numeracy and ICT skills development

This qualification can develop skills that can be used in the following qualifications:

- Functional Skills (England) – see **www.cityandguilds.com/functionalskills**
- Essential Skills (Northern Ireland) – see **www.cityandguilds.com/essentialskillsni**
- Essential Skills Wales – see **www.cityandguilds.com/esw**

Appendix 2 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 **Centres and Training Providers homepage** on **www.cityandguilds.com**.

Centre Manual - Supporting Customer Excellence contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:

- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

Our Quality Assurance Requirements encompasses all of the relevant requirements of key regulatory documents such as:

- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

and sets out the criteria that centres should adhere to pre and post centre and qualification approval.

Access to Assessment & Qualifications 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 homepage** section of the City & Guilds website also contains useful information such on such things as:

- **Walled Garden:** how to register and certificate candidates on line
- **Events**: dates and information on the latest Centre events
- **Online assessment**: how to register for e-assessments.

Centre Guide – Delivering International Qualifications contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Useful contacts

UK learners **General qualification information**	**T: +44 (0)844 543 0033** **E: learnersupport@cityandguilds.com**
International learners General qualification information	T: +44 (0)844 543 0033 F: +44 (0)20 7294 2413 E: **intcg@cityandguilds.com**
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: **centresupport@cityandguilds.com**
Single subject qualifications Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 F: +44 (0)20 7294 2404 (BB forms) E: **singlesubjects@cityandguilds.com**
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: **intops@cityandguilds.com**
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: **walledgarden@cityandguilds.com**
Employer Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 E: **business@cityandguilds.com**
Publications Logbooks, Centre documents, Forms, Free literature	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413

If you have a complaint, or any suggestions for improvement about any of the services that we provide, email: feedbackandcomplaints@cityandguilds.com

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The City & Guilds Group operates from three major hubs: London (servicing Europe, the Caribbean and Americas), Johannesburg (servicing Africa), and Singapore (servicing Asia, Australia and New Zealand). The Group also includes the Institute of Leadership & Management (management and leadership qualifications), City & Guilds Land Based Services (land-based qualifications), the Centre for Skills Development (CSD works to improve the policy and practice of vocational education and training worldwide) and Learning Assistant (an online e-portfolio).

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