QUALIFICATION HANDBOOK

Level 3 Diploma On-Aircraft Maintenance Category A (2675-04)

July 2018 Version 4.0

City & Guilds

Qualification at a glance

Subject area	Aeronautical Engineering
City & Guilds number	2675-04
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 for this qualification is suitable for applicants who have five GCSEs grades C and above in English, Maths and Science.
Assessment	Multiple Choice test, Short-Answer examination
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 3 Diploma for On-Aircraft Maintenance Category A	595	720	2675-04	600/1927/X

Version and date	Change detail	Section
3.1 July 2013	Amended Unit 006, 007 and 009	**Units**
3.2 Jan 2014	Inserted note to centres	**Assessment**
3.3 September 2017	Added TQT details Deleted QCF	**Qualification at a glance and Structure** **Throughout**
4.0 July 2018	Amended range to Unit 006 to insert updated regulation references in the range. TQT section updated with an additional explanation paragraph	**Units** **Structure**

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 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 skills 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 Engineering Manufacture apprenticeship framework.
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

Learners require a minimum total of 72 credits to achieve the Level 3 Diploma for On Aircraft Maintenance - Category A. Learners must achieve 47 credits from the Mandatory Units, **plus the required minimum from either of the following pathways:** 31 credits from Category A1, **or** 31 credits from Category A2 **or** 25 credits from Category A3 **or** 25 credits from Category A4.

Mandatory Units

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
H/503/0806	Unit 001	Fundamentals of aviation mathematics and science	5
A/503/0813	Unit 002	Fundamentals of aircraft electrics, digital techniques and electronic instrument systems	5
R/503/0817	Unit 003	Fundamentals of Aircraft Materials and Hardware	11
K/503/0824	Unit 004	Fundamentals of Aircraft Maintenance Practices	11
T/503/0857	Unit 005	Fundamentals of Aerodynamics	5
A/503/0858	Unit 006	Fundamentals of Civil Aviation Legislation	5
M/503/1263	Unit 035	Human factors in aviation	5

Category A1 – Aeroplanes (Turbine)

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
J/503/1091	Unit 007	Fundamentals of aircraft aerodynamics, structures and systems for turbine engines	12
M/503/1103	Unit 010	Fundamentals of aircraft gas turbine engines	13
F/503/0859	Unit 012	Fundamentals of aircraft propellers	6

Category A2 – Aeroplanes (Piston)

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
M/503/1098	Unit 008	Fundamentals of Aircraft Aerodynamics, Structures and Systems for Piston Engines	12
T/503/1104	Unit 011	Fundamentals of Aircraft Piston Engines	13
F/503/0859	Unit 012	Fundamentals of aircraft propellers	6

Category A3 – Helicopters (Turbine)

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
H/503/1101	Unit 009	Fundamentals of Helicopter Aerodynamics, Structures and Systems	12
M/503/1103	Unit 010	Fundamentals of aircraft gas turbine engines	13

Category A4 – Helicopters (Piston)

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
H/503/1101	Unit 009	Fundamentals of Helicopter Aerodynamics, Structures and Systems	12
T/503/1104	Unit 011	Fundamentals of Aircraft Piston Engines	13

Total Qualification Time

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

TQT is comprised of the following two elements:

1) The number of hours which an awarding organisation has assigned to a qualification for Guided Learning, and
2) an estimate of the number of hours a Learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by - but, unlike Guided Learning, not under the Immediate Guidance or Supervision of - a lecturer, supervisor, tutor or other, appropriate provider of education or training.

Title and level	GLH	TQT
Level 3 Diploma for On-Aircraft Maintenance Category A	595	720

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 3, centres already delivering the City & Guilds Certificate in aeronautical Engineering (2661) will be automatically approved to run this new qualification at both levels 2 and 3.

To offer this qualification, new centres will need to gain both centre and qualification approval. Please refer to the *Centre Manual - Supporting Customer Excellence* 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 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 A to C 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.

Please note: A note to Centres regarding CAA exams with a pass mark of 75% ('A' licence grade). Where a Learner has achieved a mark of between 65% and 74% on any of these exams, the centre can still claim the City & Guilds equivalent unit.

Centres as normal, should complete the results entry process using the equivalent City & Guilds units from 2675-04 via the Walled Garden. For external quality assurance purposes a record of the CAA exam results must be kept within the Learners portfolio.

Mandatory Units

City & Guilds unit number	Unit title	Assessment method
2675-001	Fundamentals of aviation mathematics and science	Online
2675-002	Fundamentals of aircraft electrics, digital techniques and electronic instrument systems	CAA
2675-003	Fundamentals of Aircraft Materials and Hardware	CAA
2675-004	Fundamentals of Aircraft Maintenance Practices	CAA
2675-005	Fundamentals of Aerodynamics	CAA
2675-006	Fundamentals of Civil Aviation Legislation	CAA
2675-007	Fundamentals of aircraft aerodynamics, structures and systems for turbine engines	CAA
2675-008	Fundamentals of Aircraft Aerodynamics, Structures and Systems for Piston Engines	CAA
2675-009	Fundamentals of Helicopter Aerodynamics, Structures and Systems	CAA

City & Guilds unit number	Unit title	Assessment method
2675-010	Fundamentals of aircraft gas turbine engines	CAA or Short-Answer
2675-011	Fundamentals of Aircraft Piston Engines	CAA
2675-012	Fundamentals of aircraft propellers	CAA or Short-Answer
2675-035	Human factors in aviation	Online

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.

Time constraints

Timings for e-assessments are indicated in the test specifications. 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 or short-answer test is laid out in the tables below:

Test 1: Unit 001 Fundamentals of Aviation Mathematics and Science
Duration: 70 minutes

Outcome	Number of questions	%
01 Be able to use arithmetic and algebra to solve problems	7	15
02 Be able to use simple graphs	3	6
03 Know Imperial, SI and US Customary units used in aeronautical engineering	4	9

04 Know the nature of matter	3	7
05 Know principles of Statics	8	18
06 Know principles of Kinetics	4	9
07 Know principles of Dynamics	7	16
08 Know principles of Fluid Dynamics	4	9
09 Know properties of the Earth's atmosphere.	5	11
Total	**45**	**100**

Test 2: Unit 010 Fundamentals of aircraft gas turbine engines
Duration: 60 minutes

Outcome	**Number of questions**	**%**
01 Understand the fundamental principles of aircraft gas turbine engines	4	14
02 Understand the operation of gas turbine engines	5	20
03 Understand gas turbine fuels, lubricants and associated systems	4	16
04 Understand gas turbine starting, ignition and air systems	2	8
05 Understand gas turbine engine indication systems	3	12
06 Understand auxiliary power units and power-plant installations	2	8
07 Understand gas turbine engine monitoring, fire protection and ground operation	5	20
Total	**25**	**100**

Test 3: Unit 012 Fundamentals of aircraft propellers
Duration: 60 minutes

Outcome	**Number of questions**	**%**
01 Understand propeller theory	7	33
02 Understand propeller construction	3	15

03 Understand propeller pitch control	3	15
04 Understand propeller ice and rain protection systems	2	10
05 Understand propeller maintenance, storage and preservation	5	27
Total	**20**	**100**

Test 4: 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**

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 001 Fundamentals of aviation mathematics and science

Level: 2
Credit value: 5
UAN: H/503/0806

Unit aim

The aim of this unit is to give learners a solid grounding in basic mathematics and science to enable further aeronautical engineering studies.

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will:

1. be able to use arithmetic and algebra to solve problems
2. be able to use simple graphs
3. know Imperial, SI and US Customary units used in aeronautical engineering
4. know the nature of matter
5. know principles of statics
6. know principles of kinetics
7. know principles of dynamics
8. know principles of fluid dynamics
9. know properties of the Earth's atmosphere.

Guided learning hours

It is recommended that **40** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 2 NOS Units 002, 014 etc.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number

Assessment and grading

This unit will be assessed by:

- A multiple –choice test covering underpinning knowledge.

Unit 001 Fundamentals of aviation mathematics and science

Outcome 1 Be able to use arithmetic and algebra to solve problems

Assessment Criteria

The learner can:

1. perform arithmetical calculations using whole numbers
2. prioritise basic functions within arithmetical calculations
3. manipulate fractions and decimals to solve problems
4. manipulate ratios, proportions, averages and percentages to solve problems
5. calculate areas and volumes
6. calculate simple powers of numbers
7. manipulate simple algebraic expressions.

Range/Scope/Unit content

List 1

Add
Subtract
Multiply
Divide
Positive and negative whole numbers

List 2

Using BODMAS

List 3

Simplify and solve problems
Understand numerator, denominator
Reduce fractions
Convert between mixed numbers and improper fractions
Add, subtract, multiply, divide fractions
Define 'decimal'
Express values to given number of decimal places
Add, subtract, multiply, divide decimals
Convert between decimals and fractions
Make calculations using simple decimals and fractions

List 4

Simplify and solve problems
Explain percentages
Convert percentages to decimals and fractions and vice versa
Explain 'ratio' and 'proportion'
Make simple engineering calculations involving ratios and proportion

List 5

Importance of units

State and use formulae for areas of:

- Triangle
- Rectangle
- Circle

State and use formulae for volumes of:

- Triangular prisms
- Rectangular boxes
- Cylinders

List 6

Squares

Square roots

Cubes

Cube roots

In conjunction with areas and volumes

List 7

Simplify, change the form of and evaluate first order algebraic expressions:

Add, subtract, multiply, divide

Use of brackets

Simple algebraic fractions.

Unit 001 Fundamentals of aviation mathematics and science

Outcome 2 Be able to use simple graphs

Assessment Criteria

The learner can:

1. describe the basic principles of graphical representation
2. identify graphs of simple equations and common functions
3. extract data from graphs used in aeronautical engineering.

Range/Scope/Unit content

List 1

Axes
Grid lines
Origin
Scales
Calculating key values
Plotting graphs

List 2

Eg:
$y = mx + c$
sine wave
square wave

List 3

Eg:
ICAO temp/altitude
Fuel data
Engine performance

Unit 001 Fundamentals of aviation mathematics and science

Outcome 3 Know Imperial, SI and US Customary units used in aeronautical engineering

Assessment Criteria

The learner can:

1. state base and derived SI units and representative symbols
2. state the meaning of prefixes used with SI units
3. state Imperial units and representative symbols
4. state US customary units used in aviation
5. convert between Imperial, US customary and SI units.

Range/Scope/Unit content

List 1

Explain:
Base
Derived
State base units and symbols:
Time
Length
Mass
Temperature
Current
State derived units and symbols:
Area
Volume
Density
Acceleration
Force
Pressure
Inertia
Impulse
Momentum
Torque
Energy (work)
Power
Voltage
Resistance
Frequency
Explain the relationship between Kelvin and degrees Celsius
Specific Gravity as a ratio

List 2
State meaning of prefixes and identify symbols:
Micro
Mili
Kilo
Mega
Convert between prefixes

List 3
Including US gallons and US (short) ton
Length
Mass
Velocity
Temperature (Centigrade, Kelvin, Fahrenheit)
Pressure
Volume
Torque

List 4
Convert between:
Centimetres and inches
Kilograms to pounds
Litres to gallons (Imperial and US)
US to UK gallons
Litres to kilograms
lbf to Nm.

Unit 001 Fundamentals of aviation mathematics and science

Outcome 4 Know the nature of matter

Assessment Criteria

The learner can:

1. describe the structure of atoms
2. explain concepts of chemical elements
3. explain concepts of chemical compounds
4. define the three 'classical' states of matter
5. explain how matter changes between states.

Range/Scope/Unit content

List 1

Simple explanation of:
Proton
Neutron
Electron
Nucleus
Atom

List 2

Simple explanations:
Define 'element'
How elements are different from one another
Basic element structure

List 3

Simple explanations:
Define compound, mixture
Chemical bonds
Explain 'molecule'

List 4

Solid
Liquid
Gas

List 5

Eg:
Constant temperature
Volume changes (especially expansion of water when frozen)
Physical behaviour of molecules
Latent heat.

Unit 001 Fundamentals of aviation mathematics and science

Outcome 5 Know principles of Statics

Assessment Criteria

The learner can:

1. explain forces, moments and couples
2. make simple calculations involving forces, moments and couples
3. explain equilibrium and centre of gravity
4. make calculations involving equilibrium and centre of gravity
5. explain stress, strain and elasticity, compression, shear and torsion
6. describe properties of solids, liquids and gases
7. explain pressure and buoyancy in liquids
8. solve problems involving pressure in liquids.

Range/Scope/Unit content

List 1

Define:

Force

Moment

Couple

Vector

How forces, moments and couples can be represented as vectors using simple diagrams

List 2

Using SI units only

Force

Perpendicular distance

Simple calculations for: force, moments, couples

List 3

Using two forces

List 4

Simple calculations involving two forces

List 5

Define and explain the basics of: stress, strain, elasticity, compression, shear, torsion

List 6

Basic properties eg:

Shape, viscosity, volume, compressibility

List 7

Define:
Buoyancy
Explain the relationship between density, mass and volume
Specific gravity
Explain how barometers work
Upward thrust on a body in a fluid

List 8

Including measurement of pressure using a simple barometer
Pressure at depth in a fluid.

Unit 001 Fundamentals of aviation mathematics and science

Outcome 6 Know principles of Kinetics

Assessment Criteria

The learner can:

1. explain basic principles of linear motion
2. explain basic principles of rotational movement
3. explain basic principles of periodic motion
4. explain properties of simple mechanical systems.

Range/Scope/Unit content

List 1

Explain and use basic principles:
Uniform motion in a straight line
Velocity
Momentum
Linear motion under constant acceleration (eg: gravity)
Make simple calculations involving linear motion

List 2

Explain and use basic principles:
Uniform circular movement
Centrifugal/centripetal forces
Make simple calculations involving rotational motion

List 3

Explain and use basic principles:

- Define pendular movement

Simple theory of:

- Vibration
- Harmonics
- Resonance

List 4

Explain and use basic principles:
Define:
Velocity ratio
Mechanical advantage
Efficiency
Make simple calculations involving simple mechanical systems.

Unit 001 Fundamentals of aviation mathematics and science

Outcome 7 Know principles of dynamics

Assessment Criteria

The learner can:

1. explain principles of dynamics involving mass, force and inertia
2. explain principles of dynamics involving energy, work and power
3. explain principles of dynamics involving heat
4. explain principles of dynamics involving efficiency
5. explain principles of dynamics involving momentum and impulse
6. explain gyroscopic principles
7. explain basic principles of dynamics involving friction.

Range/Scope/Unit content

List 1

Explain and use the basic principles:
Units
Make simple calculations for mass and force only

List 2

Explain and use the basic principles:
Units
Make simple calculations

List 3

Explain and use the basic principles:
Units
Conduction
Radiation

List 4

Explain and use the basic principles:

List 5

Explain and use the basic principles:
Units
Make simple calculations involving momentum

List 6

Explain:
The purpose of a gyroscope
Application in aircraft
Component parts of a basic gyroscope: spinning mass, gimbals etc
Precession
Safety precautions for working with gyroscopic equipment

List 7

Basic principles
Units
Make simple calculations.
Static Friction
Dynamic Friction
Co-efficient of Friction

Unit 001 Fundamentals of aviation mathematics and science

Outcome 8 Know principles of fluid dynamics

Assessment Criteria

The learner can:

1. make calculations using the specific gravity and density of a fluid
2. explain principles of viscosity, fluid resistance and the effects of streamlining
3. explain principles and effects of compressibility in a fluid
4. explain principles of types of fluid pressure
5. explain the principles of a venturi.

Range/Scope/Unit content

List 1

Explain basic principles
Units/lack of units
Simple calculations involving aircraft fuel and other fluids

List 2

Explain basic principles
Units

List 3

Explain basic principles
Units
Include qualitative effects of contaminants such as water in hydraulic oil

List 4

Explain basic principles of:
Static
Dynamic
Total
Units

List 5

Basic principles
Including an explanation of the simplified form of Bernoulli's Theorem

Unit 001 Fundamentals of aviation mathematics and science

Outcome 9 Know properties of the Earth's atmosphere

Assessment Criteria

The learner can:

1. describe the relationship between the three main temperature scales
2. define the term 'heat' and how it relates to temperature
3. describe the composition and structure of the Earth's atmosphere
4. explain how pressure, density and temperature vary with altitude
5. explain pressure terms
6. explain the need for a standard atmosphere.

Range/Scope/Unit content

List 1

Fahrenheit
Centigrade
Kelvin
Absolute zero

List 2

Using simple illustrations

List 3

Percentages of gases
Layers of the atmosphere

List 4

Including the effects at the Tropopause
ISA graphs

List 5

Explain and illustrate their relationship using simple examples
Atmospheric pressure
Absolute pressure
Differential pressure

List 6

Eg:
Standard measurements, particularly of altitude
Standardisation of instruments/displays
Engine performance.

Unit 001 Fundamentals of aviation mathematics and science

Notes for guidance

This unit contains the complete syllabus of the European Aviation Safety Agency EASA 2042/2003 part 66 Basic Knowledge Requirements ('Part 66') Module 1 – Maths and Module 2 - Science for category 'A' 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
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
Outcome 7: EASA Level 1
Outcome 8: EASA Level 1 (except 9.1 – EASA Level 2)
Outcome 9: EASA Level 1

Note 1: 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.

Note 2: Both UK and US Imperial units should be taught because they are both in regular use in the aviation industry and their misuse has severe safety implications.

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Level: 3
Credit value: 5
UAN: A/503/0813

Unit aim

This unit aims to give the learner an understanding of the fundamental principles of aircraft electrical systems. It contains the complete syllabi of EASA Part-66 Modules 3 and 5 for category A licences.

Learning outcomes

There are **seven** learning outcomes to this unit. The learner will:

1. understand basic electron theory, static electricity and conduction
2. understand common electrical terminology
3. understand how electricity can be generated
4. understand DC sources of electricity in aircraft
5. understand fundamental AC theory
6. understand aircraft electronic instrument systems
7. understand computer terminology and aircraft computer technology
8. know the special handling techniques associated with electrostatic sensitive device.

Guided learning hours

It is recommended that **40** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 3 NOS Units 120, 134 etc.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- A written examination covering underpinning knowledge.

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Outcome 1 Understand basic electron theory, static electricity and conduction

Assessment Criteria

The learner can:

1. describe the structure and distribution of electrical charges in particles of matter
2. describe the molecular structure of electrical materials
3. explain the nature of static electricity
4. explain the electrostatic laws of attraction and repulsion
5. explain how static electricity can be quantified
6. describe electrostatic build-up on aircraft surfaces
7. explain how electricity flows through various media.

Range/Scope/Unit content

List 1

Overview of structure and distribution of electrical charges in: atoms, molecules, ions and compounds, sufficient to allow understanding of the concepts in the remaining outcomes

List 2

Overview of the molecular structure of: conductors, semiconductors and insulators

List 3

Overview of:

How static electricity is created

The structure and distribution of electrostatic charges

The levels of voltage involved in a static discharge

Potential damage in and around aircraft in flight and on the ground

List 4

Qualitative explanation

List 5

Simple explanation of: units of charge, Coulomb's Law

List 6

How static charge builds up and where

Measures to prevent it doing harm eg:

- Bonding
- Wick dischargers
- Conductive tyres
- Special paints etc.

List 7

Simple explanation of conduction in solids, liquids, gases and vacuum.

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Outcome 2 Understand common electrical terminology

Assessment Criteria

The learner can:

1. explain terminology associated with voltage
2. explain terminology associated with current
3. explain terminology associated with resistance
4. explain terminology associated with electrical charge.

Range/Scope/Unit content

List 1

Basic definition, units and factors affecting: potential difference, electromotive force

List 2

Basic definition, units and factors affecting: current, conventional current flow, electron flow

List 3

Basic definition, units and factors affecting: resistance, conductance

List 4

Basic definition, units and factors affecting electrical charge.

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Outcome 3 Understand how electricity can be generated

Assessment Criteria

The learner can:

1. describe in simple terms common methods of electricity generation
2. describe basic principles how electricity is generated in aircraft.

Range/Scope/Unit content

List 1

Basic explanation of:
Light
Heat
Friction
Pressure
Chemical action
Magnetism and motion

List 2

Basic explanation of principles:
Light eg: photo-electric cell to control lighting levels
Heat eg: thermocouples, fire wires etc.
Friction eg: Static
Pressure eg: Piezo-electricity
Chemical action eg: aircraft battery
Magnetism and motion eg: aircraft generator.

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Outcome 4 Understand DC sources of electricity in aircraft

Assessment Criteria

The learner can:

1. describe the basic construction of battery cells
2. describe how battery cells can be connected in a system
3. explain what internal resistance is and how it affects the performance of the battery
4. describe the construction and operation of a thermocouple
5. describe the construction and operation of a photocell.

Range/Scope/Unit content

List 1

Construction and basic chemical action of:
Primary cells
Secondary cells
Lead acid cells liquid and gel
Nickel cadmium cells
Other alkaline cells (eg: re-chargeable dry cells)

List 2

Methods and reasons for connecting in:
Series
Parallel

List 3

Qualitative explanation only

List 4

Basic explanation of:
Materials
Construction
Operation

List 5

Basic explanation of:
Materials
Construction
Operation.

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Outcome 5 Understand fundamental AC theory

Assessment Criteria

The learner can:

1. describe the main features of sinusoidal waveforms
2. explain how voltage, current and power values are calculated
3. describe the main features of triangular and square waveforms
4. explain the qualitative principles of single and 3-phase supplies.

Range/Scope/Unit content

List 1

Phase
Period
Frequency
Cycle

List 2

Simple explanation and calculations
Instantaneous
Average
Root mean square
Peak
Peak to peak

List 3

Phase
Period
Frequency
Cycle

List 4

Using simple waveform diagrams
Standard 3-phase aircraft supply voltages and frequencies
Derived single phase supply values

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Outcome 6 Understand aircraft electronic instrument systems

Assessment Criteria

The learner can:

1. explain reasons for the ergonomic layout of typical aircraft flight decks or cockpits
2. describe the system arrangement for typical primary flight displays (PFD)
3. describe system arrangements for typical multi-function displays (MFD)
4. describe system arrangements for typical engine indicating and crew alerting systems (EICAS).

Range/Scope/Unit content

List 1

Eg: information priorities, ease of access, minimum distraction, positioning of information sources

List 2

Block diagram level of: information sources, major components, cockpit layout, alerting methods

List 3

Block diagram level of: information sources, major components, cockpit layout, alerting methods

List 4

Block diagram level of: information sources, major components, cockpit layout, alerting methods.

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Outcome 7 Understand computer terminology and aircraft computer technology

Assessment Criteria

The learner can:

1. explain common computer technology
2. describe computer technology used in aircraft systems.

Range/Scope/Unit content

List 1

Including: bit, byte, software, hardware, CPU, IC, RAM, ROM, PROM, EPROM, flash memory, CD/DVD, storage, input, output

List 2

Basic knowledge of eg: data bus, multiplexer, encoder, decoder, redundancy, duplex, triplex, quadruplex, navigation computer, air data computer, controller, ARINC data bus standards

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Outcome 8 Know the special handling techniques associated with Electrostatic Sensitive Devices

Assessment Criteria

The learner can:

1. describe what is meant by an electrostatic sensitive device
2. describe the damage that could be caused to an SSD by static discharge
3. describe the protection that can be applied to devices and precautions that can be taken by personnel to prevent static damage.

Range/Scope/Unit content

List 1

Basic description

List 2

Eg: size of voltage generated in a discharge, types of discharge, immediate complete failure, delayed failure, intermittent failure, reduced performance

List 3

Eg: in-built protection by design, external in-circuit protection, shielding

Handling precautions, earthing straps, grounded mats and work surfaces.

Unit 002 Fundamentals of aircraft electricals, digital techniques and electronic instrument systems

Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 3 – Electrical Fundamentals and Module 4 - Digital Techniques Electronic Instrument Systems for the Category A 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
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
Outcome 7: EASA Level 1
Outcome 8: 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 003 Fundamentals of aircraft materials and hardware

Level: **2**
Credit value: **11**
UAN: **R/503/0817**

Unit 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 outcomes

There are **ten** learning outcomes to this unit. The learner will:

1. know the properties of aircraft ferrous materials
2. know the properties of aircraft non-ferrous materials
3. know the properties of advanced, composite and other non-metallic materials
4. know wood and fabric airframe construction
5. know corrosion in aircraft materials
6. know aircraft fasteners
7. know aircraft pipes, unions and fittings
8. know aircraft bearings
9. know aircraft transmission systems and control cable mechanisms
10. know aircraft electrical cables and connectors.

Guided learning hours

It is recommended that **90** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 3 NOS Units 013, 144 etc

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Improving Own Learning and Performance

Assessment and grading

This unit will be assessed by:

- A written examination covering knowledge and understanding.

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 1 Know the properties of aircraft ferrous materials

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 2 Know the properties of aircraft non-ferrous materials

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 3 Know the properties of composite and other non-metallic materials

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 4 Know wood and fabric airframe construction

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 5 Understand corrosion in aircraft materials

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 6 Understand aircraft fasteners

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 7 Know aircraft pipes, unions and fittings

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 8 Know aircraft bearings

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 9 Know aircraft transmission systems and control cable mechanisms

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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

Unit 003 Fundamentals of aircraft materials and hardware

Outcome 10 Know aircraft electrical cables and connectors

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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

Notes for 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 004 Fundamentals of aircraft maintenance practices

Level: 3
Credit value: 11
UAN: K/503/0824

Unit aim

The aim of this unit is to provide learners with a detailed understanding of aircraft structures and maintenance practices. It covers the complete syllabus of EASA Part-66 Module 7 for category A licenses.

Learning outcomes

There are **ten** learning outcomes to this unit. The learner will:

1. understand the safety and environmental precautions required when working on aircraft and in workshops
2. understand the working practices used on aircraft and in workshops
3. understand engineering drawings, diagrams and standards of fits and clearances used on aircraft
4. understand the components and maintenance of an aircraft electrical wiring interconnection system (EWIS)
5. know the use of pipes and hoses, springs and bearings in aircraft applications
6. understand transmissions and control cables used in aircraft
7. know procedures for aircraft ground handling, maintenance and storage
8. understand disassembly, inspection, repair and assembly techniques including riveting
9. understand actions after abnormal aircraft events
10. understand maintenance procedures for safe and effective operation of aircraft

Guided learning hours

It is recommended that **90** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 3 NOS Units 303, 304 etc.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Improving Own Learning and Performance

Assessment and grading

This unit will be assessed by:

- A written examination covering underpinning knowledge.

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 1 Understand the safety and environmental precautions required when working on aircraft and in workshops

Assessment Criteria

The learner can:

1. explain legislation required whilst working on aircraft and in workshops
2. explain safe working practices used on aircraft and in workshops
3. explain actions to be taken in the event of fire or other accident.

Range/Scope/Unit content

List 1

Health and Safety legislation
Environmental protection legislation
Hazardous substance legislation

List 2

Including detailed knowledge of safe working practices associated with:
Aircraft engine intakes, exhausts and propellers
Hazards eg noise, working at height, manual handling, slips, trips falls
Electricity
High pressure gases including oxygen
Oils
Fuels
Hydraulic fluid
Chemicals (including cleaning agents, solvents, resins)
Radio wave radiation

List 3

Including detailed knowledge of:
First aid fire appliances (extinguishing agents, types of fire, how and when to use)
Applicable first aid procedures
Mains power supplies (including emergency stop switches)
Emergency evacuation from work areas

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 2 Understand the working practices and equipment used on aircraft and in workshops

Assessment Criteria

The learner can:

1. explain the care and control of tools and workshop materials
2. explain dimensions, allowances and tolerances, standards of workmanship
3. explain the calibration of tools and equipment
4. describe common hand and power tools used
5. describe the operation of precision measuring tools and equipment
6. explain lubrication equipment and methods used
7. explain the use of electrical general test equipment.

Range/Scope/Unit content

List 1

Detailed knowledge of:

Tool storage facilities

Tool control systems

Storage of oils and chemicals

Safe storage of workshop materials eg: cleaning materials, metal and non-metal sheet, oils, lubricants, paint, fasteners

List 2

Detailed knowledge of the required for aircraft maintenance tasks including: dimensions, allowances and tolerances, standards of workmanship

List 3

Detailed knowledge of:

Requirement for calibration

Calibration standards

Torque loading and torque calibration tools

Precision termination tools

Micrometers

Vernier callipers

Dial test indicators

Plug gauges

Feeler gauges

Pressure gauges

List 4
Detailed knowledge of the care and use of common hand and power tools eg:
Spanners
Sockets
Wrenches
Screwdrivers
Air tools
Electrical equipment

List 5
Detailed knowledge of measuring equipment including:
Micrometers
Vernier callipers
Dial test indicators
Plug gauges
Feeler gauges
Pressure gauges

List 6
Detailed knowledge of the care and use of:
Oil replenishment equipment
Grease guns
Types of lubricant, grades and applications

List 7
Detailed knowledge of function and use of test equipment such as: multimeters, voltmeters, power and phase meters

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 3 Understand engineering drawings, diagrams and standards of fits and clearances used on aircraft

Assessment Criteria

The learner can:

1. explain typical engineering drawings
2. identify information contained drawing title blocks
3. explain alternative methods of presenting technical information
4. describe Specification 100 of the Air transport Association (ATA) of America
5. describe alternative aeronautical standards
6. describe main features and purpose of typical wiring and schematic diagrams
7. explain drill sizes for bolts and the classes of fits
8. explain the common system of fits and clearances
9. explain the schedule of fits and clearances for aircraft and engines
10. explain limits of bow, twist and wear
11. explain the standard methods for checking shafts, bearings, and other associated parts.

Range/Scope/Unit content

List 1

Overview of:

Type of projection (First angle, third angle)

Orthographic

Isometric

ISO, AN, MS, NAS, MIL

List 2

Eg: units and dimensions, scale, title, author, issue number, date

List 3

Eg: microfilm, microfiche, computerised presentation

List 4

Overview of eg:

Organisation of chapters

Titles of chapters

Relationship to aircraft maintenance and repair manuals

How to find specific information

List 5

Overview, including: ISO, An, MS, NAS, Mil

List 6
Nil

List 7
Overview of eg: pilot drill, tapping drill, clearance drill, classes of thread fit

List 8
Basic principles of eg: ISO hole-basis fits, shaft-basis fits

List 9
Eg:
Interference, driving, push, running fits
Applications of each

List 10
Definitions of bow, twist, wear
Methods of measurement
Acceptable limits

List 11
Overview of:
Including: types of defect found in shafts, bearings etc.
Methods of checking eg: visual, static measurement using jigs, vee blocks etc.; dynamic measurement
Acceptable limits.

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 4 Understand the components and maintenance of an aircraft electrical wiring interconnection system (EWIS)

Assessment Criteria

The learner can:

1. describe techniques used to test continuity, insulation and bonding
2. describe use of hand and hydraulic operated crimp tools
3. describe how crimp joints are tested
4. describe the process of connector pin removal and insertion
5. describe the process of installing and testing co-axial cables
6. explain how types of aircraft wire are identified
7. explain the inspection criteria and damage tolerance of aircraft cable types
8. describe aircraft wiring protection techniques
9. describe wiring husbandry in EWIS installations.

Range/Scope/Unit content

List 1

Eg: continuity tester, bonding tester, automatic installation tester

List 2

Overview of:

Types of crimp end, types of tool, colour coding, ratchet devices, jaws and chucks, testing, go/no-go gauges

Preparation of cable, stripping lengths, insertion of connector into tool, correct orientation, insertion of cable, operation of tool, release of connector

Precautions for crimping aluminium cable

List 3

Eg: visual inspection, pull test, millivolt drop test

List 4

Including: selection and use of correct insertion/extraction tool, direction of insertion/extraction

List 5

Eg: selection and fitting of connectors, minimum bend radius, cable support, high and low tension

List 6

Including: solid and stranded conductors, wire size, types of insulation

Marking methods and identification codes

List 7

Types of damage (eg: cut, scuff, overheated, corrosion, chemical contamination, water ingress, broken strands etc)

Allowable damage for typical cables

List 8

Cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding

List 9

Inspection, repair, maintenance and cleanliness standards.

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 5 Know the use of pipes and hoses, springs and bearings in aircraft applications

Assessment Criteria

The learner can:

1. describe techniques for forming and fitting aircraft rigid pipes
2. describe inspection and testing of aircraft rigid pipes and flexible hoses
3. describe installation and clamping of aircraft rigid pipes
4. describe inspection and testing aircraft springs
5. describe testing, cleaning and inspection of bearings
6. describe lubrication requirements of bearings
7. describe common defects found in bearings and their causes.

Range/Scope/Unit content

List 1

Heat treatment before and after bending

Lubrication, loading and unloading filler for bending on a compression bending machine

Use of a spring instead of filler

Use of mandrel type bending machine

Radius limits

Belling/flaring process (heat treatment, preparation, use of the flaring tool, inspection for cracks, distortion etc.)

Types of flared coupling eg: AGS, AS

List 2

Eg:

Typical defects in pipe bends and flares (eg: cracks, ripples, asymmetry, splits)

Typical defects in flexible hoses eg: kinks, corrosion, damaged braiding, damaged and worn couplings and seals

Visual inspection – tell-tale signs of defects

Flaring check eg: use a coned adaptor test fitting, measurements

Bore tests eg: ball bearing, flow test

Pressure tests for hydraulic, pneumatic, oxygen: test media, test pressures and durations

Bedding-in flared couplings

Post-test cleaning, inspection and blanking

List 3

Types of coupling eg: flared, flareless, Avimo, brazed nipple, high and low pressure

Pre-installation checks

Cleanliness

Care in manoeuvring into position

Positioning in clamps to ensure correct mating and zero strain

Clamp packing

Electrical bonding

'P' clips

Clearances from surrounding structure

Connection and post-installation leak checks

Protection from accidental impact damage eg: in a cargo hold or high traffic area

List 4

Types, materials, applications, limitations, inspection and testing methods

List 5

Overview of:

Types of bearing eg: plain, roller, taper, ball, needle, self – aligning, air

Testing methods and typical limits

Cleaning methods, equipment and materials

Inspection methods

List 6

Lubrication requirements of typical bearing types and applications – installation and in-service

Lubricant type, quantity, application

List 7

Typical defects and causes

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 6 Understand transmissions and control cables used in aircraft

Assessment Criteria

The learner can:

1. explain the inspection of gears
2. explain the inspection of belts and pulleys, chains and sprockets
3. explain the inspection of screw jacks
4. explain the inspection of lever devices and push-pull rod systems
5. explain the process of swaging control cable end fittings
6. explain the inspection and testing of control cables
7. describe Bowden cables and aircraft flexible control systems.

Range/Scope/Unit content

List 1

Overview of:

Types of gear eg: helical, spur, bevel, hypoid

Method of inspection eg: visual inspection, measurement of backlash and key dimensions of the gear

Typical defects

List 2

Overview of:

Types of belt, pulley, chain, sprocket

Inspection methods: visual, mechanical, measurement

Typical defects

List 3

Overview of:

Typical types of screw jack

Inspection methods: visual, mechanical, measurement

Typical defects

List 4

Overview of:

Typical types of lever, bellcrank and pushrod systems

Main components eg: rods, turnbuckles, torque arms and tubes, universal joints

Inspection methods: visual, mechanical, measurement

Typical defects.

List 5

Overview of:

Cable construction

Handling precautions

Cutting using eg: heavy duty cable cutters, hammer and sharp chisel, pre-cut binding

Selection of swaged end fittings eg:screwed and tapped turnbarrel parts, Talurit splice

Use of portable swaging machines – swaging process including cleaning and anti-corrosion treatment

Inspection of the swaged joint – use of inspection holes, typical process defects

List 6

Overview of:

Typical defects in cables and fittings eg: corrosion, fraying, slippage

Visual inspection, signs of defects

Proof loading: use of proof-loading rig, painting of cable and swaged fittings, test load (eg: UK- 50%, US - 60% of min breaking strength), length of test, measurement of cable length

List 7

Overview of:

Bowden cable, construction and application

Types of flexible control system

Major components eg: flexible shafts, couplings, guides

Operation

Lubrication

Inspection methods: visual, mechanical, measurement

Typical defects

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 7 Know procedures for aircraft ground handling, maintenance and storage

Assessment Criteria

The learner can:

1. describe procedures for moving aircraft on the ground
2. describe aircraft jacking and security procedures
3. describe aircraft storage methods
4. describe aircraft refuelling/defuelling procedures
5. describe aircraft de-icing and anti-icing procedures
6. describe the use of electrical, hydraulic and pneumatic ground supplies
7. describe the effects of environmental conditions on aircraft handling and operation.

Range/Scope/Unit content

List 1

Aircraft taxiing including: safety checks, marshalling signals, communication, day/night

Towing including: safety precautions, personnel requirements, towing vehicles, towing arms, weak links, weight limits, turning angle limits, brake control day/night towing, communication during the tow

List 2

Principles of aircraft jacking

Types of aircraft jack

Jacking points

Balance and weight limits

Safety precautions

Jacking techniques

Levelling

Structural integrity while jacking eg: fitting structural panels, positioning flight control surfaces, undercarriage precautions, overhead clearance

Use of aircraft chocks – how many, where

Security of aircraft – doors, windows, hatches

List 3

Short-term storage procedures including: picketing, control and undercarriage locks, blanks and bungs, levelling, protection of canopy/windows, security of panels, doors

Long-term storage procedures including: draining of fluids; preservation treatments for engines, airframes, electrical/electronic equipment, wheels and tyres, undercarriage etc.; environmental control, elimination of vermin, periodic anti-deterioration maintenance

List 4

Including:

Description of pressure and open-line fuelling/de-fuelling – bowser and ring-main supplies

Safety: bonding, security of couplings, vapour during open-line operations, control of use of electrical power and equipment

Sampling of fuel, draining of water and sediment

Use of tank contents indicators

Balancing fuel contents/use of cross-feed pumps

Metering and recording of fuel delivered/removed including location of remaining fuel

Venting of tanks

List 5

Difference between de-icing and anti-icing

Reasons for preventing ice from forming on airframes, engines etc

Basic explanation of ice types and how they form

Removal of frost, ice and snow:

De-icing procedures including substances and methods of delivery, timing of process

Anti-icing equipment – mechanical, electrical, chemical, positioning

List 6

Types of electrical ground power supply eg: DC battery trolley, diesel or petrol electric set, electric/electric set, hangar power supplies

Types of hydraulic supply eg: mobile powered hydraulic rig, hangar ring main

Types of pneumatic supply eg: portable, hangar ring main

List 7

Environmental conditions eg: extreme heat, cold, high winds, heavy rain, standing water, snow

Describe precautions and measures to be taken when working on aircraft in the above conditions

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 8 Understand disassembly, inspection, repair and assembly techniques

Assessment Criteria

The learner can:

1. explain visual inspection techniques and describe typical defects
2. describe corrosion removal, assessment and re-protection methods
3. explain disassembly and re-assembly techniques for typical airframe components
4. describe the riveted joints used in aircraft
5. describe the operation of tools used for riveting and dimpling
6. describe procedures for inspecting riveted joints.

Range/Scope/Unit content

List 1

Classification of damage

Visual inspection tools and equipment

List 2

Types of corrosion

Removal methods eg abrasion, chemical

Temporary protective methods

Plating

Excluders

Paint

Primers

Sealants

List 3

Eg: hydraulic components, mechanical components, structural assemblies, wheels and brakes, control surface attachments, engine components etc

Cleanliness, tools and techniques,

List 4

Explain basics of eg: how riveted joints work, basic features, how rivets are classified, types and sizes, materials, how rivets are formed, heat treatment of rivets and materials, heating and freezing of rivets, finished dimensions of correctly formed rivet

Rivet layout: spacing and pitch

List 5

Tools used for dimpling and riveting eg: bucking bars, hand rivet and draw sets, countersinks, dimpling dies, pneumatic rivet guns

List 6

Inspection of riveted joints: appearance of a perfectly formed riveted joint, typical defects (eg: Shank joggling, shear failure, bearing failure, head failure), allowable deviations

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 9 Know actions after abnormal aircraft events

Assessment Criteria

The learner can:

1. describe inspection techniques used following lightning strikes and HIRF penetration
2. describe inspection techniques used following abnormal events.

Range/Scope/Unit content

List 1

Avionic/electrical systems
Aerials
Static discharge wick
Skin inspection
Structural inspection

List 2

Eg:
Heavy landing
Bird strike
Hail damage
Tyre burst
Brake fire
Flight through turbulence
Atmospheric contamination.

Unit 004 Fundamentals of aircraft maintenance practices

Outcome 10 Understand maintenance procedures for safe and effective operation of aircraft

Assessment Criteria

The learner can:

1. describe the operation Maintenance Planning departments and its interface with aircraft operations
2. explain the need for Modification programmes and procedure for implementation
3. explain the process for certification and release of aircraft
4. explain the quality assurance procedures for aircraft maintenance
5. explain the procedures for carrying out additional maintenance procedures
6. explain the need for the control of Life-limited components.

Range/Scope/Unit content

List 1

IRAN (Inspect and repair As Necessary)
Scheduled maintenance
Preventative maintenance
Anti-deterioration maintenance
Aircraft log books, documentation etc

List 2

Designer modification
Service/Operator modification
Modification leaflets
Technical instructions

List 3

Documentation
Authorities to sign off maintenance work

List 4

Overview of procedures for:
Maintenance Inspection
Quality Control
Quality Assurance

List 5

Eg: Emergency Airworthiness Directives (EAD)

List 6

Typical life limited components
Procedures for tracking and monitoring the life of lifed components
Documentation.

Unit 004 Fundamentals of aircraft maintenance practices

Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 7– Aircraft Maintenance Practices for A Category licences. 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 3
Outcome 2: EASA Level 3
Outcome 3: EASA Level 1
Outcome 4: EASA Level 1
Outcome 6: EASA Level 1
Outcome 7: EASA Level 1
Outcome 8: EASA Level 2 (except 5 & 6 - EASA Level 1)
Outcome 9: EASA Level 2
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 005 Fundamentals of aerodynamics

Level: 2

Credit value: 5

UAN: T/503/0857

Unit 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 outcomes

There are **six** learning outcomes to this unit. The learner will:

1. know the basic properties of the Earth's atmosphere
2. understand the nature of airflow around aerodynamic bodies
3. know the characteristics of the basic wing planforms
4. understand basic aircraft control using primary control surfaces
5. understand aircraft stability
6. know the purpose and operation of secondary control surfaces

Guided learning hours

It is recommended that **40** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 2 NOS Units 006, 007.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- A written examination covering underpinning knowledge.

Unit 005 Fundamentals of aerodynamics

Outcome 1 Know the basic properties of the Earth's atmosphere

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 005 Fundamentals of aerodynamics

Outcome 2 Understand the nature of airflow around aerodynamic bodies

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 005 Fundamentals of aerodynamics

Outcome 3 Know the characteristics of the basic wing planforms

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 005 Fundamentals of aerodynamics

Outcome 4 Understand basic aircraft control using primary control surfaces

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 005 Fundamentals of aerodynamics

Outcome 5 Understand the nature of aircraft stability

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.).

Unit 005 Fundamentals of aerodynamics

Outcome 6 Know the purpose and operation of a range of secondary control surfaces

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 006 Fundamentals of civil aviation legislation

Level: 3
Credit value: 4
UAN: A/503/0858

Unit aim

This unit aims to give the learner a working knowledge of aviation legislation to enable maintenance work to be done within the requirements of the Law. It contains the complete syllabus of EASA Part-66 Module 10 for category A licences (dated 16/11/2011).

Learning outcomes

There are **four** learning outcomes to this unit. The learner will:

1. know the roles of European and International organisations in aviation safety regulation
2. understand how civil aviation legislation relates to the maintenance of airworthiness
3. understand the contents of Part-M and other national and international requirements
4. be able to carry out procedures related to aviation legislation.

Guided learning hours

It is recommended that **30** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 3 NOS Unit 305, 306 etc

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving
- Working with Others

Assessment and grading

This unit will be assessed by an assignment covering practical skills and underpinning knowledge.

Unit 006 Fundamentals of civil aviation legislation

Outcome 1 Know the roles of European and international organisations in aviation safety regulation

Assessment Criteria

The learner can:

1. describe the role of the International Civil Aviation Organisation (ICAO)
2. describe the role of the European Aviation Safety Agency (EASA)
3. describe the role of the European Commission (EC)
4. describe the role of the EU Member States and National Aviation Authorities
5. describe the relationships between key elements of the European Aviation Safety Regulations.

Range/Scope/Unit content

List 1

Overview

List 2

Overview

List 3

Overview, with respect to EASA and European aviation

List 4

Overview of obligations and responsibilities for aviation safety

List 5

Regulation (EC) No 216/2008 and its implementing rules Regulations, (EU) No748/2012 and (EU) No 1321/2014

Part-21, Part-M, Part-145, Part-66, Part-147 and Regulation (EU) No 965/2012.

Unit 006 Fundamentals of civil aviation legislation

Outcome 2 Understand how civil aviation legislation relates to the maintenance of airworthiness

Assessment Criteria

The learner can:

1. explain the certification requirements for Maintenance Certifying Staff
2. explain the requirements for Approved Maintenance organisations
3. explain the requirements of EU-OPS for Commercial Air Transportation.

Range/Scope/Unit content

List 1

Detailed understanding of Part-66 including:

Details of the requirements for the issue of licences to maintenance personnel

The approved basic training course

Examinations

Practical experience

Log books

Privileges of a Licensed Aircraft Maintenance Engineer in each category

List 2

Detailed understanding of: Part-145 and Part-M Subpart F, including:

Approval

Maintenance Organisation Manual

Facilities

Personnel requirements

Certifying staff

Components, equipment and tools

Maintenance data, work orders and standards

Release-to-service certification of aircraft and components

Maintenance records

Privileges of the organisation

Organisational changes

Review of the organisation

Continuing approval and 'findings'

List 3

Overview of:

General understanding of Regulation (EU) No 965/2012

Air Operators Certificates

Operators Responsibilities – particularly continuing airworthiness and maintenance

Aircraft Maintenance Programme

Minimum Equipment Lists (MEL)

Configuration Deviation List (CDL)

Documents to be carried on board

Aircraft placarding (markings)

Unit 006 Fundamentals of civil aviation legislation

Outcome 3 Understand the contents of Part-M and other National and International requirements

Assessment Criteria

The learner can:

1. explain the purpose of the sub-parts and annexes of Part-M
2. explain additional National and International documentation and procedures.

Range/Scope/Unit content

List 1

A detailed understanding of:

Subparts A-I

Appendices I - VIII

List 2

Detailed understanding of Part-21 provisions related to continuing airworthiness

Overview of:

Maintenance Programmes, Maintenance checks and inspections

Airworthiness Directives

Service Bulletins, manufacturers service information

Modifications and repairs

Maintenance documentation including: maintenance manuals, structural repair manual, illustrated parts catalogue

Master Minimum Equipment Lists, Minimum Equipment List, Dispatch Deviation Lists

Unit 006 Fundamentals of civil aviation legislation

Outcome 4 Be able to carry out practical procedures related to aviation legislation

Assessment Criteria

The learner can:

1. demonstrate how to examine maintenance documentation to determine its validity
2. apply procedures related to the supply of aircraft equipment and spares
3. perform the procedures to document the replacement of a time-expired aircraft component.

Range/Scope/Unit content

List 1

Including:

Aircraft Type Certificate (authority, registration, date)

Aircraft Operator's Certificate (authority, company and address, currency)

Engineer's Licence (aircraft type, validity, authority)

List 2

Process aircraft equipment/spares from supplier to aircraft fitment

List 3

A rotatable component

Aircraft above 5700 kg MTWA (Maximum Total Weight Authorised)

Within a Part 145 Maintenance Organisation

Unit 006 Fundamentals of civil aviation legislation

Notes for guidance

This unit contains the complete syllabus of EASA 1149/2011 part 66 Basic Knowledge Requirements Module 10 – Aviation Legislation for the Category A Licences. This reflects the amendments to the syllabus dated 16/11/2011, fully effective on 1 June 2013. 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

Outcome 2: EASA Level 2 (except 3 – EASA Level 1)

Outcome 3.1: EASA Level 2

Outcome 3.2: EASA Level 1 (except 'detailed understanding of Part-21' (EASA Level 2))

Outcome 4: EASA Level 2

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 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Level: 3
Credit value: 12
UAN: J/503/1091

Unit aim

This unit aims to give the learner a broad understanding of the aircraft systems and structures they will encounter when working in the aircraft maintenance field. It covers the complete syllabus for the EASA Part-66 Module 11A for the category A1 Licence. including the amendment dated16 September 2010, fully effective 1 June 2013.

Learning outcomes

There are **ten** learning outcomes to this unit. The learner will:

1. know aspects of the theory of flight
2. understand the general concepts of airframe structure
3. know fixed wing aircraft structure
4. know equipment air, cabin conditioning, pressurisation and oxygen systems
5. know aircraft instrument, avionic and on-board maintenance systems
6. know electrical power, lighting and ice & rain protection systems
7. know equipment and furnishings, water and waste and fire protection systems
8. know aircraft flight controls
9. know aircraft fuel systems
10. know hydraulic and landing gear systems.

Guided learning hours

It is recommended that **115** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 3 NOS Units 322, 339 etc

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Information and Communication Technology
- Improving Own Learning and Performance

Assessment and grading

This unit will be assessed by:

A written examination covering underpinning knowledge.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 1 Know aspects of the theory of flight

Assessment Criteria

The learner can:

1. describe the operation and effect of primary flying controls in all three axes
2. describe the operation and effect of high lift and drag-inducing devices
3. describe the effects of stall control devices
4. describe boundary layer control
5. describe the operation and effect of trim and balance devices
6. describe terms relating to high speed flight
7. describe the aerodynamic effects of high speed flight
8. describe the effects of engine intake and swept wing design on high speed performance.

Range/Scope/Unit content

List 1

Overview of:

Operation and effect of:

Roll control: ailerons and spoilers

Pitch control: elevators, stabilators, variable incidence stabilisers and canards

Yaw control: rudder limiters

Control using elevons, ruddervators

List 2

Overview of:

High lift devices: slots, slats, flaps, flaperons

Drag inducing devices: spoilers, lift dumpers, speed brakes

List 3

Overview of:

Effects of wing fences, saw tooth leading edges

List 4

Overview of:

Using: vortex generators, stall wedges and leading edge devices

List 5

Overview of:

Trim tabs, balance and antibalance (leading) tabs, servo tabs, spring tabs, mass balance, control surface bias, aerodynamic balance panels

List 6
Overview of:
Speed of sound, subsonic flight, transonic flight, supersonic flight

List 7
Overview of:
Mach number, critical Mach number, compressibility
Buffet, shock wave, aerodynamic heating, area rule

List 8
Overview of:
Factors affecting airflow in engine intakes of high speed aircraft
Effects of sweepback on critical Mach number.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 2 Understand the general concepts of airframe structure

Assessment Criteria

The learner can:

1. explain the airworthiness requirements for structural strength
2. explain the classification of aircraft structure
3. explain the concept of in-built safety
4. explain how locations on the airframe are defined
5. explain the physical effects of flying on aircraft structures
6. explain how moisture build-up in airframe structures is minimised
7. explain how airframe design allows for the installation of aircraft systems
8. explain how the aircraft is protected from lightning strikes and other static discharges
9. describe construction methods for various airframe components
10. describe structural assembly techniques
11. describe methods of surface protection
12. describe methods of surface cleaning
13. describe measurements performed on airframes.

Range/Scope/Unit content

List 1

Eg: structural strength, strength-to-weight ratio, rigidity and flexibility

List 2

Primary, secondary and tertiary

List 3

Fail safe, safe life, damage tolerance concepts

List 4

Zonal and station identification systems

List 5

Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue

List 6

Drains and ventilation provisions

List 7

Eg: electrical system, engines (wing hard points, nacelles, fuel tanks etc), pipework, reservoirs, tanks, attachment points for undercarriage etc

List 8

Lightning strike protection provision, aircraft bonding

List 9

Overview of:

Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement

Methods of: skinning, anti-corrosive protection, wing, empennage and engine attachments

List 10

Overview of: structure assembly techniques: riveting, bolting, bonding

List 11

Overview of eg: chromating, anodising, painting

List 12

Overview of eg: polishing, use of solvents and detergents

List 13

Overview of airframe symmetry: methods of alignment and symmetry checks.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 3 Know fixed wing aircraft structures

Assessment Criteria

The learner can:

1. describe fuselage construction and pressurisation sealing
2. describe fuselage attachment points
3. describe seat installation and cargo loading systems
4. describe doors and emergency exits
5. describe windows and windscreens
6. describe wing construction
7. describe wing fuel storage
8. describe attachment points
9. describe the construction of stabilisers
10. describe flight control surfaces
11. describe methods of balancing flight control surfaces
12. describe the construction of nacelles and pylons.

Range/Scope/Unit content

List 1

Overview of

(ATA 52/53/56) including:

Design principles such as load transfer, load path continuity and reducing stress-raisers; minimising or eliminating the loads and stresses experienced by a pressurised fuselage in flight (eg: tension, hoop stress, shear stress) and to minimise crack propagation and the effects of bursting and fatigue stress

Methods used to prevent doors and other large cut-outs from opening under pressurisation loads

Methods to ensure protection from rapid decompression

List 2

Overview of

(ATA 52/53/56) including: wing, stabiliser, pylon and undercarriage attachments

List 3

Overview of

(ATA 52/53/56) including: floor strong points, seat attachment methods, seat pitch, cargo positioning and restraint

List 4

Overview of

(ATA 52/53/56) including: construction, mechanisms, operation and safety devices

List 5

Overview of

(ATA 52/53/56) including: construction and mechanisms

List 6

Overview of

(ATA 57) including: spars, ribs, skin, wing root attachments, fairings, nacelles, wing profiles

List 7

Overview of

(ATA 57) including the siting and installation in/on the wing structure of: integral tanks, bag tanks, tip tanks, access, refuelling points, externally mounted tanks

List 8

Overview of

(ATA 57) including: landing gear, pylon, control surface and high lift/drag attachments

List 9

Overview of

(ATA 55) including for horizontal and vertical: structure, attachment to fuselage, attachment of control surfaces

List 10

Overview of

(ATA 55/57): construction and attachment

List 11

(ATA 55/57): mass and aerodynamic

List 12

Overview of

(ATA 54): construction, firewalls, engine mounts.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 4 Know equipment air, cabin conditioning, pressurisation and oxygen systems

Assessment Criteria

The learner can:

1. describe sources of aircraft air supply
2. describe aircraft air conditioning systems
3. describe aircraft pressurisation systems
4. describe cabin conditioning protection and warning devices
5. describe aircraft oxygen systems
6. describe aircraft pneumatic/vacuum systems.

Range/Scope/Unit content

List 1

Overview of

(ATA 21) including: engine bleed, APU and ground cart

List 2

Overview of

(ATA 21):

Air cycle and vapour cycle machines: components, layout, operation

Distribution systems

Flow, temperature and humidity control system

List 3

Overview of

(ATA 21) including:

Control and indication including components, layout, operation, control and safety valves

Cabin pressure controllers

List 4

Overview of

(ATA 21) including:

Eg: pressure relief valve, over-temperature warning

List 5

Overview of

(ATA 35):

System lay-out: cockpit, cabin

Sources, storage, charging and distribution

Supply regulation

Indications and warnings

List 6

Overview of

(ATA 36) including:

System lay-out

Sources: engine/APU, compressors, reservoirs, ground supply

Pressure control

Distribution

Indications and warnings

Interfaces with other systems.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 5 Know aircraft instrument, avionic and on-board maintenance systems

Assessment Criteria

The learner can:

1. describe pitot static flight instruments
2. describe gyroscopic flight instruments
3. describe aircraft compasses
4. describe angle of attack and stall warning systems
5. describe indications provided for other aircraft systems
6. describe on-board maintenance systems (OMS)
7. describe the layout and operating fundamentals of auto flight control systems
8. describe the layout and operating fundamentals of communication systems
9. describe the layout and operating fundamentals of navigation systems.

Range/Scope/Unit content

List 1

Overview including:

(ATA 31):

Altimeter, air speed indicator, vertical speed indicator

Single instrument displays, glass cockpit: construction, function, aircraft installation

List 2

Overview including:

(ATA 31):

Artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator

Single instrument displays, glass cockpit: construction, function, aircraft installation

List 3

Overview including:

(ATA 31):

Direct reading, remote reading

Construction, function, aircraft installation, adjustment

List 4

Overview including:

(ATA 31):

Angle of attack: probe, indication

Stall warning sensors, indicators, warning systems – horns, visual alarms, stick-shakers

List 5

Overview including:

(ATA 31) including indications for: engines, electrical power, fuel system, hydraulics, undercarriage, flying controls, environmental

Including temperature, current, voltage, mass air flow, contents, fluid flow, pressure, position

Integrated Modular Avionics (ATA 42) – overview of modules such as:

Bleed management, air pressure control, air ventilation and control, avionics and cockpit ventilation control, temperature control, air traffic communication, avionics communication router, electrical load management, circuit breaker monitoring, electrical system bite, fuel management, braking control, steering control, landing gear extension and retraction, tyre pressure indication, oleo pressure indication, brake temperature monitoring, etc.

Overview of Core System Network Components.

List 6

Overview including (ATA 45):

Central maintenance computers: Function, data inputs, data outputs, data up/downlinks, outputs to alerting systems (eg: EICAS)

Interfaces with aircraft systems: aircraft (general), airframe, structures, propellers, power plant

Data loading system: via data links, memory devices (CD/DVD, flash drive), direct from sensors and systems

Electronic library system: storage, updating, access

Printing: on board, in-flight, remote

Structure monitoring (damage tolerance monitoring): sensors, data logs, remote monitoring and alerts

List 7

Overview including:

Auto Flight (ATA 22): Auto-trim, yaw damping, autopilot, autothrottle, autoland

Layout and fundamentals of operation of including:

Sensors and inputs

Servomotors and actuators

Computers and interfaces with other systems

Controllers and indicators

Safety cut outs

List 8

Overview including:

Communications (ATA 23): HF, VHF, UHV, Satcom, data links, audio systems (Interphone, intercom), audio integration

Layout and fundamentals of operation of including:

Controllers, transmitter/receivers, antennae,

Overview of Cabin Systems (ATA 44):
Interface between cockpit/cabin crew and cabin systems
Functions such as: access to pre-departure/departure reports, email/intranet/Internet access, passenger database;
Server
Cabin Core System; server interfacing with:
Flight attendant panels
In-flight Entertainment System;
External Communication System;
Cabin Mass Memory System;
Cabin Monitoring System;
Miscellaneous Cabin Systems

Information Systems (ATA46)
Note: Does not include units or components installed for other uses and shared with other systems, such as flight deck printer or general use display

Overview of, for example:
Air Traffic and Information Management Systems and Network Server Systems
Electronic library mass storage and controller
Aircraft General Information System
Flight Deck Information System
Maintenance Information System
Passenger Cabin Information System
Miscellaneous Information System

List 9
Overview including:
Navigation Systems (ATA 34):
Flight environmental data (eg: pitot-statics, temperature, rate of climb, central air data computer)
Attitude and direction (eg: compasses, attitude director, vertical and direction references)
Landing and taxiing (eg: Localiser, glide slope, ILS markers, ground guidance)
Independent position finding (eg: inertial navigation, star tracker, anti-collision, weather radar),
Dependent position finding (eg: DME, VOR, ADF, GPS)
Flight management computers (eg: performance data, course, display, warnings)

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 6 Know electrical power, lighting and ice & rain protection systems

Assessment Criteria

The learner can:

1. describe aircraft battery installations and their operation
2. describe aircraft DC power generation systems
3. describe aircraft AC power generation systems
4. describe aircraft emergency power generation
5. describe aircraft power distribution
6. describe inverters, transformers, and rectifiers
7. describe aircraft external and ground power systems
8. describe aircraft lighting systems
9. describe ice formation and classification, and ice detection systems
10. describe aircraft anti-icing systems
11. describe aircraft de-icing systems
12. describe aircraft rain removal systems.

Range/Scope/Unit content

List 1

Overview of

(ATA 24): batteries and battery installations, safety when charging, handling and operating batteries, care and maintenance of batteries, battery performance and testing, aircraft battery installations

List 2

Overview of

(ATA 24) eg: generators, alternators, installation, drive systems, indication,

List 3

Overview of

(ATA 24): constant speed drive (oil system, connecting devices, indicating and warning systems), alternators, generators, installations

List 4

Overview of

(ATA 24): air driven turbines, ram air turbines, auxiliary airborne power units

List 5

Overview of

(ATA 24): bus bars, load sharing, paralleling, real load, reactive load, bus tie contactors, voltage regulation, circuit protection

List 6

Overview of

(ATA 24): rotary and static invertors, power and current transformers, rectifiers (single and 3 phase, full and half-wave), transformer-rectifier units

List 7

Overview of

(ATA 24): AC and DC ground power units, DC battery cart, rectifiers, invertors, gas turbine APU, connectors (number, purpose and length of pins, compatibility) connection and disconnection procedures, power on/off procedures, earthing, safety precautions

List 8

(ATA 33): external lighting - navigation, anti-collision, landing, taxiing, ice

Internal lighting: cabin, cockpit, cargo

Emergency lighting

List 9

Overview of

(ATA 30): eg: glaze ice, rime ice, mixed (cloudy) ice, super-cooled large droplets, runback ice, intercycle ice. From eg: supercooled moisture, freezing rain/drizzle, snow

Detection systems eg: optical, ultrasonic, cold soak

List 10

Overview of

(ATA 30): electrical, hot air and chemical

Aerofoils, air intakes, pitot and static, windows, windshields and doors, antennas and radomes, propellers, probe and drain heating

List 11

Overview of

(ATA 30): Rain repellent, wiper systems.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 7 Know equipment & furnishings, water & waste and fire protection systems

Assessment Criteria

The learner can:

1. describe aircraft emergency equipment requirements
2. describe aircraft seats, harnesses and belts
3. describe lay-outs of aircraft cabin equipment
4. describe aircraft cabin furnishing installations
5. describe aircraft cabin entertainment equipment
6. describe aircraft galley installations
7. describe aircraft cargo handling and retention equipment
8. describe aircraft air-stairs
9. describe the lay-out of aircraft water systems
10. describe the layout of aircraft toilet systems
11. describe aircraft fire and smoke detection and warning systems
12. describe aircraft fire extinguishing systems.

Range/Scope/Unit content

List 1

(ATA 25) including: life rafts and jackets, emergency locator beacons (surface and underwater), first aid kit, flares, evacuation equipment

List 2

(ATA 25) including: passenger seats, seat belts and extensions, other special restraints, first class sleeping berths

Crew seats, seat belts and harnesses

List 3

Overview of

(ATA 25) including: cabin seating configuration (eg: first, club, economy), movable partitions positions, overhead storage, galley positions, lavatories, emergency exits, entertainment equipment, cabin monitoring display

Awareness of corrosion potential in the area of lavatory and galley installations

List 4

Overview of

(ATA 25) including fitting of: seats, insulation, carpets, partitions, curtains, cockpit door security, wardrobes, cupboards, other storage

List 5

Overview of

(ATA 25) including: individual multimedia screens (seat), bulkhead multimedia screens, individual entertainment controller, DVD and tape players, overhead loudspeakers

List 6

Overview of

(ATA 25) including: removable and fixed cabinets, ovens, refrigerators, waste storage and disposal, dish racks, coffee maker, water dispenser, service trolleys, electrical and water supplies.

Explain the importance of maintaining serviceability and integrity of water drains and their heaters

List 7

Overview of

(ATA 50) including: Cargo hold – nets, containers, lashing and latching points, floor rollers Main cabin in cargo or passenger/cargo role – floor fitments, rollers, tracks, hard points for nets and straps

List 8

Overview of

(ATA 60) including: structure, actuating mechanisms, controls, handrails

List 9

(ATA 38) including: supply, distribution, servicing and draining, operation of pumps, waste water extraction and storage, anti-icing measures

Describe corrosion potential around water pipes and drains and in the bilges; corrosion prevention measures

List 10

(ATA 38) including: flushing and servicing, operation of flushing system, gate valves, storage tanks, service points

Describe corrosion potential around water pipes and drains, and in the bilges; corrosion prevention measures

Explain the potential for ice to form and break off in-flight around insecure and leaking service points

List 11

(ATA 26) including:

Fire detection: continuous element or pressure type sensor responder, fire wire, thermal switch, thermocouple, infra-red

Smoke detection: carbon monoxide, photoelectric, visual, infra-red

Central warning systems: operation and indications, inputs, outputs, priority philosophy

System inspection, maintenance and test

List 12

(ATA 26) including: extinguishing agents, positioning of fire extinguisher units, method of initiating

System inspection, maintenance and test

Portable fire extinguishers: labelling, extinguishing agents, stowage, use, inspection.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 8 Know aircraft flight controls

Assessment Criteria

The learner can:

1. describe the function and operation of aircraft primary controls
2. describe trim when related to control surfaces
3. describe active load control
4. describe high lift devices
5. describe speed brakes and lift dump devices
6. describe the operation of various types of flight control system
7. describe active methods of adjusting flying controls to suit flight conditions
8. describe the function and operation of gust locks systems
9. describe the process of balancing and rigging an aircraft
10. describe aircraft stall protection/warning systems.

Range/Scope/Unit content

This outcome requires an overview knowledge of manual, power assisted and power operated controls (hydraulic, pneumatic and electric) controls:

List 1

Overview of

(ATA 27) including: control wheels, cables, rods, linkages, chains, pulleys, control surface etc

For: aileron, elevator, rudder, spoiler

List 2

Overview of

(ATA 27) including: manual trim, servo and anti-servo tabs,

List 3

Overview of

(ATA 27) including: reasons for active load control, system components, layout, system operation

List 4

Overview of

(ATA 27) including:

Control handles, cables, actuators, warning systems, linkages, control surfaces, position indicators for high lift devices including:

Trailing edge flaps

Leading edge flaps

Slats

Slots

Boundary layer control

List 5

Overview of

(ATA 27) including:

Control handles, cables, warning systems, linkages, position indicators, limiters for devices including:

Speed brakes

Variable aerodynamic fairings

Spoilers

Other drag and lift dumping devices

List 6

Overview of

(ATA 27) including: manual, hydraulic, pneumatic, electrical and

Fly-by-wire systems

List 7

Overview of

(ATA 27): Reasons for each system, system components, input, output, operation

Artificial feel via a spring strut or 'q' system

Yaw damper

Mach trim

Rudder limiter

List 8

Overview of

(ATA 27) including: reasons for using gust locks, type of gust lock,

Methods of operation

List 9

Overview of

(ATA 27) including: Reasons for balancing control surfaces, equipment, tools and methods of balancing a control surface

Reasons for checking control surface rigging, equipment, tools and methods of measuring and rigging control surfaces

List 10

Overview of

Stick shakers, stall warning audible and visual devices, automatic stall recovery devices.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 9 Know aircraft fuel systems

Assessment Criteria

The learner can:

1. describe aircraft fuel system layouts
2. describe aircraft fuel tanks
3. describe aircraft fuel supply systems
4. describe fuel dumping, venting and draining systems
5. describe fuel cross-feed and transfer systems
6. describe fuel indications and warnings
7. describe aircraft refuelling and defuelling systems
8. describe aircraft longitudinal balance fuel systems.

Range/Scope/Unit content

List 1

Overview of

(ATA 28) including: components of the fuel system, positioning and purpose of tanks, pumps, refuelling points, interconnection of system components, power supplies

List 2

Overview of

(ATA 28)including: integral tanks, tip tanks, bladder cells, baffles, ventilation, cell and tank interconnectors, over-wing filler necks and caps, reservoir feed pumping system, in-tank reservoirs, leak detection and classification, tank sealing and repair, pressurisation, fire and explosion suppression

List 3

Overview of

(ATA 28) including: pipework, pumps (including booster, ejector and backing), valves, strainers, emergency devices such as power plant fuel quick disconnect

List 4

Overview of

(ATA 28) including: pipework, jettison chutes and valves, venting system, tank drain points

List 5

Overview of

(ATA 28) including: pipework, cross-feed pumps, transfer valves, fuel manifold

List 6

Overview of

(ATA 28) including: fuel quantity, system pressure, temperature and flow; valve positions, warnings for tank pump pressure

List 7

Detailed knowledge of (ATA 28) including: over-wing and pressure refuelling, bonding, distribution to and from tanks during re-fuel/de-fuel

List 8

Overview of

(ATA 28) including: trim tanks (eg: in horizontal/vertical stabiliser), transfer pumps, valves, trim warnings.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Outcome 10 Know hydraulic and landing gear systems

Assessment Criteria

The learner can:

1. describe aircraft system lay-outs
2. describe hydraulic filters and the types and properties of hydraulic fluids in use
3. describe hydraulic reservoirs and accumulators
4. describe hydraulic pressure generation
5. describe hydraulic pressure control and power distribution
6. describe hydraulic system indication and warning systems
7. describe how hydraulic power systems interface with other systems
8. describe the construction and shock-absorbing action of aircraft landing gear
9. describe landing gear extension and retraction systems
10. describe landing gear indications and warning devices
11. describe wheels, brakes, antiskid and autobraking
12. describe aircraft tyres, their design, classification and application
13. describe aircraft landing gear steering and shimmy damping systems.

Range/Scope/Unit content

List 1

Overview of

(ATA 29) including: multiple system integration, functions and features of each system, components of a system, positioning and purpose of tanks, accumulators, valves, pumps, levers, switches, cables, pipework, seals, quick disconnection, wiring, and external connectors, up to but not including supply valves to individual systems

List 2

Overview of

(ATA 29) including: mineral, synthetic hydrocarbon and phosphate-ester based fluids, properties (eg: low compressibility, low temperature performance, resistance to combustion, resistance to moisture and gas absorption), shelf life, importance of cleanliness, contamination checks, particular health and safety issues (eg: Skydrol)

Hydraulic filters: construction, filtering operation, maintenance, alert systems, types of filter (eg: metal element, two-stage)

List 3

Overview of

(ATA 29) including: purpose, construction, operation of accumulators (diaphragm, bladder and piston type); reservoirs (reason for pressurisation, methods of pressurisation, control of pressure)

List 4

Overview of

(ATA 29) including construction, operation, location and function of:

Normal operation: electrical and mechanical pumps (engine gear driven, bleed air driven),

Emergency: hand operated double-acting and ram air turbine pumps, auxiliary tanks and accumulators, valves and pipework

List 5

Overview of

(ATA 29) including construction, operation, location and function of:

Pressure control: relief valves, regulators, reducers, thermal relief valves, de-boosters, cut-off valves, low-demand fluid circulation, protection from overpressure damage

Power distribution: manifolds, valves (eg: selector, in-line check, sequence, spool, rotary, priority, disconnect), hydraulic fuses

List 6

Overview of

(ATA 29) including: pressure, flow, contents, temperature, contamination/clogging, transmitters, indicators, interconnection, warning methods

List 7

Overview of

(ATA 29) including with: electrical and emergency systems

List 8

(ATA 32) including:

Arrangement: fixed, retractable tail wheel, tricycle, tandem, single wheel, double wheel, tandem wheel, bogie,

Construction: main and nose casting, torque link arms, pivot trunnion side braces, trunnion beam, drag brace/strut, shock strut cylinders, positioned, equaliser, pivot beam, pivot fork and shafts, up and down locks

Shock struts – construction and operation: types (metering pin, metering tube, separator piston), damping and snubbing devices, axles, mounting assemblies, glands, packing, seals and backing rings, charging and bleeding, ground locks, safety devices

List 9

(ATA 32) including:

Normal: electrical and hydraulic retraction and extension, locking methods, door mechanisms, extension and retraction sequencing

Emergency: pneumatic, hand pump and gravity, locking

List 10

(ATA 29) including: gear-located switches, cockpit indicators, air-ground sensing, warning devices (visual, mechanical, audible), typical retraction faults and associated cockpit indication

List 11

(ATA 29) including:

Types of wheel: material, detachable flange, split rim, wheel bearings, fusible plugs, inspection

Brake unit: construction, wear limits, maintenance/inspection

Hydraulic brake systems

Emergency brake systems

Parking brake systems

Mechanical/hydraulic anti-skid

Electro-hydraulic anti-skid

Auto-brake systems (landing, take-off, intensity settings, conditions for operation)

List 12

(ATA 29) including: bias (cross) ply, radial ply, tubed, tubeless, sidewall markings, tread patterns, wear limits, damage limits (eg: oil contamination, cuts, blisters)

List 13

(ATA 29) including: cockpit controls (wheel, tiller etc.), linkages (hydraulic, electrical, mechanical), pressurising assembly, power sources, metering valve, steering cylinders, compensator/accumulator, follow-up, safety valves, centring cam, differential assembly, main bogie steering

Nosewheel shimmy damping: types of damper (piston, steer, vane), causes of shimmy.

Unit 007 Fundamentals of aircraft aerodynamics, structures and systems for turbine engines

Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 (amended by 1149/2011) part 66 Basic Knowledge Requirements Module11A – Turbine Aeroplane Aerodynamics, Structures and Systems. Dated 16 September 2010, fully effective 1 June 2013. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the A1 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 2 (except 9-13 - EASA Level 1)
Outcome 3: EASA Level 1
Outcome 4: EASA Level 1
Outcome 5: EASA Level 1
Outcome 6: EASA Level 1 (except 8 - EASA Level 2)
Outcome 7: Outcomes1&2 - EASA Level 2
Outcomes 3-8 – EASA Level 1
Outcomes 9-12 – EASA Level 2
Outcome 8: EASA Level 1
Outcome 9: EASA Level 1
Outcome 10: EASA Level 1 (except 8-13 - EASA Level 2)

Note: the 'ATA' references in the range and scope are there to indicate the boundaries of the subjects as defined the Air Transport Association of America Chapters, which are an industry standard for aircraft maintenance manuals and other documentation. These chapters are included in the EASA Part-66 syllabus for the same reason.

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

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Level: **3**
Credit value: **12**
UAN: **M/503/1098**

Unit aim

This unit aims to give the learner a broad understanding of the aircraft systems and structures they will encounter when working in the aircraft maintenance field. It covers the complete syllabus for the EASA Part-66 Module 11B for the category A2 Licence.

Learning outcomes

There are **ten** learning outcomes to this unit. The learner will:

1. know aspects of the theory of flight
2. know the general concepts of airframe structure
3. know fixed wing aircraft structure
4. know cabin conditioning, pressurisation and oxygen systems
5. know aircraft instrument and avionics systems
6. know electrical power, lighting and ice and rain protection systems
7. know equipment and furnishings, water and waste and fire protection systems
8. know aircraft flight controls
9. know aircraft fuel systems
10. know hydraulic and landing gear systems

Guided learning hours

It is recommended that **100** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 3 NOS Units 313, 327 etc

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Information and Communication Technology
- Improving Own Learning and Performance

Assessment and grading

This unit will be assessed by:

- A written examination covering underpinning knowledge.

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 1 Know aspects of the theory of flight

Assessment Criteria

The learner can:

1. describe the operation and effect of primary flying controls in all three axes
2. describe the operation and effect of high lift and drag-inducing devices
3. describe the effects of stall control devices
4. describe boundary layer control
5. describe the operation and effect of trim and balance devices
6. describe the aerodynamic effects of high speed flight
7. describe the effects of engine intake and swept wing design on high speed performance.

Range/Scope/Unit content

List 1

Operation and effect of:

Roll control: ailerons and spoilers

Pitch control: elevators, stabilators, variable incidence stabilisers and canards

Yaw control: rudder limiters

Control using elevons, ruddervators

List 2

High lift devices: slots, slats, flaps, flaperons

Drag inducing devices: spoilers, lift dumpers, speed brakes

List 3

Effects of wing fences, saw tooth leading edges

List 4

Using: vortex generators, stall wedges and leading edge devices

List 5

Trim tabs, balance and antibalance (leading) tabs, servo tabs, spring tabs, mass balance, control surface bias, aerodynamic balance panels

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 2 Understand the general concepts of airframe structure

Assessment Criteria

The learner can:

1. explain the airworthiness requirements for structural strength
2. explain the classification of aircraft structure
3. explain the concept of in-built safety
4. explain how locations on the airframe are defined
5. explain the physical effects of flying on aircraft structures
6. explain how moisture build-up in airframe structures is minimised
7. explain how airframe design allows for the installation of aircraft systems
8. explain how the aircraft is protected from lightning strikes and other static discharges
9. describe typical construction methods for various airframe components
10. describe typical structural assembly techniques
11. describe methods of surface protection
12. describe methods of surface cleaning
13. describe typical measurements performed on airframes.

Range/Scope/Unit content

List 1

Eg: structural strength, strength-to-weight ratio, rigidity and flexibility

List 2

Primary, secondary and tertiary

List 3

Fail safe, safe life, damage tolerance concepts

List 4

Zonal and station identification systems

List 5

Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue

List 6

Drains and ventilation provisions

List 7

Eg: electrical system, engines (wing hard points, nacelles, fuel tanks etc), pipework, reservoirs, tanks, attachment points for undercarriage etc

List 8

Lightning strike protection provision, aircraft bonding

List 9

Overview of:

Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement

Methods of: skinning, anti-corrosive protection, wing, empennage and engine attachments

List 10

Overview of: structure assembly techniques: riveting, bolting, bonding

List 11

Overview of eg: chromating, anodising, painting

List 12

Overview of eg: polishing, use of solvents and detergents

List 13

Overview of airframe symmetry: methods of alignment and symmetry checks.

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 3 Know fixed wing aircraft structure

Assessment Criteria

The learner can:

1. describe typical fuselage construction and pressurisation sealing
2. describe fuselage attachment points
3. describe typical seat installation and cargo loading systems
4. describe typical doors and emergency exits
5. describe typical windows and windscreens
6. describe typical wing construction
7. describe typical wing fuel storage
8. describe typical attachment points
9. describe the construction of typical stabilisers
10. describe typical flight control surfaces
11. describe methods of balancing flight control surfaces
12. describe the construction of typical nacelles and pylons.

Range/Scope/Unit content

List 1

Overview of

(ATA 52/53/56) including:

Design principles such as load transfer, load path continuity and reducing stress-raisers; minimising or eliminating the loads and stresses experienced by a pressurised fuselage in flight (eg: tension, hoop stress, shear stress) and to minimise crack propagation and the effects of bursting and fatigue stress

Methods used to prevent doors and other large cut-outs from opening under pressurisation loads

Methods to ensure protection from rapid decompression

List 2

Overview of

(ATA 52/53/56) including: wing, stabiliser, pylon and undercarriage attachments

List 3

Overview of

(ATA 52/53/56) including: seat attachment methods (pilots, other cockpit seats, cabin crew and passenger), seat pitch

List 4

Overview of

(ATA 52/53/56) including: construction, mechanisms, operation and safety devices

List 5

Overview of

(ATA 52/53/56) including: construction and mechanisms

List 6

Overview of

(ATA 57) including: spars, ribs, skin, wing root attachments, fairings, nacelles, wing profiles

List 7

Overview of

(ATA 57) including the siting and installation in/on the wing structure of: integral tanks, bag tanks, tip tanks, access, refuelling points, externally mounted tanks

List 8

Overview of

(ATA 57) including: landing gear, pylon, control surface and high lift/drag attachments

List 9

Overview of

(ATA 55) including for horizontal and vertical: structure, attachment to fuselage, attachment of control surfaces

List 10

Overview of

(ATA 55/57): construction and attachment

List 11

(ATA 55/57): mass and aerodynamic

List 12

Overview of

(ATA 54): construction, firewalls, engine mounts.

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 4 Know cabin conditioning, pressurisation and oxygen systems

Assessment Criteria

The learner can:

1. describe typical aircraft air conditioning systems
2. describe typical aircraft pressurisation systems
3. describe typical cabin conditioning protection and warning devices
4. describe typical aircraft oxygen systems
5. describe typical aircraft pneumatic/vacuum systems.

Range/Scope/Unit content

List 1

Overview of (ATA 21 including: cabin air scoops, superchargers, turbochargers, ducting, valves (eg: pressure relief, negative pressure, cabin pressure control, emergency depressurisation), controllers, regulators

List 2

Overview of (ATA 21) including: air inlets, air conditioning units, distribution systems (cabin, equipment conditioning), temperature and humidity control system

List 3

Overview of (ATA 21) including: sensors and transmitters, indicators, warning devices, safety valves and cut-offs

List 4

Overview of (ATA 35):

System lay-out: cockpit, cabin

Sources, storage, charging and distribution

Supply regulation

Indications and warnings

List 5

Overview of (ATA 36) including:

System lay-out

Sources: engine/APU, compressors, reservoirs, ground supply

Pressure control

Distribution

Indications and warnings

Interfaces with other systems.

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 5 Know aircraft instrument and avionics systems

Assessment Criteria

The learner can:

1. describe typical pitot static flight instruments
2. describe typical gyroscopic flight instruments
3. describe typical aircraft compasses
4. describe typical angle of attack and stall warning systems
5. describe indications provided for other aircraft systems
6. describe the layout and operating fundamentals of auto flight control systems
7. describe the layout and operating fundamentals of communication systems
8. describe the layout and operating fundamentals of navigation systems

Range/Scope/Unit content

List 1

Overview including:

(ATA 31):

Altimeter, air speed indicator, vertical speed indicator

Construction, function, aircraft installation

List 2

Overview including:

(ATA 31):

Artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator

Construction, function, aircraft installation

List 3

Overview including:

(ATA 31):

Direct reading, remote reading

Construction, function, aircraft installation, adjustment

List 4

Overview including:

(ATA 31):

Angle of attack: probe, indication

Stall warning sensors, indicators, warning systems – horns, visual alarms, stick-shakers

List 5

Overview (ATA 31) including indications for: engines, electrical power, fuel system, hydraulics, undercarriage, flying controls, environmental

Including temperature, current, voltage, contents, fluid flow, pressure, position

Independent instruments such as clocks, inclinometers etc

List 6

Overview including:

Auto Flight (ATA 22): Auto-trim, yaw damping, autopilot, autothrottle, autoland

Layout and fundamentals of operation of including:

Sensors and inputs

Servomotors and actuators

Computers and interfaces with other systems

Controllers and indicators

Safety cut outs

List 7

Overview including:

Communications (ATA 23): HF, VHF, UHV, Satcom, data links, audio systems (Interphone, intercom), audio integration

Layout and fundamentals of operation of including:

Controllers, transmitter/receivers, antennae,

List 8

Overview including:

Navigation Systems (ATA 34):

Flight environmental data (eg: pitot-statics, temperature, rate of climb, central air data computer)

Attitude and direction (eg: compasses, attitude director, vertical and direction references)

Landing and taxiing (eg: Localiser, glide slope, ILS markers, ground guidance)

Independent position finding (eg: inertial navigation, star tracker, anti-collision, weather radar),

Dependent position finding (eg: DME, VOR, ADF, GPS)

Flight management computers (eg: performance data, course, display, warnings)

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 6 Know electrical power, lighting and ice and rain protection systems

Assessment Criteria

The learner can:

1. describe typical aircraft battery installations and their operation
2. describe aircraft DC power generation systems
3. describe aircraft power distribution, voltage regulation and circuit protection
4. describe inverters, transformers, and rectifiers
5. describe aircraft external and ground power systems
6. describe aircraft lighting systems
7. describe ice formation and classification, and ice detection systems
8. describe aircraft de-icing systems
9. describe aircraft rain removal systems.

Range/Scope/Unit content

List 1

Overview of

(ATA 24): batteries and battery installations, safety when charging, handling and operating batteries, care and maintenance of batteries, battery performance and testing, aircraft battery installations

List 2

Overview of

(ATA 24) eg: generators, alternators, installation, drive systems, indication,

List 3

Overview of

(ATA 24): bus bars, load sharing, paralleling, real load, reactive load, bus tie contactors, voltage regulation, circuit protection

List 4

Overview of

(ATA 24): rotary and static invertors, power and current transformers

List 5

Overview of

(ATA 24): ground power units, DC battery cart, rectifiers, invertors, APUs, connectors (number, purpose and length of pins, compatibility) connection and disconnection procedures, power on/off procedures, earthing, safety precautions

List 6

(ATA 33): external lighting - navigation, anti-collision, landing, taxiing, ice

Internal lighting: cabin, cockpit, cargo

Emergency lighting

List 7

Overview of

(ATA 30): eg: glaze ice, rime ice, mixed (cloudy) ice, super-cooled large droplets, runback ice, intercycle ice. From eg: supercooled moisture, freezing rain/drizzle, snow

Detection systems eg: optical, ultrasonic, cold soak

List 8

Overview of

(ATA 30): electrical, hot air, pneumatic and chemical

Aerofoils, air intakes, pitot and static, windows, windshields and doors, antennas and radomes, propellers, probe and drain heating

List 9

Overview of

(ATA 30): wiper systems.

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 7 Know equipment and furnishings, water and waste and fire protection systems

Assessment Criteria

The learner can:

1. describe aircraft emergency equipment requirements
2. describe aircraft seats, harnesses and belts
3. describe typical lay-outs of aircraft cabin equipment
4. describe typical aircraft cabin furnishing installations
5. describe aircraft cabin entertainment equipment
6. describe aircraft galley installations
7. describe aircraft cargo handling and retention equipment
8. describe aircraft airstairs
9. describe the lay-out of a typical aircraft water system
10. describe the layout of a typical aircraft toilet system
11. describe aircraft fire and smoke detection and warning systems
12. describe aircraft fire extinguishing systems.

Range/Scope/Unit content

List 1

(ATA 25) including: life rafts and jackets, emergency locator beacons (surface and underwater), first aid kit, flares, evacuation equipment

List 2

(ATA 25) including: passenger seats, seat belts and extensions, other special restraints, first class sleeping berths

Crew seats, seat belts and harnesses

List 3

Overview of

(ATA 25) including: cabin seating configuration (eg: first, club, economy), movable partitions positions, overhead storage, galley positions, lavatories, emergency exits, entertainment equipment, cabin monitoring display

Awareness of corrosion potential in the area of lavatory and galley installations

List 4

Overview of

(ATA 25) including fitting of: seats, insulation, carpets, partitions, curtains, cockpit door security, wardrobes, cupboards, other storage

List 5

Overview of

(ATA 25) including: individual multimedia screens (seat), bulkhead multimedia screens, individual entertainment controller, DVD and tape players, overhead loudspeakers

List 6

Overview of

(ATA 25) including: removable and fixed cabinets, ovens, refrigerators, waste storage and disposal, dish racks, coffee maker, water dispenser, service trolleys, electrical and water supplies.

Explain the importance of maintaining serviceability and integrity of water drains and their heaters

List 7

(ATA 50) including: Cargo hold – nets, containers, lashing and latching points, floor rollers Main cabin in cargo or passenger/cargo role – floor fitments, rollers, tracks, hard points for nets and straps

List 8

Overview of

(ATA 60) including: structure, actuating mechanisms, controls, handrails

List 9

(ATA 38) including: supply, distribution, servicing and draining, operation of pumps, waste water extraction and storage, anti-icing measures

Describe corrosion potential around water pipes and drains and in the bilges; corrosion prevention measures

List 10

(ATA 38) including: flushing and servicing, operation of flushing system, gate valves, storage tanks, service points

Describe corrosion potential around water pipes and drains, and in the bilges; corrosion prevention measures

Explain the potential for ice to form and break off in-flight around insecure and leaking service points

List 11

(ATA 26) including:

Fire detection: continuous element or pressure type sensor responder, fire wire, thermal switch, thermocouple, infra-red

Smoke detection: carbon monoxide, photoelectric, visual, infra-red

Central warning systems: operation and indications, inputs, outputs, priority philosophy

System inspection, maintenance and test

List 12

(ATA 26) including: extinguishing agents, positioning of fire extinguisher units, method of initiating

System inspection, maintenance and test

Portable fire extinguishers: labelling, extinguishing agents, stowage, use, inspection.

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 8 Know aircraft flight controls

Assessment Criteria

The learner can:

1. describe the function and operation of aircraft primary controls
2. describe the operation of trim tabs
3. describe high lift devices
4. describe speed brakes and lift dump devices
5. describe the operation of manual flight control systems
6. describe the function and operation of gust lock systems
7. describe the process of balancing and rigging an aircraft
8. describe aircraft stall warning systems.

Range/Scope/Unit content

This outcome requires a knowledge of manual controls only:

List 1

Overview of (ATA 27) including: control wheels, cables, rods, linkages, chains, pulleys, control surface etc

For: aileron, elevator, rudder, spoiler

List 2

Overview of (ATA 27) including: manual trim, servo and anti-servo tabs

List 3

Overview of (ATA 27) including: control handles, cables, warning systems, linkages, control surfaces, position indicators for high lift devices including:

Trailing edge flaps

Leading edge flaps

Slats

Slots

List 4

Overview of (ATA 27) including: control handles, cables, warning systems, linkages, position indicators

Limiters for devices including:

Speed brakes

Variable aerodynamic fairings

Spoilers

Other drag and lift dumping devices

List 5

Overview of (ATA 27) manual flight control system operation including: cables and pulleys, push/pull rods, chain and sprocket, torque tubes, trim and balance, linkages, adjustment, inspection, maintenance, location and layout, fairleads, position indication

List 6

Detailed knowledge of (ATA 27) including: reasons for using gust locks, type of gust lock,
Methods of operation

List 7

Detailed knowledge of (ATA 27) including: reasons for balancing control surfaces, equipment, tools and methods of balancing a control surface

Reasons for checking control surface rigging, equipment, tools and methods of measuring and rigging control surfaces

List 8

Detailed knowledge of (ATA 27) including: sensors and detectors, stick shakers, stall warning audible and visual devices

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 9 Know aircraft fuel systems

Assessment Criteria

The learner can:

1. describe typical aircraft fuel system layouts
2. describe typical aircraft fuel tanks
3. describe typical aircraft fuel supply systems
4. describe typical fuel cross-feed and transfer systems
5. describe typical fuel indications and warnings
6. describe typical aircraft refuelling and defuelling systems.

Range/Scope/Unit content

List 1

Overview of (ATA 28) including: components of the fuel system, positioning and purpose of tanks, pumps, refuelling points, interconnection of system components, power supplies

List 2

Overview of (ATA 28)including: integral tanks, tip tanks, bladder cells, baffles, ventilation, cell and tank interconnectors, over-wing filler necks and caps, reservoir feed pumping system, in-tank reservoirs, leak detection and classification, tank sealing and repair, pressurisation, fire and explosion suppression

List 3

Overview of (ATA 28) including: pipework, pumps (including booster, ejector and backing), valves, strainers, emergency devices such as power plant fuel quick disconnect

List 5

Overview of (ATA 28) including: pipework, cross-feed pumps, transfer valves, fuel manifold

List 6

Overview of (ATA 28) including: fuel quantity, system pressure, temperature and flow; valve positions, warnings for tank pump pressure

List 7

Overview of (ATA 28) including: methods of refuelling, location and access to refuelling points, bonding, distribution to and from tanks during re-fuel/de-fuel.

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Outcome 10 Know hydraulic and landing gear systems

Assessment Criteria

The learner can:

1. describe typical aircraft system lay-outs
2. describe hydraulic filters and the types and properties of hydraulic fluids in use
3. describe typical hydraulic reservoirs and accumulators
4. describe hydraulic pressure generation (electric and mechanical)
5. describe typical hydraulic pressure control and power distribution
6. describe typical hydraulic system indication and warning systems
7. describe the construction and shock-absorbing action of aircraft landing gear
8. describe typical landing gear extension and retraction systems
9. describe typical landing gear indications and warning devices
10. describe wheels, brakes, antiskid and autobraking
11. describe typical aircraft tyres, their design, classification and application
12. describe typical aircraft landing gear steering and shimmy damping systems.

Range/Scope/Unit content

List 1

Overview of (ATA 29) including: components of a system, positioning and purpose of tanks, accumulators, valves, pumps, levers, switches, cables, pipework, seals, quick disconnection, wiring, and external connectors, up to but not including supply valves to individual systems

List 2

Overview of (ATA 29) including: mineral, synthetic hydrocarbon and phosphate-ester based fluids, properties (eg: low compressibility, low temperature performance, resistance to combustion, resistance to moisture and gas absorption), shelf life, importance of cleanliness, contamination checks, particular health and safety issues (eg: Skydrol)

Hydraulic filters: construction, filtering operation, maintenance, alert systems, types of filter (eg: metal element, two-stage)

List 3

Overview of (ATA 29) including: purpose, construction, operation of accumulators (diaphragm, bladder and piston type); reservoirs (reason for pressurisation, methods of pressurisation, control of pressure)

List 4
Overview of (ATA 29) including construction, operation, location and function of:
Electric and mechanical pumps (eg: constant and variable delivery, piston, gear, gerator, vane)

List 5
Overview of (ATA 29) including construction, operation, location and function of:
Pressure control: relief valves, regulators, reducers, thermal relief valves, de-boosters, cut-off valves, low-demand fluid circulation, protection from overpressure damage
Power distribution: manifolds, valves (eg: selector, in-line check, sequence, spool, rotary, priority, disconnect), hydraulic fuses

List 6
Overview of (ATA 29) including: pressure, flow, contents, temperature, contamination/clogging, transmitters, indicators, interconnection, warning methods

List 7
Overview of (ATA 32) including:
Arrangement: fixed, retractable tail wheel, tricycle, tandem, single wheel, double wheel, tandem wheel, bogie,
Construction: main and nose casting, torque link arms, pivot trunnion side braces, trunnion beam, drag brace/strut, shock strut cylinders, positioned, equaliser, pivot beam, pivot fork and shafts, up and down locks
Shock struts – construction and operation: types (metering pin, metering tube, separator piston), damping and snubbing devices, axles, mounting assemblies, glands, packing, seals and backing rings, charging and bleeding, ground locks, safety devices

List 8
Overview of (ATA 32) including:
Normal: electrical and hydraulic retraction and extension, locking methods, door mechanisms, extension and retraction sequencing
Emergency: pneumatic, hand pump and gravity, locking

List 9
Overview of (ATA 29) including: gear-located switches, cockpit indicators, warning devices (visual, mechanical, audible), typical retraction faults and associated cockpit indication

List 10
Overview of (ATA 29) including:
Types of wheel: material, detachable flange, split rim, wheel bearings, fusible plugs, inspection
Brake unit: construction, wear limits, maintenance/inspection
Hydraulic brake systems
Emergency brake systems
Parking brake systems
Mechanical/hydraulic anti-skid
Electro-hydraulic anti-skid
Auto-brake systems (landing, take-off, intensity settings, conditions for operation)

List 11

Overview of (ATA 29) including: bias (cross) ply, radial ply, tubed, tubeless, sidewall markings, tread patterns, wear limits, damage limits (eg: oil contamination, cuts, blisters)

List 12

Overview of (ATA 29) including: cockpit controls (wheel, tiller etc.), linkages (hydraulic, electrical, mechanical), pressurising assembly, power sources, metering valve, steering cylinders, compensator/accumulator, follow-up, safety valves, centring cam, differential assembly

Nosewheel shimmy damping: types of damper (piston, steer, vane), causes of shimmy.

Unit 008 Fundamentals of aircraft aerodynamics, structures and systems for piston engines

Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module11B – Turbine Aeroplane Aerodynamics, Structures and Systems. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the A2 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 2 (except 9-13 - EASA Level 1)
Outcome 3:	EASA Level 1
Outcome 4:	EASA Level 1
Outcome 5:	EASA Level 1
Outcome 6:	EASA Level 1 (except 6 - EASA Level 2)
Outcome 7:	Outcomes1, 2, 9, 10 - EASA Level 2 Outcomes 5-8, 11&12 – EASA Level 1
Outcome 8:	EASA Level 1
Outcome 9:	EASA Level 1
Outcome 10:	EASA Level 1 (except 7-12 - EASA Level 2)

Note: the 'ATA' references in the range and scope are there to indicate the boundaries of the subjects as defined the Air Transport Association of America Chapters, which are an industry standard for aircraft maintenance manuals and other documentation. These chapters are included in the EASA Part-66 syllabus for the same reason.

Note: the above list equates to the EASA requirement for category A2 licence and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Level: 3
Credit value: 12
UAN: H/503/1101

Unit aim

This unit aims to give the learner a broad and detailed knowledge of helicopter systems as part of a comprehensive training programme for aircraft maintenance engineers. It covers the complete syllabus for the EASA Part-66 Module 12 for the category A3 and A4 licences. including the amendment dated16 September 2010, fully effective 1 June 2013.

Learning outcomes

There are **ten** learning outcomes to this unit. The learner will be able to:

1. know aspects of rotary wing aerodynamics
2. understand the operation of helicopter flight controls
3. know blade tracking and the operation of helicopter transmission systems
4. understand helicopter airframe structures
5. know helicopter air conditioning, pneumatics and vacuum systems
6. know helicopter instrumentation and avionics systems
7. know helicopter electrical power and lighting
8. understand helicopter landing gear, equipment and furnishings
9. know helicopter fuel and hydraulic systems
10. know helicopter ice, rain and fire protection systems.

Guided learning hours

It is recommended that **115** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 3 NOS Units 310, 316 etc

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Improving Own Learning and Performance

Assessment and grading

This unit will be assessed by:

- A written examination covering underpinning knowledge.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 1 Know aspects of rotary wing aerodynamics

Assessment Criteria

The learner can:

1. describe terminology related to rotary wing aerodynamics
2. describe the effects of gyroscopic precession
3. describe torque reaction and directional control
4. describe dissymmetry of lift, blade tip stall
5. describe the translating tendency and its correction
6. describe the Coriolis Effect and its compensation
7. describe ground effect
8. describe vortex ring state, power settling, over-pitching
9. describe auto-rotation

Range/Scope/Unit content

List 1

Overview

Including terminology to enable an understanding of the fundamentals of rotary wing flight in the following categories: rotor blade architecture, production of lift by rotor blades considered as a spinning disc, control of lift and conversion into motion in vertical and horizontal planes, control of helicopter attitude and motion by altering rotor blade, rotor blade behaviour (eg: flap up, flap down, coning, blade tip vortex)

Configurations of rotorcraft eg: autogyro, dual rotor, single rotor

List 2

Overview including:

Application of basic gyroscope theory to a rotary wing aircraft:

Definition of gyroscopic precession

Effect on a spinning mass eg: rotor blades

List 3

Overview including:

Explanation of how torque is generated on helicopter with a single turning main rotor

Explanation of how dual rotor systems cancel out the torque

Different types of antitorque system eg: variable pitch tail rotor, fenestron (fan-in-tail), low pressure air duct producing a 'Coanda effect' lift force

How directional control is achieved

List 4

Overview including:

Definition of lift dissymmetry

Cause eg: differential relative airflow across the main rotor disc in forward flight

Effect on the aircraft without correction

Designed-in corrective action (eg: flap up and flap down)

Effect of increasing forward speed leading to retreating blade tip stall

Limiting effect on top speed (VNE)

List 5

Overview including:

Definition of translation tendency (drift) in a hovering single rotor helicopter

Counteracting translation tendency eg: tilting the main rotor mast, adjustment of flight control rigging, bias on the cyclic pitch control

List 6

Overview including:

Definition of the Coriolis Effect (Law of conservation of Angular Momentum)

Effect on spinning rotor blades

Effect on flight

Counteraction measures eg: underslung rotor, dampers, blade twist

Explanation of why an underslung two bladed rotor is least effected

List 7

Overview including:

Define ground effect and illustrate airflow through the rotor and underneath the aircraft

List 8

Overview including:

Define vortex ring state (settling with power)

Conditions under which it happens: eg: Low forward speed with high upflow into the rotor, descending exit from a ground effect hover, autorotation recovery

Effects eg: loss of rotor efficiency, secondary vortex ring, uncommanded pitch and roll oscillations, little or no cyclic authority

Corrective action eg: increase forward speed and/or partially lower the collective

Definition of over-pitching

List 9

Overview including:

Principles of autorotation, freewheeling unit, use of controls

Autorotation with forward speed – blade regions

Vertical autorotation – blade regions

Effects of excessively high or low autorotation RPM

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 2 Understand the operation of helicopter flight controls

Assessment Criteria

The learner can:

1. explain the principles of cyclic control
2. explain the principles of collective control
3. explain the principles of operation of a swash plate
4. explain the principles of yaw control
5. explain the design and operational features of a main rotor head
6. explain the function and construction of blade dampers
7. explain the construction and attachment of rotor blades
8. explain the construction and operation of trim control, fixed and adjustable stabilisers
9. explain the operation of flight control systems
10. explain the principles and operation of artificial feel
11. explain the principles and processes of balancing and rigging.

Range/Scope/Unit content

List 1

Detailed knowledge of: mechanical and electrical layout, control movement produced by each movement of the control, aerodynamic effect of each movement

Including grip mounted switches

Maintenance, typical faults, symptoms, causes, corrective measures

List 2

Detailed knowledge of: mechanical and electrical layout, control movement produced by each movement of the control, aerodynamic effect of each movement

Including throttle and the combined and separate effects of collective and throttle on rotor RPM and piston engine manifold pressure, function of a correlator/governor

Typical faults, symptoms, causes, corrective measures

List 3

Detailed knowledge of: purpose, design and mechanical layout, function, maintenance, typical faults, symptoms, causes, corrective measures

List 4

Detailed knowledge of: purpose, design and mechanical layout, function, maintenance, typical faults, symptoms, causes, corrective measures:

Anti-Torque Control

Tail rotor

Bleed air

List 5

Detailed knowledge of: types (fully articulated, semi-rigid, rigid); design and operation features purpose, mechanical layout, function, maintenance, typical faults, symptoms, causes, corrective measures

List 6

Detailed knowledge of: purpose, design and installation, function, maintenance, typical faults, symptoms, causes, corrective measures

List 7

Detailed knowledge of: design and installation, function, maintenance, typical faults, symptoms, causes, corrective measures:

Main and tail rotor blade construction and attachment

List 8

Detailed knowledge of: design and installation, function, maintenance, typical faults, symptoms, causes, corrective measures

List 9

Detailed knowledge of: design and installation, function, maintenance, typical faults, symptoms, causes, corrective measures

System types: manual, hydraulic, electrical and fly-by-wire

List 10

Detailed knowledge of: design and installation, function, maintenance, typical faults, symptoms, causes, corrective measures

List 11

Detailed knowledge of main rotor control system including: rigging procedure including freedom of operation, range of movement, throttle-collective correlation, synchronised elevator operation, friction

Detailed knowledge of tail rotor control system including: pedal travel, pedal alignment, T/R range of movement, cable tension, control chain twist and sprocket engagement, rod/tube adjustment.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 3 Know blade tracking and the operation of helicopter transmission systems

Assessment Criteria

The learner can:

1. describe the procedures for rotor alignment
2. describe the procedures for main and tail rotor tracking
3. describe the procedures for static and dynamic balancing
4. describe the common vibration types and vibration reduction methods
5. describe what is meant by ground resonance
6. describe the construction and operation of rotor gear boxes
7. describe the construction and operation of clutches, free wheel units and rotor brakes
8. describe the construction and installation of tail rotor power transmission components
9. describe the construction and function of vibration dampers and bearing hangers.

Range/Scope/Unit content

List 1

Overview including:

Alignment and adjustment procedures including when they are required, measurements, limits and limits and possible adjustments

List 2

Overview including: tracking and adjustment procedures including when they are required, measurements, limits and possible adjustments

Main rotor blades

Tail rotor blades

List 3

Overview including: static and dynamic balancing procedures including when they are required, measurements, limits and possible adjustments

List 4

Overview including: vibration types, their causes and methods of reducing the vibration levels

List 5

Overview of the phenomenon for example: associated with fully articulated rotor systems and can occur if the helicopter is touched down hard on one wheel. The resulting shock is transmitted to the main rotor system causing a change in rotor blade alignment along the drag hinge. If not corrected immediately the helicopter can shake itself to pieces very quickly.

List 6

Overview including: design and installation, function, maintenance, typical faults, symptoms, causes, corrective measures for:

Main rotor gearbox

Tail rotor gearbox

List 7

Overview including: design and installation, function, maintenance, typical faults, symptoms, causes, corrective measures for:

Clutches

Free wheel units

Rotor brakes

List 8

Overview including: design and installation, function, maintenance, typical faults, symptoms, causes, corrective measures for:

Drive shafts

Flexible couplings

Bearings

List 9

Overview including: design and installation, function, maintenance, typical faults, symptoms, causes, corrective measures for:

Vibration dampers

Bearing hangers.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 4 Understand helicopter airframe structures

Assessment Criteria

The learner can:

1. explain the airworthiness requirements for structural strength
2. explain the classification of aircraft structure
3. explain the concept of in-built safety
4. explain how locations on the airframe are defined
5. explain the physical effects of flying on aircraft structures
6. explain how moisture build-up in airframe structures is minimised
7. explain how airframe design allows for the installation of aircraft systems
8. explain how the aircraft is protected from lightning strikes and other static discharges
9. explain typical construction methods and techniques for the airframe structure
10. explain the construction and installation of typical pylons, stabilisers and undercarriage attachments
11. explain the construction and attachment of the seat installations
12. explain the construction and attachment of doors and windows
13. explain the construction and installation of fuel tanks
14. explain the construction and installation of engine firewalls
15. explain the construction and installation of engine mounts
16. explain how airframe symmetry is measured.

Range/Scope/Unit content

List 1

Eg: structural strength, strength-to-weight ratio, rigidity and flexibility

List 2

Primary, secondary and tertiary

List 3

Fail safe, safe life, damage tolerance concepts

List 4

Zonal and station identification systems

List 5

Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue

List 6

Drains and ventilation provisions

List 7

Including types of fuselage construction eg: monocoque, semi-monocoque

Systems eg: electrical system, engines (fuselage mounting points, cowlings, fuel tanks etc), transmission and rotor pylons, transmission shafts, pipework, reservoirs, tanks, attachment points for undercarriage etc

Structural assembly techniques: riveting, bolting, bonding

Methods of surface protection eg: chromating, anodising, painting

Surface cleaning

List 8

Lightning strike protection provision, aircraft bonding

List 9

Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning and anti-corrosive protection

List 10

Construction, function, installation and maintenance of:

Pylon and transmission mounts

Stabilisers: synchronised elevator/horizontal stabiliser, vertical stabiliser, fins

Undercarriage attachments

List 11

Construction, function, installation and maintenance of:

Seats, seat rails, operating and locking mechanisms

List 12

Construction, function, installation and maintenance of:

Doors: construction, mechanisms, operation and safety devices;

Windows and windscreen construction

List 13

Location, attachment, maintenance and inspection of

Integral tanks

Externally mounted tanks

Internally mounted (eg: ferry) tanks

List 14

Design, construction, materials, and installation of engine firewalls

List 15

Design, materials, construction location, attachment, maintenance and inspection of engine mounts for:

Piston engines

Gas turbine engines

List 16

Methods of alignment and symmetry checks including: datum points and lines, methods of measurement, preparation for measurement, recording data, calculations, tolerances, interpretation of data.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 5 Know helicopter air conditioning, pneumatics and vacuum systems

Assessment Criteria

The learner can:

1. describe where air is sourced for air conditioning and heating
2. describe the function of air conditioning systems
3. describe helicopter air distribution systems
4. describe air flow and temperature control systems;
5. describe air conditioning protection and warning devices
6. describe the lay-out and function of a typical pneumatic and vacuum system.

Range/Scope/Unit content

List 1

Overview (ATA21) including: gas turbine engine bleed, piston engine systems, ground cart

List 2

Overview (ATA21):

Types of system, equipment, function, installation and maintenance

Bleed air heating

Exhaust heat exchanger

Ram-air cooling

List 3

Overview of (ATA21) including: ducting (shape, material, size), attachment and routing, outlets

List 4

Overview of (ATA21) including: sensors, positioning, indication and control units

List 5

Overview of (ATA21) eg: over-temperature, noxious gas, flow rate

List 6

Overview of (ATA 36) including:

System lay-out

Sources: engine driven compressors, bleed air, air bottles, ground supply

Pressure control including manual and automatic control valves, pressure relief valves

Distribution - hardware including pipework, valves, manifolds, selectors, isolators

Indications and warnings

Interfaces with other systems.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 6 Know helicopter instrumentation and avionics systems

Assessment Criteria

The learner can:

1. describe typical pitot static flight instruments
2. describe typical gyroscopic flight instruments
3. describe typical aircraft compasses
4. describe the function of vibration indicating systems — HUMS
5. describe indications provided for other aircraft systems
6. describe the layout and operating fundamentals of auto flight control systems
7. describe the layout and operating fundamentals of communication systems
8. describe the layout and operating fundamentals of navigation systems.

Range/Scope/Unit content

List 1

Overview (ATA 31):

Altimeter, air speed indicator, vertical speed indicator

Construction, function, aircraft installation

List 2

Overview (ATA 31):

Artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator

Single instrument displays, glass cockpit: construction, function, aircraft installation

List 3

Overview (ATA 31):

Direct reading, remote reading

Single instrument displays, glass cockpit: construction, function, aircraft installation, adjustment

List 4

Overview of Vibration Health Monitoring (VHM)/HUMS sensors, parameters measured, alarms and alerts, information provided, pilot interface

List 5

Overview (ATA 31) including indications for: engines, electrical power, fuel system, hydraulics, undercarriage, flying controls, environmental

Including temperature, current, voltage, mass air flow, contents, fluid flow, pressure, position

Integrated Modular Avionics (ATA 42) – overview of modules such as:
Bleed management, air pressure control, air ventilation and control, avionics and cockpit ventilation control, temperature control, air traffic communication, avionics communication router, electrical load management, circuit breaker monitoring, electrical system bite, fuel management, braking control, steering control, landing gear extension and retraction, tyre pressure indication, oleo pressure indication, brake temperature monitoring, etc.
Overview of Core System, Network Components.

Overview of On Board Maintenance Systems (ATA45):
Central maintenance computers;
Data loading system;
Electronic library system;
Printing;
Structure monitoring (damage tolerance monitoring).

Overview of Cabin Systems (ATA 44):
Interface between cockpit/cabin crew and cabin systems
Functions such as: access to pre-departure/departure reports, email/intranet/Internet access, passenger database;
Server
Cabin Core System; server interfacing with:
Flight attendant panels
In-flight Entertainment System;
External Communication System;
Cabin Mass Memory System;
Cabin Monitoring System;
Miscellaneous Cabin Systems

Information Systems (ATA46)
Note: Does not include units or components installed for other uses and shared with other systems, such as flight deck printer or general use display

Overview of, for example:
Air Traffic and Information Management Systems and Network Server Systems
Electronic library mass storage and controller
Aircraft General Information System
Flight Deck Information System
Maintenance Information System
Passenger Cabin Information System
Miscellaneous Information System

List 6

Overview including:

Auto Flight (ATA 22): Stability Augmentation System (SAS), autopilot

Layout and fundamentals of operation of including:

Force trim system

Two-axis system

Three-axis system

Four-axis system

Sensors and inputs

Servomotors and actuators

Computers and interfaces with other systems

Controllers and indicators

Manual over-rides and safety cut outs

List 7

Overview including:

Communications (ATA 23): HF, VHF, UHV, Satcom, data links, audio systems (Interphone, intercom), audio integration

Layout and fundamentals of operation of including:

Controllers, transmitter/receivers, antennae,

List 8

Overview including:

Navigation Systems (ATA 34):

Flight environmental data (eg: pitot-statics, temperature, rate of climb, central air data computer)

Attitude and direction (eg: compasses, attitude director, vertical and direction references)

Landing and taxiing (eg: Localiser, glide slope, ILS markers, ground guidance)

Independent position finding (eg: anti-collision, weather radar),

Dependent position finding (eg: DME, VOR, ADF, GPS)

Flight management computers (eg: performance data, course, display, warnings).

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 7 Know helicopter electrical power and lighting

Assessment Criteria

The learner can:

1. describe typical helicopter battery installations and their operation
2. describe helicopter DC power generation systems
3. describe helicopter AC power generation systems
4. describe helicopter emergency power generation
5. describe helicopter power distribution
6. describe inverters, transformers, and rectifiers
7. describe helicopter external and ground power systems
8. describe helicopter lighting systems.

Range/Scope/Unit content

List 1

Overview of including (ATA 24): batteries and battery installations, safety when charging, handling and operating batteries, care and maintenance of batteries, battery performance and testing, aircraft battery installations

List 2

Overview including:

(ATA 24) eg: starter/generators, alternators, installation, drive systems, indication,

List 3

Overview of including (ATA 24): constant speed drive (oil system, connecting devices, indicating and warning systems), alternators, generators, installations

List 4

Overview of including (ATA 24): emergency battery power, air driven turbines

List 5

Overview of including (ATA 24): bus bars, load sharing, paralleling, real load, reactive load, bus tie contactors, voltage regulation, circuit protection

List 6

Overview of (ATA 24): rotary and static invertors, power and current transformers, rectifiers (single and 3 phase, full and half-wave), transformer-rectifier units

List 7

Overview of including (ATA 24): AC and DC ground power units, DC battery cart, rectifiers, invertors, connectors (number, purpose and length of pins, compatibility) connection and disconnection procedures, power on/off procedures, earthing, safety precautions

List 8

Overview of (ATA 33): external lighting - navigation, anti-collision, landing, taxiing, ice

Internal lighting: cabin, cockpit

Fitting of strobe lights to helicopters

Emergency lighting.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 8 Understand helicopter landing gear, equipment and furnishings

Assessment Criteria

The learner can:

1. explain the construction and shock-absorbing action of helicopter landing gear
2. explain typical helicopter landing gear extension and retraction systems
3. explain typical helicopter landing gear indications and warning devices
4. explain helicopter wheels, brakes
5. explain typical helicopter tyres, their design, classification and application
6. explain typical helicopter landing gear steering and shimmy damping systems
7. explain typical helicopter skids, floats and skis
8. explain the requirements for helicopter emergency equipment
9. explain helicopter seats, harnesses and belts
10. explain helicopter lifting systems
11. describe helicopter emergency flotation systems
12. describe helicopter cabin lay-out and cargo retention equipment
13. describe the typical layout of equipment in a helicopter
14. describe typical helicopter cabin furnishing installations.

Range/Scope/Unit content

List 1

Detailed knowledge of (ATA 32) including: reasons for shock-absorbing (eg: avoidance of ground resonance caused by shocks transmitted to the main rotor head), design, attachment, maintenance, inspection of shock absorbing mechanisms on:

Skids

Floats

Skis

Wheels including: construction and configuration

List 2

Detailed knowledge of (ATA 32) including:

Normal: electrical and hydraulic retraction and extension, locking methods, door mechanisms, extension and retraction sequencing

Emergency: pneumatic, hand pump and gravity, locking

List 3

Detailed knowledge of (ATA 29) including: gear-located switches, cockpit indicators, warning devices (visual, mechanical, audible), typical retraction faults, associated cockpit indication and air-ground sensing

List 4

Detailed knowledge of (ATA 29) including:

Types of wheel: material, detachable flange, split rim, wheel bearings, fusible plugs, inspection

Brake unit: construction, wear limits, maintenance/inspection

Hydraulic brake systems

Emergency brake systems

Parking brake systems

List 5

Detailed knowledge of (ATA 29) including: bias (cross) ply, radial ply, tubed, tubeless, sidewall markings, tread patterns, wear limits, damage limits (eg: oil contamination, cuts, blisters)

List 6

Detailed knowledge of (ATA 29) including: cockpit controls (wheel, tiller etc.), linkages (hydraulic, electrical, mechanical), pressurising assembly, power sources, metering valve, steering cylinders, compensator/accumulator, follow-up, safety valves, centring cam, differential assembly, main bogie steering

Nosewheel shimmy damping: types of damper (piston, steer, vane), causes of shimmy

List 7

Detailed knowledge of the design, construction, attachment, maintenance, and inspection of:

Skids

Floats

Skis

List 8

(ATA 25) including: life rafts and jackets, emergency locator beacons (surface and underwater), first aid kit, flares, evacuation equipment

List 9

(ATA 25) including: passenger seats, seat belts and extensions, other special restraints, first class sleeping berths

Crew seats, seat belts and harnesses

List 10

(ATA 25) design, construction, attachment, maintenance, and inspection of helicopter lifting gear above the point at which the load is released eg:

Hoists, attachment points, beams, load panels, load poles, cargo release units

List 11

Overview of:

(ATA 25) design, construction, attachment, maintenance, and inspection of helicopter emergency floatation systems eg:

List 12

Overview of:

(ATA 25) design, construction, attachment, maintenance, and inspection of helicopter cargo restraint equipment

Typical cabin layouts

List 13

Overview of:

(ATA 25) typical helicopter equipment layouts including: electronic equipment bays, emergency equipment, mechanical linkages, controls, electrical panels etc

List 14

Overview of:

(ATA 25) typical helicopter furnishing layouts including: removable bulkheads, carpets, lavatories, galley equipment etc.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 9 Know helicopter fuel and hydraulic systems

Assessment Criteria

The learner can:

1. describe the lay-out and functioning of a typical helicopter fuel system
2. describe typical fuel indications and warnings
3. describe helicopter refuelling and defuelling
4. describe typical helicopter system lay-outs
5. describe hydraulic filters and types and properties of hydraulic fluids in use in helicopters
6. describe typical helicopter hydraulic reservoirs and accumulators
7. describe helicopter hydraulic pressure generation
8. describe typical helicopter hydraulic pressure control and power distribution
9. describe typical helicopter hydraulic system indication and warning systems
10. describe how helicopter hydraulic power systems interface with other systems.

Range/Scope/Unit content

List 1

Overview of including (ATA 28): layout, location and functioning of supply and fuel control systems for both gas turbine and piston engines including:

Piston engine, gravity feed: fuel tanks, pipework, supply pumps, transfer pump, priming pump, shut-off valves, fuel strainer, throttle control, carburettor, vents, drains, refuelling points

Pressurised supply systems – fuel injected piston engines and gas turbines: engine driven pumps, electric pumps, fuel manifold

List 2

Overview of including (ATA 28): fuel flow, contents and pressure sensors, indicators, warning lights and feeds to FADEC etc.

List 3

Overview of including (ATA 28):

Standard refuelling procedure ie: engine(s) off, rotors stationary – earthing, safety precautions, fuel sampling

Hot refuelling ie: engine(s) running/rotors turning – additional safety precautions

List 4

Overview of (ATA 29) including: multiple system integration, functions and features of each system, components of a system, positioning and purpose of tanks, accumulators, valves, pumps, levers, switches, cables, pipework, seals, quick disconnection, wiring, and external connectors, up to but not including supply valves to individual systems

List 5

Overview of (ATA 29) including: mineral, synthetic hydrocarbon and phosphate-ester based fluids, properties (eg: low compressibility, low temperature performance, resistance to combustion, resistance to moisture and gas absorption), shelf life, importance of cleanliness, contamination checks, particular health and safety issues (eg: Skydrol)

Hydraulic filters: construction, filtering operation, maintenance, alert systems, types of filter (eg: metal element, two-stage)

List 6

Overview of (ATA 29) including: purpose, construction, operation of accumulators (diaphragm, bladder and piston type); reservoirs (reason for pressurisation, methods of pressurisation, control of pressure)

List 7

Overview of (ATA 29) including: construction, operation, location and function of:

Normal operation: electrical and mechanical pumps (engine gear driven, bleed air driven),

Emergency: hand operated double-acting and ram air turbine pumps, auxiliary tanks and accumulators, valves and pipework

List 8

Overview of (ATA 29) including: construction, operation, location and function of:

Pressure control: relief valves, regulators, reducers, thermal relief valves, de-boosters, cut-off valves, low-demand fluid circulation, protection from overpressure damage

Power distribution: manifolds, valves (eg: selector, in-line check, sequence, spool, rotary, priority, disconnect), hydraulic fuses

List 9

Overview of (ATA 29) including: pressure, flow, contents, temperature, contamination/clogging, transmitters, indicators, interconnection, warning methods

List 10

Overview of (ATA 29) including with: electrical and emergency systems.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Outcome 10 Know helicopter ice, rain and fire protection systems

Assessment Criteria

The learner can:

1. describe ice formation and classification, and ice detection systems
2. describe typical helicopter anti-icing systems
3. describe helicopter de-icing systems
4. describe helicopter rain removal systems
5. describe helicopter fire and smoke detection and warning systems
6. describe helicopter fire extinguishing systems.

Range/Scope/Unit content

List 1

Overview of (ATA 30): eg: glaze ice, rime ice, mixed (cloudy) ice, super-cooled large droplets, runback ice, intercycle ice. From eg: supercooled moisture, freezing rain/drizzle, snow

Detection systems eg: optical, ultrasonic, cold soak

List 2

Overview of (ATA 30): electrical, hot air and chemical

Aerofoils, air intakes, pitot and static, windows, windshields and doors, antennas and radomes, propellers, probe and drain heating

List 3

Overview of:

(ATA 30): Rain repellent, wiper systems

List 4

Overview of (ATA 26) including:

Fire detection: continuous element or pressure type sensor responder, fire wire, thermal switch, thermocouple, infra-red

Smoke detection: carbon monoxide, photoelectric, visual, infra-red

Central warning systems: operation and indications, inputs, outputs, priority philosophy

System inspection, maintenance and test

List 5

Overview of (ATA 26) including: extinguishing agents, positioning of fire extinguisher units, method of initiating

System inspection, maintenance and test.

Unit 009 Fundamentals of helicopter aerodynamics, structures and systems

Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 (amended by 1149/2011) part 66 Basic Knowledge Requirements Module12 – Helicopter Aerodynamics, Structures and Systems. dated 16 September 2010, fully effective 1 June 2013. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the A3 and A4 categories - 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 2
Outcome 3: EASA Level 1
Outcome 4: EASA Level 2 (except 9-16 - EASA Level 1)
Outcome 5: EASA Level 1
Outcome 6: EASA Level 1
Outcome 7: EASA Level 1 (except 8 - EASA Level 2)
Outcome 8: EASA Level 2 (except 11-14 - EASA Level 1)
Outcome 9: EASA Level 1
Outcome 10: EASA Level 1

Note: the 'ATA' references in the range and scope are there to indicate the boundaries of the subjects as defined the Air Transport Association of America Chapters, which are an industry standard for aircraft maintenance manuals and other documentation. These chapters are included in the EASA Part-66 syllabus for the same reason.

Note: the above list equates to the EASA requirement for category A3 and A4 licences and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject.

Unit 010 Fundamentals of aircraft gas turbine engines

Level: 2

Credit value: 13

UAN: M/503/1103

Unit aim

This unit aims to provide learners with a basic understanding of aircraft gas turbine engines and their associated systems. It covers the complete syllabus for EASA Part-66 Module 15 for Category A licenses.

Learning outcomes

There are **seven** learning outcomes to this unit. The learner will be able to:

1. understand the fundamental principles of aircraft gas turbine engines
2. understand the operation of gas turbine engines
3. understand gas turbine fuels, lubricants and associated systems
4. understand gas turbine starting, ignition and air systems
5. understand gas turbine engine indication systems
6. understand auxiliary power units and power-plant installations
7. understand gas turbine engine monitoring, fire protection and ground operation

Guided learning hours

It is recommended that **115** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Level 2 Aeronautical Engineering NOS Unit 7

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Improving Own Learning and Performance

Assessment and grading

This unit will be assessed by:

- An internally marked short answer question paper covering underpinning knowledge.

Unit 010 Fundamentals of aircraft gas turbine engines

Outcome 1 Understand the fundamental principles of aircraft gas turbine engines

Assessment Criteria

The learner can:

1. explain the need for gas turbine propulsion
2. describe how the laws of motion and energy apply to the operation of gas turbine engines
3. describe shaped ducts
4. describe the constructional arrangement of turbojet, turbofan, turboshaft and turbo-prop engines.

Range/Scope/Unit content

List 1

In simple terms:

Limitations of a piston engine

Requirement to fly high and fast

Fuel economy

Power

List 2

In simple terms:

Newton's Third Law of Motion

Force

Work

Power

Energy

Acceleration

List 3

In simple terms:

Inlet

Convergent and divergent ducts

Intake design eg:

Pod, side, bifurcated, wing root, bellmouth, variable geometry, chin intake, S-duct

The effect shaped ducts have on gas flows

Velocity

Temperature

Acceleration

Intake anti-icing

List 4

In simple terms:
Compressor
Combustion
Turbine
Exhaust
Engine spools
Gearboxes including output drives
Propellers and rotors.

Unit 010 Fundamentals of aircraft gas turbine engines

Outcome 2 Understand the operation of gas turbine engines

Assessment Criteria

The learner can:

1. describe the operation of a compressor section
2. describe the operation of a combustion section
3. describe the operation of a turbine section
4. describe the operation of an exhaust section
5. describe the operation of the main gas turbine engine types.

Range/Scope/Unit content

List 1

In simple terms:
Purpose
Axial flow compressor
Centrifugal compressor
Single, twin and multi spool compressors
Rotors
Stators
Airflow

List 2

In simple terms:
Purpose
Typical materials
Combustion chambers
Air/fuel ratio

List 3

In simple terms:
Purpose
Materials
LP and HP turbines

List 4

In simple terms:
Purpose
Jet pipe/exhaust unit/propelling nozzle
Noise suppression
Reverse thrust
Thrust augmentation

List 5

In simple terms:
Turbojet
Turbo-prop
Turbo-shaft
Bypass (fan) engine
Torque producing engines
Thrust producing engines.
Simple explanation of engine rating and factors affecting performance

Unit 010 Fundamentals of aircraft gas turbine engines

Outcome 3 Understand gas turbine fuels, lubricants and associated systems

Assessment Criteria

The learner can:

1. describe the properties and specifications required for gas turbine fuels and lubricants
2. describe safety precautions applicable to gas turbine fuels and lubricants
3. describe gas turbine lubrication systems
4. describe gas turbine fuel systems.

Range/Scope/Unit content

List 1

In simple terms:
Specification
Viscosity
Calorific value
Synthetic oils
Additives eg anti icing

List 2

Fire
Contamination
Specification
Water sediment
Bacterial growth

List 3

In simple terms:
Purpose
Loss and re-circulatory systems
Engine oil level checks
Pumps
Filters
Replenishment documentation

List 4

In simple terms:
Purpose
Safety issues
Fuel tanks
Fuel pumps

Main and emergency switches
Filters
Refuelling
Defuelling
Fuel jettison
Fuel contents
Engine control and fuel metering (eg: FADEC).

Unit 010 Fundamentals of aircraft gas turbine engines

Outcome 4 Understand gas turbine starting, ignition and air systems

Assessment Criteria

The learner can:

1. describe the operation of a gas turbine starting system
2. describe the operation of a gas turbine ignition system
3. describe the operation of a gas turbine air system.

Range/Scope/Unit content

List 1

In simple terms:

Purpose

Types of starting systems eg: electric, air, gas turbine, hydraulic, cartridge

List 2

In simple terms:

Purpose

Typical ignition system components eg: high energy ignition units, igniter plug

Safety precautions

List 3

In simple terms:

Purpose

Anti icing

Internal cooling

External air services.

Unit 010 Fundamentals of aircraft gas turbine engines

Outcome 5 Understand gas turbine engine indication systems

Assessment Criteria

The learner can:

1. describe gas turbine exhaust/turbine temperature indications/indicators
2. describe gas turbine oil pressure/temperature indications/indicators
3. describe gas turbine fuel pressure/flow indications/indicators
4. describe gas turbine engine speed indications/indicators
5. describe gas turbine vibration measurement and indication
6. describe gas turbine engine thrust/torque/power indications/indicators.

Range/Scope/Unit content

List 1

In simple terms:
Gauges
Thermocouples
Warning panel/attention getters

List 2

In simple terms:
Temperature sensitive transmitter
Temperature indicator
Pressure switches/ transducers
Pressure gauge/indicator
Warning panel/attention getters

List 3

In simple terms:
Pressure switches/transducers
Pressure indicators/gauges
Fuel flow transmitters
Flow indicator
Warning panel/attention getters

List 4

In simple terms:
Engine speed indicator
Engine speed generator

List 5
In simple terms:
Vibration transmitter
Warning indicator

List 6
In simple terms:
Engine pressure transmitter
Engine pressure ratio
Engine turbine discharge pressure/jet pipe pressure systems
Torque transmitter
Torque indicator.

Unit 010 Fundamentals of aircraft gas turbine engines

Outcome 6 Understand auxiliary power units and power-plant installations

Assessment Criteria

The learner can:

1. describe the operation of a typical auxiliary power unit
2. describe a typical power plant installation.

Range/Scope/Unit content

List 1

In simple terms:
Purpose
Operation including safety monitoring
Protection systems

List 2

In simple terms eg:
Intakes
Exhaust and jet pipe
Firewalls
Cowlings
Acoustic panels
Engine mounts
Anti-vibration mounts
Accessories
Hoses
Pipes
Connectors
Wiring looms
Control cables and rods
Lifting and slinging points
Drains.

Unit 010 Fundamentals of aircraft gas turbine engines

Outcome 7 Understand gas turbine engine monitoring, fire protection and ground operation

Assessment Criteria

The learner can:

1. describe the operation of fire detection and extinguishing systems
2. describe the procedure for starting and engine ground run-up
3. describe engine monitoring systems
4. describe compressor washing
5. describe foreign object damage (FOD).

Range/Scope/Unit content

List 1

In simple terms:
Prevention of engine fire ignition
Engine cooling and ventilation
Fire detectors
Fire warning
Attention getters
Fire extinguishers and discharge nozzles

List 2

In simple terms:
Fire precautions
Performance checks
Mechanical integrity
Noise suppression
Safe running zones
Personal protective equipment

List 3

In simple terms:
Scheduled maintenance
Unscheduled maintenance
Oil sampling
Condition monitoring
Purpose
Equipment
Periodicity

List 4

In simple terms:

Reasons for washing compressors

Precautions when washing eg: blanking off electrics and air ducts to prevent ingress

Washing methods using water or detergent

Describe a typical compressor wash rig

List 5

Causes of foreign object damage eg:

Loose articles in or on the aircraft eg: loose panels, lost fasteners

Loose articles on taxiways, ramps etc

Types of foreign object damage to engines eg:

Impact damage to inlet components,

Damage by small, hard objects to compressor and turbine blades

Ways of preventing FOD eg

Strict cleaning and inspection of aircraft both inside and out

Following maintenance procedures and practices

Aircraft Runway and taxiway cleaning.

Unit 010 Fundamentals of aircraft gas turbine engines

Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 15 – Gas Turbine Engine. 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 3. – EASA Level 2)
Outcome 2: EASA Level 1 (except 3. – EASA Level 2)
Outcome 3: EASA Level 1
Outcome 4: EASA Level 1
Outcome 5: EASA Level 1
Outcome 6: EASA Level 1
Outcome 7: EASA Level 1
Outcome 8: EASA Level 1
Outcome 9: 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 011 Fundamentals of aircraft piston engines

Level: **2**

Credit value: **13**

UAN: **T/503/1104**

Unit aim

This unit aims to give the learner a comprehensive knowledge of aircraft piston engine principles. It covers the complete syllabus for EASA Part-66 Module 16 – Piston Engine, for Licence Categories A2 and A4

Learning outcomes

There are **eight** learning outcomes to this unit. The learner will be able to:

1. know the fundamentals of aircraft piston engines and their performance
2. know the construction of aircraft piston engines
3. know aircraft piston engine fuel and lubrication systems
4. know aircraft piston engine starting and ignition systems
5. know aircraft piston engine induction, exhaust, turbocharging, supercharging and cooling
6. know engine indication systems
7. know typical piston engine powerplant installation
8. know engine monitoring, ground operation, storage and preservation

Guided learning hours

It is recommended that **115** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 2 NOS Unit 007.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Improving Own Learning and Performance

Assessment and grading

This unit will be assessed by:

- A written examination covering and underpinning knowledge.

Unit 011 Fundamentals of aircraft piston engines

Outcome 1 Know the fundamentals of aircraft piston engines and their performance

Assessment Criteria

The learner can:

1. describe the ways in which the efficiency of a reciprocating engine is measured
2. describe the operating principles of different types of reciprocating engine
3. describe what is meant by piston displacement and compression ratio
4. describe various engine configurations and explain firing order
5. describe engine power calculation and measurement
6. describe the factors affecting engine power
7. describe fuel/air mixture and the effects of altering it.

Range/Scope/Unit content

List 1

Overview of:

Explanation and simple calculations for the following efficiencies:

Thermal eg: the ratio of work done to fuel used, expressed in heat or work units

Mechanical eg: the ratio of power developed by expanding gas in the cylinders to the power delivered to the output shaft

Volumetric eg: the volume of fuel/air charge (temperature and pressure corrected) compared with the total piston displacement of the engine (expressed as a percentage)

List 2

Overview of including:

Define: top dead centre (TDC), bottom dead centre (BDC), clearance volume, bore, stroke, swept volume, firing order, ignition timing, valve timing, 'heat engine', 'reciprocating engine'

Methods of ignition (spark and compression), arrangement of

Description of the Otto cycle – events during induction, compression, power and exhaust strokes

Illustrate the Otto cycle using spark ignition with simple diagrams showing piston and bore, crank, inlet and exhaust valves and spark plug

Illustrate the Otto cycle using compression ignition with simple diagrams showing piston and bore, crank, inlet and exhaust valves and injector

Description of the 2-stroke cycle using simple diagrams of piston, bore, ports, crank and spark plug describing events during the up and down strokes

Requirements for an engine suitable for aircraft eg: reliability, durability, maintainability, compactness, high power/weight ratio, high specific power output, fuel economy, low vibration, flexibility, cost

Advantages and disadvantages of each engine type for aircraft use

List 3

Overview of:

Definition of piston displacement and compression ratio

List 4

Overview of:

Explain the basic layout of in-line, vee and opposed engines

Explain the importance of numbering cylinders and different manufacturer conventions for similar engines

Explain firing order in different engine configurations

Explain the effect of the number of cylinders on smoothness of running

List 5

Overview of:

The relationship between 'free' horsepower, 'friction' horsepower and 'brake' or 'shaft' horsepower, how they are calculated and how they are measured

Perform calculations for the power values given appropriate data, in Imperial and metric (kW)

List 6

Overview of:

Factors including: icing, altitude, temperature, ram air, barometric pressure, humidity, manifold pressure

Define brake specific fuel consumption (BSFC) and calculate from given data

List 7

Overview of:

Define, with approximate fuel/air ratios:

Rich best power mixture

Lean best power mixture

Cruise power mixture

'Stoichiometric' mixture

Effects of varying mixture at different power settings

Causes of pre-ignition, backfire etc.

Unit 011 Fundamentals of aircraft piston engines

Outcome 2 Know the construction of aircraft piston engines

Assessment Criteria

The learner can:

1. describe the construction and assembly and function of the crank case and its contents
2. describe the construction, assembly and function of accessory gearboxes
3. describe the construction, assembly and function of cylinders, pistons and connecting rod assemblies
4. describe the construction, assembly and function of inlet and exhaust manifolds
5. describe the construction, assembly and function of valve mechanisms;
6. describe the construction, assembly and function of propeller reduction gearboxes.

Range/Scope/Unit content

List 1

Overview of:

Constructional features, function, classification, materials of items including: crank shaft, cam shafts, sumps, counterweights, vibration dampers, ball bearings (including thrust bearings, representative plain and roller bearings, oil seals

Typical defects to be found in the above, with causes and corrective action

Inspection and replacement of seals, packing and gaskets

Inspection of crankshafts and measurement of run-out

Maintenance of magnesium castings

Torque loading of components

List 2

Overview of:

Purpose, typical design, components, lubrication, location, fitting, operation, maintenance, typical defects, causes and corrective action

List 3

Overview of:

Constructional features, function, classification, materials of: pistons, gudgeon pins (fixed and floating), piston rings, cylinders, cylinder heads and connecting rods

Typical defects associated with each of the above – detection, cause, corrective action

Types of cylinder bore surface – rough, smooth, reasons for each, precautions when working with each, types of piston ring for each

Maintenance of piston rings – gap measurement, adjustment

Piston ring stagger - reasons

Compression testing – equipment, methods, typical results, limits

Removing and fitting cylinder assemblies

Attachment of cylinder heads and bores

List 4

Overview of:

Constructional features, function and materials of exhaust and inlet manifolds

Attachment, gaskets and seals, inspection, typical defects, corrective action

List 5

Overview of:

Cam followers, push rods, inlet and exhaust valves sodium filled exhaust valves, seats, guides, springs, rocker assemblies, tappets (including hydraulic)

Valve springs, fitting, number on each valve, prevention of binding

Checking of valve for bowing of stems, pitting, glazing and chipping

Valve clearances: purpose, procedure for checking and adjustment on engines with camshafts, effects of excessive valve clearance on valve timing and engine performance

Typical defects, causes, corrective action associated with valves and their operating mechanisms

List 6

Overview of:

Purpose, construction, attachment to engine, propeller attachment, lubrication, typical faults, causes and corrective actions.

Unit 011 Fundamentals of aircraft piston engines

Outcome 3 Know aircraft piston engine fuel and lubrication systems

Assessment Criteria

The learner can:

1. describe various carburettor types
2. describe fuel injection systems
3. describe electronic engine control
4. describe aviation fuels used in aircraft piston engines
5. describe lubricants used in aircraft piston engines
6. describe aircraft piston engine lubrication systems.

Range/Scope/Unit content

List 1

Overview of:

Float type:

Principles including: down-draft and up-draft configurations;

Components:

Control systems

Typical faults, symptoms, causes and corrective action

Advantages and disadvantages

Icing: fuel evaporation ice, throttle ice, impact ice; carburettor heat (sources, application)

Pressure injection type:

Principles including differences and advantages over float type

Components

Control systems

Typical faults, symptoms, causes and corrective action

Advantages and disadvantages

List 2

Overview of:

Types, construction and principles of operation

Types eg: Bendix, Continental

Main components, Bendix, including: fuel injector, airflow section, regulator section, fuel metering section, flow divider, fuel discharge nozzles

Main Components, Continental including: fuel injection pump, fuel/air control unit, fuel control unit, fuel manifold valve, fuel discharge nozzle

Typical faults, symptoms, causes and corrective action

Advantages and disadvantages

List 3

Overview of:

Operation of electronic engine control and fuel metering systems: EEC, ECU, FADEC

Types, construction and principles of operation – differences between EEC, ECU and FADEC, inputs, outputs, degrees of manual override, fault tolerant control, typical faults, symptoms, causes and corrective action

Systems lay-out and components

List 4

Overview of:

Properties and specifications (Avgas and jet fuel): fuel types, colour coding, grading, labelling

Fuel additives

Contamination – types, avoidance, sampling

Safety precautions: during engine maintenance (use for cleaning and preparing components), re-fuelling

Use of jet fuel in aircraft diesel engines

Use of automotive fuel in aircraft piston engines

List 5

Overview of:

Types, properties and specifications of lubrication oils including 2-stroke oil

Types, properties and specifications of grease used in aircraft engines

Safety precautions

List 6

Overview of:

Types of lubrication system (eg: pressure, splash, spray, combination) and application, components, system operation, system lay-out, typical faults, symptoms, causes and corrective action.

Unit 011 Fundamentals of aircraft piston engines

Outcome 4 Know aircraft piston engine starting and ignition systems

Assessment Criteria

The learner can:

1. describe typical piston engine starting and pre-heat systems
2. describe the types of magneto used in aircraft piston engines
3. describe the construction of ignition harnesses
4. describe the operation of spark plugs
5. describe low and high tension ignition systems.

Range/Scope/Unit content

List 1

Overview of:

Construction and principles of operation of starter system types including:

Direct –cranking electric (auto and manual engage), electric inertia; using external and internal power

Typical faults, symptoms, causes and corrective action

Pre-heat systems: purpose, construction, operation

Typical faults, symptoms, causes, and corrective action

List 2

Overview of:

Construction and principles of operation various magneto types eg: rotating coil, polar inductor, rotating magnet

Including mechanical and electrical layout, adjustment, typical faults, causes, symptoms and corrective actions (including purpose of and procedure for 'mag drop' testing pre-take-off

List 3

Overview of:

Ignition harnesses including: types of cable, connectors, suppression of radio interference, dual crossover system, maintenance, harness testing, typical faults, causes, symptoms and remedial actions

List 4

Overview of:

Spark plugs; importance of using plugs of the correct reach and temperature; operating life, maintenance, faults, causes, symptoms, corrective actions

List 5

Overview of:

High tension ignition systems: Construction, installation and operation, faults, causes, symptoms and corrective actions, advantages and disadvantages

Low tension ignition systems: reasons for development, advantages over high tension systems, Construction, installation and operation, faults, causes, symptoms and corrective actions.

Unit 011 Fundamentals of aircraft piston engines

Outcome 5 Know aircraft piston engine induction, exhaust, turbocharging, supercharging and cooling

Assessment Criteria

The learner can:

1. describe the construction and operation of piston engine induction systems
2. describe the construction and operation of piston engine exhaust systems
3. describe the principles and purpose of supercharging
4. describe the construction and operation of supercharging/turbocharging systems
5. describe piston engine cooling systems.

Range/Scope/Unit content

List 1

Overview of:

Non-supercharged (naturally aspirated) induction system: of: air scoop, ducting, carburettor, intake manifold, alternate air valve, temperature control unit, carburettor heat source, temperature sensor, fluid de-icing system

Inspection and maintenance, faults, causes, symptoms and corrective actions

List 2

Overview of:

Short stack and collector exhaust systems: construction and installation

Inspection and maintenance, faults, causes, symptoms and corrective actions

List 3

Overview of:

Principles of supercharging and its effects on engine parameters (eg: critical altitude, manifold air pressure

List 4

Overview of:

System terminology including: waste gate, compressor, turbine, intercooler, overboost

The difference between a supercharger and a turbocharger – advantages and disadvantages

Construction and installation of superchargers and turbochargers,

Control systems eg: automatic waste gate control, manual boost lever

System protection

Inspection and maintenance, faults, causes, symptoms and corrective actions

List 5

Overview of:

Air cooling systems: air inlet, baffles, cowl flaps (fixed and hinged), finned cylinders and cylinder heads, cylinder head temperature indication, augmenters,

Inspection, maintenance and adjustment, faults, symptoms, corrective action

Liquid cooling systems: internal cooling by oil (oil cooler), other liquid cooling systems.

Unit 011 Fundamentals of aircraft piston engines

Outcome 6 Know engine indication systems

Assessment Criteria

The learner can:

1. describe engine speed indication
2. describe cylinder head temperature indication
3. describe coolant temperature indication
4. describe oil pressure and temperature indication
5. describe exhaust gas temperature indication
6. describe fuel pressure and flow indication
7. describe manifold pressure indication.

Range/Scope/Unit content

List 1

Overview of:
Reason for displaying the information
Sensing: types of sensors, location output
Indication: types of indicator

List 2

Overview of:
Reason for displaying the information
Sensing: types of sensors, location output
Indication: types of indicator

List 3

Overview of:
Reason for displaying the information
Sensing: types of sensors, location output
Indication: types of indicator

List 4

Overview of:
Reason for displaying the information
Sensing: types of sensors, location output
Indication: types of indicator

List 5

Overview of:
Reason for displaying the information
Sensing: types of sensors, location output
Indication: types of indicator

List 6
Overview of:
Reason for displaying the information
Sensing: types of sensors, location output
Indication: types of indicator

List 7
Reason for displaying the information
Sensing: types of sensors, location output
Indication: types of indicator.

Unit 011 Fundamentals of aircraft piston engines

Outcome 7 Know typical piston engine powerplant installation

Assessment Criteria

The learner can:

1. describe the configuration of firewalls, cowlings and acoustic panels
2. describe the configuration of engine mounts and anti-vibration mounts
3. describe the configuration of feeders, connectors and wiring looms
4. describe the configuration of control cables and rods
5. describe the configuration of hoses, pipes and drains
6. describe the configuration of lifting points.

Range/Scope/Unit content

List 1

Overview

List 2

Overview

List 3

Overview

List 4

Overview including the need for duplicate inspections of engine controls

List 5

Overview

List 6

Overview

Unit 011 Fundamentals of aircraft piston engines

Outcome 8 Know engine monitoring, ground operation, storage and preservation

Assessment Criteria

The learner can:

1. describe procedures for starting and ground run-up of an aircraft piston engine
2. describe how to interpret engine power output and parameters
3. describe inspection of engine and components.

Range/Scope/Unit content

List 1

Overview of of:

Pre-start arrangements eg; aircraft position, safety of ground personnel, chocks, external checks

Pre-start checks eg: brakes, fuel, fluids, battery power, magneto switches, prop clearance, pitch settings, permissions, security of panels etc

Start procedure eg: engine priming, switch settings, starter operation, hand swinging, control settings, engage starter

Post start checks eg: RPM, pitch, mag drop checks, temperatures and pressures, carb heat, mixture, checks and measurements including cold cylinder check

Shut down procedure eg: idle cut-off, mixture, carb heat, mag drop checks, throttle, pitch, magneto switches, main battery power, fuel switches

List 2

Overview of the use of graphs and tables

List 3

Overview of inspection and checking procedures to criteria, tolerances and data specified by the engine manufacturer

Unit 011 Fundamentals of aircraft piston engines

Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Module 16 – Piston Engine. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the A2 and A4 categories - 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
Outcome 7: EASA Level 1
Outcome 8: EASA Level 1

Note: the above list equates to the EASA requirement for category A2 and A4 licences and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject.

Unit 012 Fundamentals of aircraft propellers

Level: 3

Credit value: 6

UAN: F/503/0859

Unit aim

This unit aims to provide learners with a detailed understanding of aircraft propellers, and associated systems. It contains the complete syllabus for EASA Part-66 Module 17 for A1 and A2 Categories.

Learning outcomes

There are **five** learning outcomes to this unit. The learner will:

1. understand propeller theory
2. understand propeller construction
3. understand propeller pitch control
4. understand propeller ice and rain protection systems
5. understand propeller maintenance, storage and preservation.

Guided learning hours

It is recommended that **50** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 3 NOS Units 143, 331 etc.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Communication
- Improving Own Learning and Performance

Assessment and grading

This unit will be assessed by:

- A written examination covering underpinning knowledge.

Unit 012 Fundamentals of aircraft propellers

Outcome 1 Understand propeller theory

Assessment Criteria

The learner can:

1. explain blade element theory
2. explain the effects of varying blade angles, angle of attack and rotational speed
3. explain propeller slip
4. explain the aerodynamic, centrifugal and thrust forces on a propeller
5. explain the torque effect of a propeller
6. explain the effect of relative airflow on a blade's angle of attack
7. explain vibration and resonance produced by a propeller.

Range/Scope/Unit content

List 1

In simple terms:

General configuration: fixed and variable pitch

Parts of the propeller, features of the blades

Division of the blades into an infinite number of thin elements used to calculate total forces on the blade

List 2

In simple terms

Coarse and fine pitch

Combinations of rotational speed, blade angle and angle of attack in different phases of flight

Reasons for each combination

List 3

Define: geometric pitch and effective pitch

Calculate propeller slip (geometric pitch – effective pitch)

List 4

In simple terms qualitative description using simple diagrams

List 5

Qualitative explanation

List 6

Qualitative explanation

List 7

Qualitative explanation.

Unit 012 Fundamentals of aircraft propellers

Outcome 2 Understand propeller construction

Assessment Criteria

The learner can:

1. describe materials and construction methods for propellers
2. explain basic propeller terminology
3. describe the construction of different types of propeller
4. describe how propellers and spinners are installed.

Range/Scope/Unit content

List 1

Overview of typical:

Materials for composite, wood and metal blades

Composite, laminated, single piece

List 2

Overview of eg: blade station, blade face, blade shank and hub assembly, cuffs, fixed pitch, reverse-pitch, feathering, tractor, pusher, tipping and shielding

List 3

In simple terms an overview of fixed and controllable pitch and constant speed propellers

List 4

In simple terms an overview of typical installations eg:

Techniques used to ensure correct fitment

Types of bolts and locking devices

Alignment

Measuring and testing.

Unit 012 Fundamentals of aircraft propellers

Outcome 3 Understand propeller pitch control

Assessment Criteria

The learner can:

1. describe propeller speed control and pitch change methods
2. describe feathering and reverse pitch
3. explain how overspeed protection is achieved.

Range/Scope/Unit content

List 1

In simple terms an overview of eg: flyweight governor, counterweight and piston, alpha and beta ranges, engine oil pressure, HP pump for metered pressure, electronic control, propeller control unit (PCU), pitch lock

Differences between typical piston engine and turbine engine systems

List 2

Reasons for feathering and reverse pitch controls

Overview of:

Methods of achieving necessary blade angles for each (eg: engine oil, feather pump)

Mechanism for unfeathering

Other methods

List 3

Overview of eg: overspeed governor, springs, flyweights.

Unit 012 Fundamentals of aircraft propellers

Outcome 4 Understand propeller ice and rain protection systems

Assessment Criteria

The learner can:

1. describe fluid de-icing equipment for propellers
2. describe electrical de-icing equipment for propellers.

Range/Scope/Unit content

List 1

In simple terms typical systems eg::
Fluid storage
Control
Ducting
Pumps

List 2

In simple terms typical systems eg:
Sensors
Switches
Cabling and connectors
Other controls.

Unit 012 Fundamentals of aircraft propellers

Outcome 5 Understand propeller maintenance, storage and preservation

Assessment Criteria

The learner can:

1. describe propeller static and dynamic balancing
2. describe propeller blade tracking
3. describe how damage to propeller blades is assessed
4. describe propeller treatment and repair schemes
5. describe basic procedures for propeller engine running
6. describe how propellers are typically stored and preserved.

Range/Scope/Unit content

List 1

In simple terms overview of:
Causes of propeller imbalance
Balance limits
Effects of an out-of-balance propeller
Balancing equipment
Balancing methods
Relative accuracy of static and dynamic balancing

List 2

In simple terms overview of:
Causes of out-of-track propeller blades
Effects of an out-of-track propeller blade
Methods of measuring tracking
Tracking limits
Repair and adjustment

List 3

In simple terms overview of:
Erosion, corrosion, delamination, impact damage
Visual inspection, x-ray, ultrasound, other methods
Limits

List 4

In simple terms overview of:
Types of damage that can and cannot be repaired
Typical repair and treatment schemes for each type of propeller construction eg: wood, composite, metal, and each area of the propeller
Limits for repairs
Post-repair measurements and actions such as balancing, tracking, tip clearance
Recording of repairs

List 5

Including: safety, authorisations,

Engine and propeller limits for ground running: power, condition, RPM

List 6

In simple terms overview of:

Methods of cleaning

Mounting to prevent distortion

Preservative coatings

Protective coverings – humidity and temperature-controlled bags and containers

Recovery from storage and preservation eg: cleaning, lubrication, inspection (visual, NDT), checking modification states.

Unit 012 Fundamentals of aircraft propellers

Notes for guidance

Practical assignments and short-answer papers will be set by the Centre using templates and examples provided by City & Guilds and approved by the External Verifier.

This unit contains the complete syllabi of EASA 2042/2003 part 66 Basic Knowledge Requirements Module17 – Propeller. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the A1 and A2 categories - 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

Note: the above list equates to the EASA requirement for category A1 and A2 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

Level: **3**

Credit value: **5**

UAN: **M/503/1263**

Unit 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 B1 and B2 licences.

Learning outcomes

There are **ten** learning outcomes to this unit. The learner will:

1. understand why human factors are important in aviation
2. understand features and limitations of human performance
3. understand aspects of social psychology
4. understand personal factors that affect human performance
5. understand how physical aspects of the working environment affect human performance
6. understand how categories of tasks can affect human performance
7. understand communication in the workplace
8. understand the causes of human error
9. understand the human factors aspects of aircraft incidents
10. understand risk assessments in aeronautical engineering environments.

Guided learning hours

It is recommended that **40** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Aeronautical Engineering Level 2 NOS Unit 001 and Level 3 NOS Unit 003.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Complete the **Key Skills** section **only** if the unit's outcomes have actually been signposted to one or more key skills qualifications, otherwise remove. Remove any key skills that aren't relevant.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Improving Own Learning and Performance
- Problem Solving
- Working with Others

Assessment and grading

This unit will be assessed by:

- An online multiple-choice test.

Unit 035 Human factors in aviation

Outcome 1 Understand why human factors are important in aviation

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 035 Human factors in aviation

Outcome 2 Understand features and limitations of human performance

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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 in 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.

Unit 035 Human factors in aviation

Outcome 3 Understand aspects of social psychology

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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? (eg 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.

Unit 035 Human factors in aviation

Outcome 4 Understand personal factors that affect human performance

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 035 Human factors in aviation

Outcome 5 Understand how physical aspects of the working environment affect human performance

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 035 Human factors in aviation

Outcome 6 Understand how categories of tasks can affect human performance

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 035 Human factors in aviation

Outcome 7 Understand communication in the workplace

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 035 Human factors in aviation

Outcome 8 Understand the causes of human error

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 035 Human factors in aviation

Outcome 9 Understand the human factors aspects of aircraft incidents

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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.

Unit 035 Human factors in aviation

Outcome 10 Understand risk assessments in aeronautical engineering environments

Assessment Criteria

The learner can:

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

Range/Scope/Unit content

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 and 3

Recommend ways of eliminating or reducing to an acceptable level, a range of identified risks

List 5

Steps 3 and 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

Notes for 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.

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.

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

About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

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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City & Guilds
1 Giltspur Street
London EC1A 9DD
T +44 (0)844 543 0000
F +44 (0)20 7294 2413
www.cityandguilds.com

WW-04-2675