QUALIFICATION HANDBOOK

# Level 3 Diploma in Aircraft Maintenance (Military Aircraft Electrical and Avionics) (2675-03)

**September 2017 Version 1.4**

City & Guilds


# Qualification at a glance

| | |
|---|---|
| **Subject area** | Aeronautical Engineering |
| **City & Guilds number** | 2675 |
| **Age group approved** | 16-18, 19+ |
| **Entry requirements** | City & Guilds does not set a minimum requirement for entry to this qualification. The apprenticeship framework **suggests** the following:<br><br>Employers would be interested in candidates that:<br>• Are keen and motivated to work in an engineering environment<br>• Are willing to undertake a course of training both on-the-job and off-the-job and apply this learning in the workplace<br>• Have previous work experience or employment in the sector<br>• Have completed a 14 to 19 Diploma in Engineering or Manufacturing<br>• Have completed a Young Apprenticeship in Engineering or other related area<br>• Have GCSEs in English, Maths and Science<br>• Have completed tests in basic numeracy, literacy and communication skills and have spatial awareness<br>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** | Assignment, 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 in Aircraft Maintenance (Military Aircraft Electrical and Avionics) | 575 | 720 | 2675-03 | 600/1971/2 |

| Version and date | Change detail | Section |
|---|---|---|
| 1.1 June 2013 | Amended Unit 30 | **Units** |
| 1.2 March 2014 | Correction in unit 203 - Density: $kgm^{-2}$ to Density: $kgm^{-3}$ | **Units** |
| 1.3 June 2014 | Amended Test Spec 5 | **Test Spec** |
| 1.4 September 2017 | Added TQT details<br><br>Deleted QCF | **Qualification at a glance and Structure**<br><br>**Throughout** |
| V2 February 2019 | Removed range from Unit 203 Outcome 1 List 3<br><br>Corrected layout and numbering | **Unit 203**<br><br>**All units** |


# 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:<br>• Level 2 NVQ Diploma in Aeronautical Engineering (City & Guilds 1789)<br>• Level 3 Diploma in Aircraft Engineering (City & Guilds 2675)<br>• Level 3 Certificate/Diploma in Aircraft Manufacturing (City & Guilds 4597)<br>• Level 3 Diploma in Survival Equipment (City & Guilds 5412) |

## Structure

Learners require a total of **72 credits** to achieve the Level 3 Diploma in Aircraft Maintenance (Military Aircraft Electrical and Avionics).

Learners can obtain a further 5 credits from the Elective Unit 111. However, these credits do not contribute to the required minimum for the qualification.

**Mandatory Units**

| Unit accreditation number | City & Guilds unit number | Unit title | Credit value |
|---|---|---|---|
| T/503/0888 | Unit 030 | Digital techniques and electronic instrument systems in aircraft | 9 |
| M/503/1263 | Unit 035 | Human factors in aviation | 5 |
| A/503/0956 | Unit 201 | Fundamentals of electronics and avionics | 10 |
| L/503/0959 | Unit 202 | Military policy and regulation in aviation | 4 |
| D/503/0965 | Unit 203 | Aerodynamics and control in a fixed-wing aircraft | 5 |
| J/503/1107 | Unit 208 | Maintaining aircraft electrical cables | 10 |
| J/503/1110 | Unit 209 | Electronics in aircraft | 9 |
| T/503/1216 | Unit 210 | Maintaining avionic and electrical systems in aircraft | 12 |
| D/503/1128 | Unit 215 | Aviation mathematics and science for technicians | 8 |

**Elective Unit**

| Unit accreditation number | City & Guilds unit number | Unit title | Credit value |
|---|---|---|---|
| D/503/0951 | Unit 111 | Working safely with aircraft armament systems | 5 |

## Total Qualification Time

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

| Title and level | GLH | TQT |
|---|---|---|
| Level 3 Diploma in Aircraft Maintenance (Military Aircraft Electrical and Avionics) | 575 | 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 D to E in English, Maths and Science. The selection process on behalf of employers may include initial assessment where applicants will be asked if they have any qualifications or experience that can be accredited against the requirements of the apprenticeship. They may also be required to take tests in basic numeracy and literacy, communications skills and spatial awareness. There may also be an interview to ensure applicants have selected the right occupational sector and are motivated to become an apprentice, as undertaking an apprenticeship is a major commitment for both the individual and the employer.'

**Recognition of prior learning**

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

## Age restrictions

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

# 3 Delivering the qualification

## Initial assessment and induction

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

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

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

## Support materials

The following resources are available for these qualifications:

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

# 4 Assessment

## Assessment of the qualification

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

**Mandatory Units**

| City & Guilds unit number | Unit title | Assessment method |
|---|---|---|
| 2675-030 | Digital techniques and electronic instrument systems in aircraft | CAA or Short-Answer |
| 2675-035 | Human factors in aviation | e-assessments |
| 2675-201 | Fundamentals of electronics and avionics | e-assessments |
| 2675-202 | Military policy and regulation in aviation | Centre Devised Assignment |
| 2675-203 | Aerodynamics and control in a fixed-wing aircraft | e-assessments |
| 2675-208 | Maintaining aircraft electrical cables | Centre Devised Assignment |
| 2675-209 | Electronics in aircraft | Centre Devised Assignment |
| 2675-210 | Maintaining avionic and electrical systems in aircraft | Centre Devised Assignment |
| 2675-215 | Aviation mathematics and science for technicians | e-assessments |

**Elective Unit**

| City & Guilds unit number | Unit title | Assessment method |
|---|---|---|
| 2675-111 | Working safely with aircraft armament systems | Centre Devised Assignment |

### Online multiple-choice assessments

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

### Centre set assignments

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

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

### Approval process for centre set assignments

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

## Time constraints

Timings for e-assessments are indicated in the test specifications. 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

**Test 1:** Unit 030 Further Digital Techniques and Electronic Instrument Systems in Aircraft Level 3

**Duration:** 45 or 60 minutes

| Outcome | Number of questions | % |
|---|---|---|
| 01 Understand electronic flight instrument systems (EFIS) | 4 | 10.5 |
| 02 Understand numbering systems and data methods | 6 | 12.5 |
| 03 Understand data buses and the standards applying to them | 3 | 8 |
| 04 Understand the operation of logic circuits and microprocessors | 4 | 11.5 |
| 05 Understand computer structure and the principles of software management control | 5 | 12.5 |

| | | |
|---|---|---|
| 06 Understand the principles of multiplexing | 3 | 6.5 |
| 07 Understand fibre-optic principles and their application in aircraft | 4 | 10.5 |
| 08 Understand the principles of displays used in modern aircraft | 3 | 9 |
| 09 Understand electrostatic sensitive devices and the electromagnetic environment | 4 | 9 |
| 10 Understand the general arrangement of typical electronic/digital aircraft systems and BITE. | 4 | 10 |
| **Total** | **40** | **100** |

**Test 2:** Unit 035 Human Factors in Aviation
**Duration:** 60 minutes

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

**Test 3:** Unit 201 Fundamentals of electronics and avionics
**Duration:** 90 minutes

| Outcome | Number of questions | % |
|---|---|---|
| 01 Understand the principles of electrical current and charge | 9 | 15 |
| 02 Understand the principles of aircraft electrical power generation | 8 | 13 |
| 03 Understand the principles and uses of aircraft batteries | 7 | 12 |
| 04 Understand the use of aircraft cables and associated devices | 8 | 13 |
| 05 Understand aircraft cabling tasks | 1 | 2 |
| 06 Understand aircraft power supplies | 7 | 12 |
| 07 Understand aircraft flight instruments and lighting systems | 7 | 12 |
| 08 Understand digital aircraft control and monitoring systems | 13 | 22 |
| **Total** | **60** | **100** |

**Test 4:** Unit 203 Aerodynamics and control in a fixed-wing aircraft
**Duration:** 90 minutes

| Outcome | Number of questions | % |
|---|---|---|
| 01 Know the basic properties of the Earth's atmosphere | 4 | 7 |
| 02 Understand the nature of airflow around aerodynamic bodies | 13 | 22 |
| 03 Understand the characteristics of the basic wing planforms | 4 | 6 |
| 04 Understand the principles of aircraft control | 9 | 15 |
| 05 Understand the principles of aircraft stability | 7 | 12 |
| 06 Understand the purpose and operation of secondary flying control surfaces | 10 | 16 |
| 07 Understand methods of balancing and trimming control surfaces | 6 | 10 |
| 08 Understand the basic theory of high speed flight | 7 | 12 |
| **Total** | **60** | **100** |

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

| Outcome | Number of questions | % |
|---|---|---|
| 01 Be able to use principles of arithmetic | 8 | 11.5 |
| 02 Be able to use SI, Imperial and US customary units | 7 | 10 |
| 03 Be able to manipulate algebraic expressions and formulae using standard techniques | 7 | 10 |
| 04 Be able to calculate physical properties of common two and three dimensional shapes | 5 | 7 |
| 05 Be able to use graphs to determine values and solve engineering problems | 6 | 8.6 |
| 06 Understand the nature of matter | 9 | 12.9 |
| 07 Understand principles of statics | 9 | 12.9 |
| 08 Understand principles of linear, angular and oscillating motion related to aircraft in flight | 8 | 11.4 |
| 09 Understand principles of dynamics related to aircraft in flight | 7 | 10 |
| 10 Understand principles of fluid motion related to aircraft in flight. | 4 | 5.7 |
| **Total** | **70** | **100** |

# 5 Units

## Availability of units

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

## Structure of units

These units each have the following:

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

# Unit 030 Digital techniques and electronic instrument systems in aircraft

**Level:** **3**
**Credit value:** **9**
**UAN:** **T/503/0888**

### Unit aim

This unit aims to give the learner an understanding of digital principles to enable further study of digital avionics systems. It contains the complete syllabus of Module 5 for category B2 licences.

### Learning outcomes

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

1. understand electronic flight instrument systems (EFIS)
2. understand numbering systems and data methods
3. understand data buses and the standards applying to them
4. understand the operation of logic circuits and microprocessors
5. understand computer structure and the principles of software management control
6. understand the principles of multiplexing
7. understand fibre-optic principles and their application in aircraft
8. understand the principles of displays used in modern aircraft
9. understand electrostatic sensitive devices and the electromagnetic environment
10. understand the general arrangement of typical electronic/digital aircraft systems and BITE.

### Guided learning hours

It is recommended that **70** 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 – numerous units

### 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:

- An internally marked short answer question paper.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 1 Understand electronic flight instrument systems (EFIS)

**Assessment Criteria**

The learner can:

1. explain the reasons for the ergonomic layout of an aircraft flight deck or cockpit
2. describe primary flight displays (PFD)
3. describe multi-function displays (MFD)
4. describe engine indicating and crew alerting systems (EICAS).

**Range/Scope/Unit content**

**List 1**

For a typical flight deck/cockpit eg:

Information priorities, ease of access, minimum distraction, positioning of information sources

**List 2**

The arrangement for a typical system:

Information sources, control units, layouts, monitoring, data processing alerting methods

**List 3**

The arrangement for a typical system:

Information sources, control units, layouts, monitoring, data processing, alerting methods

**List 4**

The arrangement for a typical system:

Information sources, control units, layouts, monitoring, data processing, alerting methods.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 2 Understand numbering systems and data methods

**Assessment Criteria**

The learner can:

1. explain the need for different numbering systems
2. explain the structure and rules of binary
3. explain the structure and rules of octal
4. explain the structure and rules of hexadecimal
5. convert numerical values between number systems
6. explain the principles of analogue-to-digital conversion
7. explain the principles of digital-to-analogue conversion.

**Range/Scope/Unit content**

**List 1**

Related to electronics and digital systems

Reasons why the base 10 system is generally not suitable for electronic systems

**List 2**

Including definitions of bit, byte, kilo, mega, tera

Binary Coded Decimal (BCD)

Uses in digital systems

Make simple calculations

**List 3**

Uses in digital systems

Make simple calculations

**List 4**

Uses in digital systems including use in representing memory addresses

Make simple calculations

**List 5**

Binary, binary coded decimal (BCD), hexadecimal, octal and decimal

Including use of tables

Learners should be able to readily convert four or five digit decimal values between systems

**List 6**

Including:

Positive and negative logic

Operation and application of A-D converters in aircraft systems

Inputs, outputs and limitations of a range of convertors

**List 7**

Including

Operation and application of D-A converters in aircraft systems.

Inputs, outputs and limitations of a range of convertors.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 3 Understand data buses and the standards applying to them

**Assessment Criteria**

The learner can:

1. explain data buses in aircraft systems
2. describe components of a data bus and their function
3. describe common data bus standards
4. explain the principles of data bus protocols.

**Range/Scope/Unit content**

**List 1**

Define the term 'data bus'

Explain the purpose of data buses applied to:

A range of civil and military systems with particular focus on at least one civil or military system

Data bus families eg: ARINC, Military

**List 2**

Typical components of aircraft data bus systems eg:

Transceiver, controller, cabling, fibre-optics

Aircraft Network/Ethernet

**List 3**

Describe their features and applications eg: ARINC 429, ARINC 629, MIL-STD-I 553 (DEF STAN 00-18)

**List 4**

Including the definition and composition of a databus word, explanation of error detection, parity and application of individual databus standards to types of aircraft system.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 4 Understand the operation of logic circuits and microprocessors

**Assessment Criteria**

The learner can:

1. explain logic gate symbols, tables and equivalent circuits
2. describe typical aircraft applications of logic circuits
3. explain the circuits represented by schematic diagrams of logic circuits
4. describe the basic layout and uses of a typical microprocessor
5. describe the operation of key components of a typical microprocessor.

**Range/Scope/Unit content**

**List 1**

AND, OR, NAND, NOR, NOT (invertor), XOR, XNOR

Symbols, truth tables, equivalent circuits

**List 2**

Practical examples relevant to the learner

**List 3**

Typical aircraft-related circuits

**List 4**

A typical generic microprocessor

**List 5**

Including: control and processing unit, clock, register, arithmetic logic unit.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 5 Understand computer structure and the principles of software management control

**Assessment Criteria**

The learner can:

1. explain computer related terminology
2. describe avionic computers
3. describe the operation of typical memory devices used in avionics
4. describe aircraft data storage systems
5. explain the issues surrounding aircraft software and its control.

**Range/Scope/Unit content**

**List 1**

Basic terminology eg: CPU, RAM, ROM, PROM, bus, interface

**List 2**

The layout, operation and interfaces of typical computers eg:

Inputs, outputs, processors, memory devices

**List 3**

Eg: RAM, ROM, PROM, EPROM, hard disk, CD/DVD, flash drive

**List 4**

Operation, advantages and disadvantages of typical data storage

**List 5**

Possible consequences of unauthorised and un-recorded software changes

Restrictions on changes and recording

Airworthiness requirements for the development and implementation of software changes.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 6 Understand the principles of multiplexing

**Assessment Criteria**

The learner can:

1. define multiplexing
2. explain why multiplexing is required how it is achieved
3. describe typical applications of multiplexing.

**Range/Scope/Unit content**

**List 1**

Basic definition

**List 2**

Eg: efficient use of transmission media
Multiplexers
Demultiplexers
Identification in logic diagrams

**List 3**

In avionic systems relevant to the learner.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 7 Understand fibre-optic principles and their application in aircraft

**Assessment Criteria**

The learner can:

1. describe aircraft fibre-optic cable
2. describe how fibre-optic cable is terminated
3. explain the advantages and disadvantages of using fibre-optics
4. describe the layout and operation of a fibre-optic data bus
5. describe applications of fibre optics in aircraft systems.

**Range/Scope/Unit content**

**List 1**

The construction and operation of typical eg:

Materials used, relative refractive indices, internal reflection, signal capacity

**List 2**

Typical methods eg: types of termination, preparation, importance of clean cut and polishing surfaces, care of outer casing when installing and working near fibre-optics

**List 3**

As against electrical wire eg: weight, reliability, cost, signal density, faultfinding, maintenance

**List 4**

Typical example eg: couplers, control terminals, remote terminals

**List 5**

Typical applications relevant to the learner.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 8 Understand the principles of displays used in modern aircraft

**Assessment Criteria**

The learner can:

1. explain how aircraft liquid crystal displays (LCD) function
2. explain how aircraft Light Emitting Diode (LED) displays function
3. explain how aircraft Cathode Ray Tube (CRT) displays function.

**Range/Scope/Unit content**

**List 1**

The principles and operation of typical displays:
Monochrome
Colour
Handling precautions

**List 2**

The principles and operation of typical displays
Monochrome
Colour
Handling precautions

**List 3**

The principles and operation of typical displays:
Monochrome
Colour
Handling precautions.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 9 Understand electrostatic sensitive devices and the electromagnetic environment

**Assessment Criteria**

The learner can:

1. define 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 SSDs
4. explain the principles of electromagnetic phenomena.

**Range/Scope/Unit content**

**List 1**

Basic definition including aircraft-related examples

**List 2**

Including precautions that can be taken by personnel to prevent static damage 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

**List 4**

Including their influence on aircraft electronic system maintenance

Description, implications, precautions and measures to ensure Electromagnetic Compatibility (EMC) and to prevent and protect from:

Electromagnetic Interference (EMI)

High Intensity Radiated Field (HIRF)

Lightning.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## Outcome 10 Understand the general arrangement of typical electronic/digital aircraft systems and BITE

**Assessment Criteria**

The learner can:

1. describe the general arrangements of digital/electronic aircraft systems
2. describe Built In Test Equipment (BITE) testing in digital/electronic aircraft systems.

**Range/Scope/Unit content**

**List 1 and List 2**

A range of typical systems relevant to the learner eg:
ACARS-ARINC Communication and Addressing and Reporting System
ECAM-Electronic Centralised Aircraft Monitoring
EFIS-Electronic Flight Instrument System
EICAS-Engine Indication and Crew Alerting System
FBW-Fly by Wire
FMS-Flight Management System
GPS-Global Positioning System
IRS-Inertial Reference System
TCAS-Traffic Alert Collision Avoidance System
Integrated Modular Avionics
Cabin Systems
Information Systems.

# Unit 030 Digital techniques and electronic instrument systems in aircraft

## 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 Quality Assurer.

This unit contains the complete syllabus of EASA 2042/2003 (amended by 1149/2011)part 66 Basic Knowledge Requirements Module 5 – Digital Techniques Electronic Instrument Systems, dated 16 Sept 2010, fully effective1 June 2013. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the B2 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 2
Outcome 3: EASA Level 2
Outcome 4: EASA Level 2
Outcome 5: EASA Level 2
Outcome 6: EASA Level 2
Outcome 7: EASA Level 2
Outcome 8: EASA Level 2
Outcome 9: EASA Level 3
Outcome 10: EASA Level 2

Note: the above list equates to the EASA requirement for category B2 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 B 1 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.

**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 i combination (such as in older people)
Sight eg:

- Long and short sight
- Optical illusion including the strobe effect
- Persistence
- Moving from light area to work in the dark
- Optimum lighting for typical tasks
- Long and short sight
- Use of spectacles and magnifiers

Hearing eg:

- High and low tone deafness
- Tinnitus
- Hearing damage, poor communication

Social isolation (at work and at home)

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

# 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.

# Unit 111 Working safely with aircraft armament systems

**Level:** 2
**Credit value:** 5
**UAN:** D/503/0951

### Unit aim

The aim of this unit is to give learners a solid grounding in safe working on aircraft fitted with armament systems and assisted escape systems (AAES).

### Learning outcomes

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

1. understand explosive safety
2. understand aircraft assisted escape systems (AAES)
3. know aircraft armament role equipment
4. know aircraft stores management systems
5. know aircraft gun systems
6. know aircraft missiles
7. understand aircraft countermeasure systems
8. know aircraft weapons
9. understand safety precautions for armed aircraft

### 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 7 and 8

### 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

(Note: due to the safety implications of this unit, and its product-specific content, the assessment must be centre-set. The pass-mark will be 100% in this case, which is the industry standard.

This unit will be assessed by:

- Centre-set multiple –choice test covering underpinning knowledge
- Centre-set practical assessment.

# Unit 111 Working safely with aircraft armament systems

## Outcome 1 Understand explosive safety

**Assessment Criteria**

The learner can:

1. describe what explosives are and how they are categorised
2. describe the Explosive Train
3. explain explosive lifing
4. describe the dangers of static electricity and explosive devices
5. define thunderstorm risk categories and actions
6. describe general explosive safety rules
7. describe dangers involving armed aircraft
8. state the use of role colours and hazard application bands on explosive devices
9. describe the United Nations classification of explosives
10. describe the dangers in relation to Radio Frequency hazards and Explosive devices.

**Range/Scope/Unit content**

**List 1**

Define the term 'explosive'
Define terms related to explosives:
Velocity of Detonation
Figure of Power
Figure of Insensitivity
Describe the hierarchy of explosives
Describe the difference between Low and High Explosive

**List 2**

Eg:
Step-up-System of Detonation
Low explosive train (eg: primer – igniter – propellant)
High explosive train eg:
Two-step (eg: detonator – explosive)
Three step (eg: detonator – booster – main charge)

**List 3**

Eg:
How explosives deteriorate over time
Effects of environment (temperature, humidity etc)
Labelling and recording of manufacture and expiry dates

**List 4**

Eg: potential to detonate when in contact with static discharge

**List 5**

Thunderstorm Category and Definition:

Category 1 (High) - Thunderstorms will develop / have developed in the area

Category 2 (Moderate) - Thunderstorms may develop in the area

Category 3 (Low) - Thunderstorms are not expected in the area. Category and Definition

**List 6**

General and organisation-specific rules contained in eg:

BAe Systems Explosive and Prohibited Weapons Safety (QMS)

JAP 100A

**List 7**

Armed aircraft danger areas potential risks

Eg:

Front – Guns, Missiles and Rockets.

Rear – Missiles, Rockets, Chaff and Flare, Towed Decoy, Smoke Marker/Sonar buoy Discharger.

Generally- Bombs, Ejector Release Units, Drop Tanks, Explosive Start Valves

**List 8**

Colour Coding and Marking of Stores:

Explosive stores carry markings used to indicate:

Primary role

Degree of danger or hazard to personnel who come in contact or handle them

**List 9**

Reason eg: to facilitate fire fighting

Explosives and ammunition divided according to their behaviour when involved in a fire

Symbols: orange coloured with black numerals denoting the fire division

**List 10**

Eg: spontaneous detonation of EEDs in the presence of external RF radiation

Define ‘intrinsically safe’.

# Unit 111 Working safely with aircraft armament systems

## Outcome 2 Understand aircraft assisted escape systems (AAES)

**Assessment Criteria**

The learner can:

1. describe ejection seats fitted to military fast-jet aircraft
2. describe ejection seat major assemblies
3. describe the purpose of ejection seat components
4. describe Command Ejection systems
5. describe Canopy Jettison and Fragmentation Systems.

**Range/Scope/Unit content**

**List 1**

One or more seats eg: Tornado, Typhoon
Including safety pin positions and other device selections for:
Safe for Parking
Safe for Maintenance

**List 2**

Description of:
BTRU
Drogue Gun
Head Box
Top Latch Assembly
Firing Units
Cartridges
Main Gun
QRF
Rocket Pack

**List 3**

Locate and explain the purpose of:
Main beam assembly
Main Gun Assembly
Top Latch Assembly
Seat pan Assembly
Parachute harness and head box
Quick Release Fittings (QRF)
Barostatic Time Release Unit (BTRU)
Drogue Gun/Parachute Deployment Unit (PDU)
Emergency Oxygen System (EO2)
Leg/Limb Restraint Systems
Harness Power Retraction Unit (HPRU)
Personal Equipment Conector (PEC)
Personal Survival Pack (PSP)

Auto Deployment Unit (ADU)
Auto Liferaft Inflation Unit (ALIU)
Trip rods
Armed/Safe/Egress Handle

**List 4**
For specific aircraft eg: Tornado, Typhoon:
Command Control Valve
Command Ejection Controller
Command Mode Selector

**List 5**
For specific aircraft eg: Tornado, Typhoon eg:
MDC
CLC.

# Unit 111 Working safely with aircraft armament systems

## Outcome 3 Know aircraft armament role equipment

**Assessment Criteria**

The learner can:

1. identify types of suspension lugs
2. identify items of carriage and release equipment used on aircraft
3. explain the operation of carriage and release equipment.

**Range/Scope/Unit content**

**List 1**

Purpose of including:
Bail Lugs
MACE Lugs

**List 2**

Including:
Wing Pylons
Fuselage Pylons
Twin Store Carrier (TSC)
Carrier Bomb Light Store (CBLS)
Ejector Release Units (ERU): No.122EX; LDERU; HDERU; ALDERU; AHDERU
Fuzing Units

**List 3**

Operation and purpose of including:
Wing Pylons
Fuselage Pylons
Twin Store Carrier (TSC)
Carrier Bomb Light Store (CBLS)
Ejector Release Units (ERU)
Fuzing Units.

# Unit 111 Working safely with aircraft armament systems

## Outcome 4 Know aircraft stores management systems (SMS)

**Assessment Criteria**

The learner can:

1. state the purpose of a SMS
2. identify the components of the SMS.

**Range/Scope/Unit content**

**List 1**

For typical aircraft:
Requirement for managing armament stores
Basic function of the SMS

**List 2**

Including:
Weapon Programming Unit
Weapon Control Panels
Attack / Weapon Release Button
Master Armament Safety Switch (MASS)
Late Arm Switch
Selective / Emergency Jettison
Trigger
Armament System Ground Test Switch (ASGTS).

# Unit 111 Working safely with aircraft armament systems

## Outcome 5 Understand aircraft gun systems

**Assessment Criteria**

The learner can:

1. state the purpose of aircraft gun systems
2. identify components of aircraft gun systems
3. explain the operation of aircraft gun systems.

**Range/Scope/Unit content**

**List 1**

Specific aircraft eg: Tornado, Typhoon

**List 2**

Locate and name components eg:
Breech
Barrel
Cocking mechanism

**List 3**

Eg:
Loading ammunition tanks
Cocking
Firing
Spent case ejection
Ammunition feed
Live round insertion.

# Unit 111 Working safely with aircraft armament systems

## Outcome 6 Know aircraft missiles

**Assessment Criteria**

The learner can:

1. identify Air-to-Air & Air-to-Ground missiles
2. identify components of an air-to-air missile
3. explain the operation of an air-to-air missile.

**Range/Scope/Unit content**

**List 1**

Identify and name missiles eg:
Sidewinder
ASRAAM
Brimstone
ALARM

**List 2**

Identify and name components of eg: Sidewinder

**List 3**

Explain the purpose and operation of eg: Sidewinder.

# Unit 111 Working safely with aircraft armament systems

## Outcome 7 Understand aircraft countermeasure systems

**Assessment Criteria**

The learner can:

1. identify countermeasure systems used on aircraft
2. state the purpose of countermeasure systems
3. explain the operation of countermeasure systems.

**Range/Scope/Unit content**

**List 1**

Eg:
Chaff
Flare

**List 2**

Eg: to disrupt and distract enemy airborne target acquisition systems

**List 3**

Including:
Chaff dispensers and the action of chaff
Flare dispensers and the action of flares.

# Unit 111 Working safely with aircraft armament systems

## Outcome 8 Know aircraft weapons

**Assessment Criteria**

The learner can:

1. identify bomb types including
2. identify major bomb components
3. identify role and hazard colour coding.

**Range/Scope/Unit content**

**List 1**

Eg:
3kg and14kg practice bombs

**List 2**

Tail units
Shear Wires
Lead Electrical Fuzing and Arming (LEFA)

**List 3**

Colour Coding and Marking of Stores

# Unit 111 Working safely with aircraft armament systems

## Outcome 9 Understand safety precautions for armed aircraft

**Assessment Criteria**

The learner can:

1. understand safety precautions relating to armed aircraft.

**Range/Scope/Unit content**

**List 1**

Including:

Aircraft Armed signs
Safe Approach to the aircraft
Angle of approach
Check the Master Armament Safety Switch
Undercarriage locks and earthing leads.

# Unit 111 Working safely with aircraft armament systems

## Notes for guidance

This unit has been designed to cover the essential safety knowledge required by all personnel working on or near aircraft that are fitted with any weapon or device that includes explosive charges. The nature of the subject requires a clear, unambiguous understanding of all of the safety rules, instructions and procedures and this unit allows recognition of an individual's achievement of that understanding. The knowledge in this unit will be assessed by both written and practical (walk-through) means to ensure that the learner is able to relate class-room knowledge to real working environments.

# Unit 201 Fundamentals of electronics and avionics

**Level:** 3
**Credit value:** 10
**UAN:** A/503/0956

### Unit aim
This unit aims to give the learner sufficient knowledge of aircraft electrical and avionic principles to allow further study on specific systems.

### Learning outcomes
There are **eight** learning outcomes to this unit. The learner will:
1. understand the principles of electrical current and charge
2. understand the principles of aircraft electrical power generation
3. understand the principles and use of aircraft batteries
4. know the use of aircraft cables and associated devices
5. understand aircraft cabling tasks
6. understand aircraft power supplies
7. understand aircraft flight instruments and lighting systems
8. understand digital aircraft control and monitoring systems

### Guided learning hours
It is recommended that **75** 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 121, 123 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
- Problem Solving
- Working with Others

### Assessment and grading
This unit will be assessed by:
- An online multiple choice test.

# Unit 201 Fundamentals of electronics and avionics

## Outcome 1 Understand the principles of electrical current and charge

**Assessment Criteria**

The learner can:

1. describe the structure of the atom
2. describe the distribution of electrical charge in different types of particle
3. describe the molecular structure of electrical materials
4. explain the principle of attraction and repulsion of charged particles
5. explain electrical conduction in different media
6. describe the nature of static electricity
7. describe safety precautions associated with static electricity
8. define terms associated with electricity
9. Illustrate the relationship between voltage, current, resistance and power.

**Range/Scope/Unit content**

**List 1**

To a depth which allows understanding of:

Electrical current

Static electricity

Molecules

Compounds

**List 2**

Atom

Molecule

Compound

**List 3**

To a depth which allows understanding of:

Electrical current

Operation of semi-conductors

Electrical resistance

Conductors

insulators

**List 4**

Simple explanation

Including Coulomb's Law

**List 5**

Solid, liquid, gas, vacuum

**List 6**

Eg:

Mechanism of formation of static electricity (friction then separation of different materials)

Types of materials

Environmental conditions

Generation of high discharge voltages

Potential to damage semiconductors etc

Practical examples

**List 7**

With practical, aircraft-related examples eg:

Refuelling

Conductive tyres

Workshop practice

Lox plants

**List 8**

Including SI and Imperial (where appropriate) units for each:

Coulomb

Charge

Current

Resistance

Conductance

Electron flow

Conventional current flow

Potential difference

Electromotive force

Voltage

Electrical power

**List 9**

Practically and theoretically:

Ohms Law

Kirchhoff's Current and Voltage Laws

Series and parallel

Solve practical problems

# Unit 201 Fundamentals of electronics and avionics

## Outcome 2 Understand the principles of aircraft electrical power generation

**Assessment Criteria**

The learner can:

1. describe how electricity can be produced using a range of methods
2. explain how to calculate the internal resistance of a battery
3. describe the features of a sinusoidal waveform
4. explain terms relating to a sinusoidal waveform
5. describe the features of other common wave forms
6. make calculations relating to alternating current, voltage and power
7. describe a range of sensors.

**Range/Scope/Unit content**

**List 1**

Including:

Light (photoelectric cells)

Heat Thermocouples)

Pressure (piezoelectric)

Chemical action (battery)

Magnetism and motion (generators)

**List 2**

Standard calculation

Include the effects of internal resistance on an electrical circuit

**List 3**

Including definitions of:

Phase

Frequency

Cycle

**List 4**

Sinusoidal values:

Instantaneous

Average

Root mean square

Peak

Peak-to-peak

**List 5**
Triangular (saw-tooth)
Square

**List 6**
Calculations for:
Instantaneous
Average
Root mean square
Peak
Peak-to-peak

**List 7**
The construction, operation and typical aircraft applications of eg:
Piezoelectric crystal
Thermocouple
Photoelectric cell/Light Dependent Resistor (LDR)
“Firewire”.

# Unit 201 Fundamentals of electronics and avionics

## Outcome 3 Understand the principles and uses of aircraft batteries

**Assessment Criteria**

The learner can:

1. explain the chemical action of electrical cells
2. describe aircraft batteries
3. explain how the state of charge of aircraft batteries can be determined
4. describe the mandatory safety precautions for the servicing of aircraft batteries
5. describe maintenance procedures for aircraft batteries
6. explain how aircraft batteries are capacity-tested
7. explain constant voltage and constant current charging of aircraft batteries
8. explain 'thermal runaway'

**Range/Scope/Unit content**

**List 1**

Basic principles
Qualitative explanation of action
Primary and secondary cells
Standard cell voltages

**List 2**

Construction and operation of typical:
Dry battery
Lead-acid battery
Nickel-cadmium battery
Other alkaline cells

**List 3**

Using standard procedures

**List 4**

Including during:
Charging
Testing
Transportation
Installation
Removal

**List 5**

Lead-acid
Nickel-cadmium

**List 6**
Explaining how and why, including:
Definition of capacity
Why capacity reduces
Consequences of un-noticed reduction in capacity
Minimum permissible capacity

**List 7**
Define constant current
Basic explanation of constant current charging
How and why it is done

**List 8**
Including:
How thermal runaway happens
Consequences of thermal runaway
How to avoid thermal runaway

# Unit 201 Fundamentals of electronics and avionics

## Outcome 4 Understand the use of aircraft cables and associated devices

**Assessment Criteria**

The learner can:

1. describe aircraft cables
2. explain the effect on performance of individual cables when placed in a loom or conduit
3. describe connector types used in aircraft
4. describe crimping tools used in aircraft applications
5. demonstrate the use of wire selection charts
6. describe installation procedures for aircraft cable looms
7. describe the process of soft soldering
8. describe the function and use of general aircraft test equipment
9. describe techniques for testing aircraft cables
10. explain aircraft electrical safety devices.

**Range/Scope/Unit content**

**List 1**

Define EWIS (Electrical Wiring Interconnection System)
The construction and purpose of typical cables eg:
High tension
Co-axial
'Kapton' (explain special safety issues)
Special-purpose
General purpose

**List 2**

Eg:
Reduced current-carrying
Possible signal interference

**List 3**

Eg connectors used for:
High tension
Power
Data
Communications
Fibre-optics

**List 4**

Full range of aircraft-use tools for, including:
Ring tongue terminals
Splices
Miniature connectors

Explain:
Construction and operation
Calibration and pre-use checks
Consequences of using an incorrectly calibrated crimp tool

**List 5**
Explain why and how they are used
Demonstrate using standard industry tables

**List 6**
Eg:
Safety precautions
Routing
Securing
Protection
Cooling
Screening
Individual cables
Looms
Connectors and connector pins

**List 7**
When and how it would be used including:
Flux
Solder composition
Heat sources
Cleanliness
Application
Joint inspection

**List 8**
Electrical and avionic general test equipment including:
Ammeter
Voltmeter
Multimeter (analogue and digital)
Basic oscilloscope

**List 9**
Including:
Automatic test equipment
Multimeter
Continuity tester
Insulation tester
Time Domain Reflectometer (TDR)

**List 10**
The function and use of devices such as:
Relays
Fuses
Differential current detection

# Unit 201 Fundamentals of electronics and avionics

## Outcome 5 Understand aircraft cabling tasks

**Assessment Criteria**

The learner can:

1. explain the use of crimping tools to terminate cables
2. explain construction processes for aircraft cable looms
3. describe how aircraft cables are identified using the ATA 100 system.

**Range/Scope/Unit content**

**List 1**

Use of a range of terminations and crimp tools eg:
Ring tongue terminals
Splices
Miniature connectors
Standard connectors
Testing crimp joints

**List 2**

General principles and methods using representative aircraft cable and components including:
Different sizes of cable
Different types of cable
Signal and power
Different types of loom tie
Inspection
Repair and maintenance
Standards of cleanliness

**List 3**

Marking systems eg: ATA100
Marking materials eg:
Ink
Sleeves
Stamping
For a range of cables eg:
Screened
Co-axial
High tension.

# Unit 201 Fundamentals of electronics and avionics

## Outcome 6 Understand aircraft power supplies

**Assessment Criteria**

The learner can:

1. describe aircraft battery systems
2. describe the layout of a generic multi-engine electrical power distribution system
3. describe components of an aircraft electrical power distribution system
4. describe the main categories of aircraft electrical-powered services
5. explain how aircraft electrical power is maintained in the event of emergencies
6. explain the sequence of connection and disconnection of aircraft ground/external electrical power
7. describe the standard dc and ac ground power connectors.

**Range/Scope/Unit content**

**List 1**

Block diagram

Including the purpose of each component

**List 2**

Block diagram

Including the purpose of each component

**List 3**

Generator

Constant speed drive unit

Main battery

Emergency battery

Rotary and static inverters

Transformer rectifier units

Generator control unit

Bus tie relay

Generator control relay

Battery isolation switch

RCCB (Reverse Current Circuit Breaker)

**List 4**

Vital services

Essential services

Non-essential services

**List 5**
Using:
Standby generators
Duplication of systems
Batteries
Emergency batteries
Ram air turbines
Transformer rectifier units
Static inverters
Auxiliary power unit

**List 6**
Engine(s) running, pre/post taxi
DC battery trolley
Ground maintenance
Petrol/diesel power set
Electric/electric power set

**List 7**
DC and AC connectors
Position and purpose of each pin.

# Unit 201 Fundamentals of electronics and avionics

## Outcome 7 Understand aircraft flight instruments and lighting systems

**Assessment Criteria**

The learner can:

1. explain the operation of pitot-static instruments
2. explain gyroscopic motion
3. explain the operation of gyroscopic flight instruments
4. compare the operation of direct and remote reading compasses
5. describe the layout and operation of aircraft stall warning systems
6. describe the layout and operation of the three main aircraft lighting systems.

**Range/Scope/Unit content**

**List 1**

Altimeter
Airspeed indicator
Vertical speed indicator
Mach meter

**List 2**

Qualitative explanation
Define related terms including:
Degrees of freedom
Rigidity
Precession
Gimballing
Topple

**List 3**

Principles and purpose of:
Artificial horizon
Attitude indicator
Direction indicator
Turn and slip indicator

**List 4**

Function, purpose and components of eg:
Emergency magnetic compass
Detector unit
Compass computer
Compass indicator

**List 5**
Typical arrangement and operation of eg:
Sensors
Warning devices

**List 6**
External: navigation, landing, taxiing, ice
Internal: cabin, cockpit, cargo
Emergency

# Unit 201 Fundamentals of electronics and avionics

## Outcome 8 Understand digital aircraft control and monitoring systems

**Assessment Criteria**

The learner can:

1. explain types of electrical signal
2. explain computer terminology
3. explain the purpose of a range of aircraft computer hardware
4. describe the main features of aircraft auto-flight control systems
5. explain radio signals
6. describe aircraft communication systems
7. describe the airborne navigation aids
8. explain the term 'databus'
9. describe aircraft electronic instrument systems
10. describe safety precautions when working on aircraft avionic equipment
11. describe aircraft onboard maintenance systems.

**Range/Scope/Unit content**

**List 1**

Analogue and digital

Simple explanation using sketched wave-forms

**List 2**

Commonly used terminology eg:

- Bit
- Byte
- Software
- Hardware
- CPU
- Chip

Memory:

- RAM
- ROM
- PROM
- Hard Drive

**List 3**

Input devices

Output devices

Microprocessor and interface devices

Visual display

Storage devices

**List 4**

Eg:
The inherent instability of aircraft
The need for automatic stabilisation
Axes of control
Sensing devices (eg: rate gyros)
Basics of negative and positive feedback and their effect on a control system
Full automatic control including heading and height
Inputs from other systems and ability to program in way-points etc

**List 5**

Simple explanation of what they are and how they are propagated:
Nature eg:
Electromagnetic waves
Basic frequency bands and their uses
Modulation types (frequency and amplitude)
Propagation eg:
Ionosphere
Sky wave
Typical ranges
Typical shapes of aircraft antennae

**List 6**

Typical layout and operation of:
VHF
UHF
HF
Intercom
Satcom

**List 7**

Basic function, inputs and outputs of:
VHF Omni-directional Ranging (VOR)
Instrument Landing System (ILS)
Automatic Direction Finder (ADF)
Distance Measuring Equipment (DME)
Global Positioning System (GPS)
Identification Friend or Foe/Secondary Surveillance Radar (IFF/SSR)
Traffic Alert and Collision Avoidance System (TCAS)
Weather Radar
Radio Altimeter
RNAV/FMS

**List 8**

Simple explanation including aircraft applications
Overview of databus types and designations

**List 9**

Layout and operation of a typical system eg:
Electronic Flight Instrument System (EFIS)
Engine Indicating and Crew Alerting System (EICAS)
Electronic Centralised Aircraft Monitoring (ECAM)
Automatic Flight Control System (ACS)

**List 10**

Eg:
ESD protection
Manual handling
Power management
Working at height

**List 11**

Typical layout, components and information outputs for a maintenance system eg:
Simple explanation of main monitoring areas and information output
Standard for OMS is ARINC 624

# Unit 201 Fundamentals of electronics and avionics

## Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 3 – Electrical Fundamentals for the EASA Category A licence. It also contains parts of the B category requirements for other relevant modules.

The unit is intended to give a broad understanding of electrical and avionics systems in preparation for studying units 019, 020 and 021 of this qualification.

This unit contains the syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 3 A Category and for parts of B Category modules The equivalent EASA knowledge level indicators for each of the above outcomes - required for the A Category items - 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 (Module 3)
Outcome 2: EASA Level 1 (Module 3)
Outcome 3: EASA Level 1 (Module 3)
Outcome 4: EASA Level 3 (Module 7.7 – B1 & B2)
Outcome 5: EASA Level 3 (Module 7.7 – B1 & B2)
Outcome 6: EASA Level 3 (Module 13.5 – B2 only)
Outcome 7: EASA Level 2 (Module 11.5 – B1 only)
Outcome 8: EASA Level 3 (Module 11.5 – B1 only)

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

# Unit 202 Military policy and regulation in aviation

**Level:** 3
**Credit value:** 4
**UAN:** L/503/0959

### Unit aim

This unit aims to give a working knowledge of military aviation policy and regulation and how aircraft maintenance records are created and archived.

### Learning outcomes

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

1. understand military aviation policy
2. understand military aviation documentation
3. be able to create and maintain military aircraft maintenance documentation.

### 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 2 NOS Units 001, 002 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 assessment covering practical skills and underpinning knowledge.

# Unit 202 Military policy and regulation in aviation

## Outcome 1 Understand military aviation policy

**Assessment Criteria**

The learner can:

1. describe the principal sources of military aviation policy
2. explain the responsibility of maintenance personnel towards local orders and procedures
3. describe the function of military organisational manuals in aircraft maintenance
4. explain the significance of signatures on aircraft maintenance documents
5. explain the levels of personal authority in military aircraft maintenance.

**Range/Scope/Unit content**

**List 1**

Eg:
Military Aviation Authority
JAP 100A (Military Aviation Engineering Policy & Regulations)
Current Single Service Aviation Engineering Orders and Procedures

**List 2**

Eg:
Any Local Military Aviation Engineering Orders

**List 3**

Eg:
AP 33376 (Trade Structure of the Royal Air Force)
Catalogue of Army Qualifications (CATAQ)
B.R. 3 (Naval Personnel Management)

**List 4**

Eg:
Legally binding signature
Implications of false declaration

**List 5**

Eg:
Signing for work
Supervisory
Individual authorisation
Acceptable Deferred Faults Log
Limitations Log
Authority levels (JAP 100A).

# Unit 202 Military policy and regulation in aviation

## Outcome 2 Understand military aviation documentation

**Assessment Criteria**

The learner can:

1. describe the content of military aircraft maintenance publications
2. explain the contents of the MOD Form 700 series
3. explain the independent check regulations
4. explain electronic data recording for maintenance purposes
5. explain terminology used in the Aircraft Safety and Servicing Notes
6. explain the purpose and typical content of maintenance instructions.

**Range/Scope/Unit content**

**List 1**

Eg:

System of numbering of Air Publications

Main titles common to all aircraft

Examples of main titles (eg: Power plant, Undercarriage, Communications etc.)

**List 2**

Eg:

Description

Legal status

Sections

Information contained in the folder

**List 3**

Purpose

From JAP100A-01 Chapter 6.10

**List 4**

a typical system of Purpose

What it records

How information is organised

Security provisions and procedures

How information is inserted

Legal status of entries

Password

Data accuracy

**List 5**

As required from list in JAP 100A-01 chapter 0.4

**List 6**

Purpose

From JAP 100A-01

Eg

- Special Technical Instructions (STI)
- Servicing Instructions (SI)
- Urgent Technical Instructions (UTI)
- Routine Technical Instructions (RTI)
- Modifications
- Special Trial Fits (STF)

# Unit 202 Military policy and regulation in aviation

## Outcome 3 Be able to create and maintain typical military aircraft maintenance documentation

**Assessment Criteria**

The learner can:

1. extract information from engineering Air Publications for given maintenance tasks
2. carry out all actions required to report a fault on an aircraft that renders it 'unserviceable'
3. complete all required documentation following an aircraft repair task
4. complete all required documentation following scheduled maintenance tasks
5. complete documentation for equipment or components removed from an aircraft.

**Range/Scope/Unit content**

**List 1**

For relevant trade tasks eg:

Diagnosis

Repair/replacement

Adjustment

Post-repair testing

**List 2**

Eg

MOD F700 series forms

Electronic data recording

**List 3**

Eg

MOD F700 series forms

Electronic data recording

**List 4**

Eg

MOD F700 series forms

Electronic data recording

**List 5**

Using relevant equipment conditioning documentation

# Unit 202 Military policy and regulation in aviation

## Notes for guidance

This unit has been produced to meet military aviation training requirements.

On completion of this unit the learner will be able to show a comprehensive knowledge of the aviation policy and regulation relating to the servicing of military aircraft.

Assessment is to be designed to demonstrate underpinning knowledge and use of relevant documentation.

# Unit 203 Aircraft aerodynamics and control in fixed-wing aircraft

**Level:** **3**
**Credit value:** **4**
**UAN:** **D/503/0965**

### 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 contains syllabi for the EASA 2042/2003 part 66 Basic Knowledge Requirements Module 8 and for part of Module 11A (11.1 only).

### Learning outcomes

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

1. know the properties of the Earth's atmosphere
2. understand the nature of airflow around aerodynamic bodies
3. understand the characteristics of the basic wing plan forms
4. understand the principles of aircraft control
5. understand the principles of aircraft stability
6. understand the purpose and operation of secondary flying control surfaces
7. understand methods of balancing and trimming control surfaces
8. understand the basic theory of high speed flight

### 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 140, 154 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
- Problem Solving
- Working with Others

### Assessment and grading

This unit will be assessed by:

- An online multiple choice test.

# Unit 203 Aircraft aerodynamics and control in fixed-wing aircraft

## 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. solve problems using the basic gas laws
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**

Boyle's Law
Charles' Law
Gay-Lussac's Law
Combined Gas Law

**List 4**

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

# Unit 203 Aircraft aerodynamics and control in fixed-wing aircraft

## 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
4. explain the effect of a stalled aerofoil on an aircraft in flight
5. describe the main characteristics of symmetrical and cambered aerofoils
6. describe how the airflow around aerofoils changes with angle of attack and velocity
7. explain how lift and drag affect aircraft performance
8. use standard equations to explain how lift and drag can vary
9. explain how a high lift device alters the flow characteristics of an aerofoil
10. explain how the total drag of an aircraft is generated
11. 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
Up and down wash
Vortices
Features including:
Stagnation point/region
Transition and separation points

**List 3**

Mechanism in terms of airflow

**List 4**

Effect in terms of passage through the air and degree of control available
Eg: level stall, spin.

**List 5**
Related to 2 and including:
Chord line
Mean camber line
Angle of attack
Angle of incidence
Fineness ratio
Thickness to chord ratio (percentage)

**List 6**
With reference to Bernoulli's principle
Including resulting static pressure changes following:
Changes in angle of attack, including around the stall
Velocity changes

Effects including changes in:
Pressure distribution
Total air reaction
Lift
Drag

**List 7**
Simple explanation

**List 8**
Including, for both cambered and symmetrical aerofoils:
How the following change with angle of attack:
Lift coefficient
Drag coefficient
Lift/drag ratio

**List 9**
Eg:
Airflow separation
Changes in lift and drag coefficients

**List 10**
Including explanations of:
Induced drag
Pressure or form drag
Skin friction
Interference drag
Parasite drag

**List 11**
Eg:
Polished surfaces
Fairings
Special materials
Aerodynamic shape

# Unit 203 Aircraft aerodynamics and control in fixed-wing aircraft

## Outcome 3 Understand the characteristics of the basic wing planforms

**Assessment Criteria**

The learner can:

1. describe the basic wing planforms and their typical applications
2. apply simple dimensional calculations 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 203 Aircraft aerodynamics and control in fixed-wing aircraft

## Outcome 4 Understand the principles of aircraft control

**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 need for instinctive control
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.

**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 instinctive control
Describe the relationship between:
Control movements made by the pilot
Control surface movement
Movement of the aircraft

**List 5**

Straight and level flight
Climb
Descent
Glide
Turn

**List 6**
Aerodynamic explanation
Spins

**List 7**
Simple explanation including the effect on structural defects.

# Unit 203 Aircraft aerodynamics and control in fixed-wing aircraft

## Outcome 5 Understand the principles 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 203 Aircraft aerodynamics and control in fixed-wing aircraft

## Outcome 6 Understand the purpose and operation of secondary flying control surfaces

**Assessment Criteria**

The learner can:

1. describe 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. explain the purpose and operation of stall strips/wedges
8. describe methods of boundary layer control
9. compare the operation of high drag devices.

**Range/Scope/Unit content**

**List 1**

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

**List 2**

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
Explanation to centre on:
Airflow changes on deployment eg:
Change in lift and drag coefficients
Airflow separation

**List 4**
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**
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
Wing fences

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

# Unit 203 Aircraft aerodynamics and control in fixed-wing aircraft

## Outcome 7 Understand methods of balancing and trimming control surfaces

**Assessment Criteria**

The learner can:

1. explain the effects of airspeed on flying controls
2. explain the need for aerodynamic balancing
3. explain the operation of control surface trimming devices
4. describe control surface flutter
5. explain mass balance

**Range/Scope/Unit content**

**List 1**

Eg: Increased airspeed = greater force on controls
Eg: Increased airspeed = smaller controlled movements required

**List 2**

Eg: Counter-acting increased force from increased airspeed

**List 3**

Include reasons for trimming devices
Balance tab
Anti-balance tab
Spring tab
Trim tab
Servo tab
Variable incidence tailplane

**List 4**

Related to airspeed
Effects of vibration on:
Pilot
Airframe
Control linkage

**List 5**

Why is it done and how is it achieved?
Include explanations of:
Out of balance force
Forward and rear limits
Centre of gravity

# Unit 203 Aircraft aerodynamics and control in fixed-wing aircraft

## Outcome 8 Understand the basic theory of high speed flight

**Assessment Criteria**

The learner can:

1. explain the significance of 'speed of sound' to an aircraft in flight
2. explain terms related to high speed flight
3. explain 'Mach number' and 'critical Mach number'
4. describe the formation and development of shock waves
5. explain terms related to transonic flight
6. explain methods of overcoming problems during transonic flight
7. describe the factors affecting airflow through an intake of a high speed aircraft.

**Range/Scope/Unit content**

**List 1**

Define 'speed of sound'

Include variation of speed of sound with atmospheric conditions eg:

Altitude

Air density

Temperature

**List 2**

Subsonic flight

Transonic flight

Supersonic flight

**List 3**

Including their significance to aircraft flight

**List 4**

Including:

How and when they are formed

How and why they develop

Their properties

Effect on the airflow eg:

Movement of the centre of pressure

**List 5**
Compressibility
Buffet
Shockwave formation
Spanwise flow
Shock stall
Boundary layer flow separation
Control ineffectiveness
Instability

**List 6**
Swept wings
Wing fences
Saw-tooth leading edges
Notched leading edges
Vortex generators
Area rule
Spoilers
Slab tailplane/stabilators
Active stability devices

**List 7**
Intakes eg:
Engine intakes
Air scoops
Problems with high sped and supersonic air eg:
Shock wave
Air too fast for engine intake
Solutions eg:
Variable geometry intakes

# Unit 203 Aircraft aerodynamics and control in fixed-wing aircraft

## Notes for guidance

It is expected that the learner will carry out suitable practical experiments to assist understanding of some aspects of this unit, however these will not be assessed.

This unit contains the syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 8 and for part of Module 11A (11.1 only). The equivalent EASA knowledge level indicators for each of the above outcomes - required for the B1 and B2 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 2
Outcome 2: EASA Level 2
Outcome 3: EASA Level 2
Outcome 4: EASA Level 2
Outcome 5: EASA Level 2
Outcome 6: EASA Level 2 (B1 only)
Outcome 7: EASA Level 2 (B1 only)
Outcome 8: EASA Level 2 (B1 only)

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

# Unit 208 Maintaining aircraft electrical cables

**Level:** 3
**Credit value:** 10
**UAN:** J/503/1107

### Unit aim

The aim of this unit is to give the learner a detailed understanding of the process of testing electrical and avionics equipment and maintaining aircraft wiring. It contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 7 – Maintenance Principles for the B2 Category licence.

### Learning outcomes

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

1. know workshop safety, tool selection and tool control
2. understand standards for engineering drawings in the aviation industry
3. know procedures and precautions for aircraft handling tasks
4. understand inspection and quality assurance procedures in aircraft maintenance
5. know types of aircraft electrical cable
6. know how aircraft cable is prepared and terminated
7. know how aircraft cable is installed and maintained
8. understand the electrical bonding of aircraft structure
9. be able to use electrical wiring maintenance and testing techniques.

### Guided learning hours

It is recommended that **80** 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 122, 131 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
- Working with Others

### Assessment and grading

This unit will be assessed by:

- an assignment covering practical skills and underpinning knowledge.

# Unit 208 Maintaining aircraft electrical cables

## Outcome 1 Know workshop safety, tool selection and tool control

**Assessment Criteria**

The learner can:

1. describe fire precautions and procedures in workshop environments
2. describe compressed gas procedures in workshop environments
3. describe oil and chemical procedures in workshop environments
4. describe safe working procedures in workshop environments
5. describe tool and material control procedures in workshop environments
6. describe tools used in aircraft electrical installation work
7. describe standards of electrical and avionic work
8. describe the system of fits and clearances used in aircraft engineering.

**Range/Scope/Unit content**

**List 1**

Knowledge of precautions in both training environment and typical workplace environments such as:

Composite production, wiring shops, aircraft major component assembly, (fuselage, wings etc), clean rooms

Demonstrate knowledge of emergency procedures eg: tackling small fires, evacuation

**List 2**

Knowledge of precautions in both training environment and typical workplace environments such as:

Composite production, wiring shops, aircraft major component assembly, (fuselage, wings etc), clean rooms, confined spaces

Demonstrate knowledge of emergency procedures eg: minor incidents, evacuation

**List 3**

Knowledge of precautions in both training environment and typical workplace environments such as:

Composite production, wiring shops, aircraft major component assembly, (fuselage, wings etc), clean rooms, confined spaces

Demonstrate knowledge of emergency procedures eg: tackling small spillages, evacuation

**List 4**

Safe use of eg: standard hand tools (saw, hammer, file, pliers etc), specialist tools (hot and mechanical wire strippers, heat gun, knife, crimp tools etc.), power tools (drill, power driver etc.), lubrication tools

**List 5**

Tools including: shadow boards, personal tool kits, automatic tool check, tool inspection, renewal and calibration, personal discipline, responsibility to report losses and damage

Materials including: ordering and issue of large (eg sheet material) and small (eg: nuts, bolts, washers) items, responsibility to check before use

**List 6**

How they are used and maintained Inspection, calibration and care of eg: strippers, crimp tools (mechanical and hydraulic), cutters, wire gauges, go/no-go gauges, heat shrink guns, marking and sleeving equipment, wrapping tools, torque drivers

**List 7**

Correct methods of work, dimensions, tolerances, allowances

**List 8**

With respect to electrical and avionics equipment, an overview of:

Drill sizes for bolt holes, classes of fits

Common system of fits and clearances

Schedule of fits and clearances for aircraft equipment

Standard methods of checking shafts, bearings and other common parts (eg in generators and motors).

# Unit 208 Maintaining aircraft electrical cables

## Outcome 2 Understand standards for engineering drawings in the aviation industry

**Assessment Criteria**

The learner can:

1. describe the main types of aircraft engineering drawings
2. describe how drawings are uniquely identified and maintained up to date
3. describe features of other common drawing standards used in the aviation industry
4. explain the use of wiring diagrams, tables and other schematic diagrams used in aircraft electrical and avionics systems.

**Range/Scope/Unit content**

**List 1**

The features and uses of each type using information from

CAA CAP562 Leaflet 2-1or equivalent documents

Including BS8888 general symbols and conventions, local approved standards where applicable (detailed where applicable to electrical systems, overview of important other items)

**List 2**

Including information in CAA CAP562 Leaflet 2-1or equivalent documents

**List 3**

Overview of eg: ISO, Mil, AN, MS, NAS, ATA Spec100

**List 4**

Including presentation methods: paper, computer, microfilm/fiche

Standards eg civil or military.

# Unit 208 Maintaining aircraft electrical cables

## Outcome 3 Know procedures and precautions for aircraft handling tasks

**Assessment Criteria**

The learner can:

1. describe procedures for aircraft towing
2. describe procedures for jacking, chocking and securing aircraft
3. describe procedures for storing aircraft
4. describe procedures for aircraft refuelling and defueling
5. describe procedures ground de-icing and anti-icing aircraft
6. describe procedures for using aircraft ground services
7. describe effects of environmental conditions on aircraft handling and operation.

**Range/Scope/Unit content**

**List 1**

General knowledge of practice and theory

Including safety precautions

**List 2**

General knowledge of practice and theory

Including safety precautions

**List 3**

General knowledge of practice and theory including anti-deterioration maintenance

Including safety precautions

**List 4**

General knowledge of practice and theory especially bonding and other safety precautions Open line and pressure refuelling

**List 5**

General knowledge of practice and theory including difference between anti-icing and de-icing and the substances used

Including safety precautions

**List 6**

Electrical, hydraulic and pneumatic ground supplies

Detail of typical procedures and precautions for each

**List 7**

General knowledge of practice and theory eg:

Heavy rain

Ice and snow

High winds

# Unit 208 Maintaining aircraft electrical cables

## Outcome 4 Understand inspection and quality assurance procedures in aircraft manufacture

**Assessment Criteria**

The learner can:

1. describe the organisation of quality departments in aircraft manufacturing organisations
2. describe stores facilities in aircraft manufacturing organisations
3. describe defects that may be found during inspection of aircraft and associated equipment
4. describe inspection techniques used to find defects in aircraft
5. describe trouble-shooting techniques
6. describe assembly and disassembly techniques
7. explain the principles of aircraft modification
8. explain the life-limitation of aircraft components
9. describe how to inspect aircraft following unusual events
10. explain the principles of aircraft Centre of Gravity calculations.

**Range/Scope/Unit content**

**List 1**

Including: compliance, auditing, inspection, training

**List 2**

General knowledge of function and responsibilities including: procurement and control of: Tools

Spares and materials

Bonded store

Quarantine

**List 3**

Overview of: structural defects (eg: cracks, skin damage, corrosion), mechanical system defects (eg: broken or chafed pipes, fluid leaks, signs of overheating)

Detail of: electrical/avionic equipment damage (external, signs of overheating, damaged cooling ducts), wiring defects (eg: wrongly routed, chafed, overheated cable or terminations, impact or chemical damage, corrosion, ageing, wrongly labelled), bonding defects (eg: corrosion, poorly sited, incorrect fasteners – type or material)

**List 4**

Overview of techniques for mechanical inspection eg: NDT (x-ray, ultrasonic, visual, borescope); destructive eg: removal of skin; functional and performance testing

Detail of techniques for electrical, avionics and wiring eg: visual inspection, electrical testing (programmable loom testing, TDR, insulation testing), functional and performance testing)

**List 5**

Eg: half-split, signal injection, input/output, functional and diagnostic test, self test/check

**List 6**

Emphasis on electrical wiring and equipment eg: connector blocks, panels, connector blocks, multi-way connectors

Techniques eg: use of correct tools; anti-seize fluids; care of loose items; marking items for re-assembly; replacing single-use, lifed and worn items, protection of re-assembled items

**List 7**

Using an appropriate regulatory framework eg: EASA, CAA, Mil:

Typical reasons for modifications

Design and approval procedure – overview

Modification procedures – typical electrical/avionics

Recording and marking modified items

**List 8**

Reasons for life-limitation

Control of lifed items

**List 9**

Overview of: lightning strike, HIRF, heavy landing, excessive turbulence

**List 10**

General knowledge of the reasons for the calculations eg:

Effects on aircraft performance of C of G position, safe limits

How the measurements and calculations are done

Use of the relevant documents.

# Unit 208 Maintaining aircraft electrical cables

## Outcome 5 Know types of aircraft electrical cable, its properties and uses

**Assessment Criteria**

The learner can:

1. describe electrical and environmental challenges to aircraft electrical wiring
2. describe cable types used in aircraft electrical power supply systems
3. describe cable types used in aircraft digital systems
4. describe cable types used in aircraft communication systems
5. describe fibre-optic cable used in aircraft systems.

**Range/Scope/Unit content**

**Note:** It is impossible to cover every type of cable in this outcome. Learners should be taught a range of cables that is relevant to their individual needs. It is important not to concentrate exclusively on the cable types used by one particular aircraft manufacturer, rather to learn about similar alternatives.

**List 1**

Eg: overheating due to excessive current, poor cooling, poor connections, chemical contamination, deterioration and damage to insulation, water ingress/absorption, mechanical damage due to abrasion, poor routing and excessive pull-through forces

**List 2**

Including: insulation and conductor materials, size and capacity, main manufacturers and users

Physical properties including mechanical and insulation performance, relative safety in challenging environments, uses in specific applications

**List 3**

Including: insulation and conductor materials, size and capacity, main manufacturers and users

Physical properties including mechanical and insulation performance, relative safety in challenging environments, uses in specific applications

**List 4**

Including: insulation and conductor materials, size and capacity, main manufacturers and users

Physical properties including mechanical and insulation performance, relative safety in challenging environments, uses in specific applications

**List 5**

Including: materials, construction, size and signal capacity

Physical properties including mechanical performance, relative safety in challenging environments, uses in specific applications (eg: lighting, flight controls, data transmission)

# Unit 208 Maintaining aircraft electrical cables

## Outcome 6 Know how aircraft cable is prepared and terminated

**Assessment Criteria**

The learner can:

1. describe the preparation of typical aircraft cable for crimping
2. describe the preparation of typical aircraft cable for soldering
3. describe the termination of typical aircraft cable by crimping
4. describe the termination of typical aircraft cable by soldering
5. describe the preparation and assembly of a range of electrical connectors
6. describe the termination of aircraft fibre optic cable.

**Range/Scope/Unit content**

**List 1**

Use of a range of preparation tools

Including pre-use checks, calibration and function, information on length of bared conductor

**List 2**

Use of a range of preparation tools

Including pre-use checks (calibration and function), information on length of bared conductor etc, selection of soldering iron and solder (include Health and Safety considerations), sleeving and labelling

**List 3**

Use of a range of Precision Termination Tools (PTT), eg: sub-miniature connectors, hydraulic crimp for heavy duty power cable, different manufacturers

Including pre-use checks (calibration and function), correct use of the PTT, inspection of finished termination, heat-shrink and labelling

Describe how the PTT works and what the termination should look like when complete; points to watch for indicating a poor termination, diagnosing PTT faults

**List 4**

Use of a range of soldering iron bits and other soldering tools

Including pre-use checks (calibration and function), correct use of solder, flux and heat source, inspection of finished joint

Describe how the solder works and what it should look like when complete; points to watch for indicating a poor joint, diagnosing soldering faults

**List 5**

Including power and signal connectors, multi-pin, co-axial, data

Explaining and demonstrating selection of connectors, sealing, environmental protection, potting, strain relief, orientation, and use of pin insert/extractors

Explain the safety precautions for typical potting compound

**List 6**

Explain the vulnerabilities of fibre-optic cable and its physical limitations

Pre-use checks on termination equipment (blade, polishing materials, gauges etc.).

# Unit 208 Maintaining aircraft electrical cables

## Outcome 7 Know how aircraft cable is installed and maintained

**Assessment Criteria**

The learner can:

1. describe effects on individual cables when bunched together in wiring looms
2. describe techniques used in the manufacture of aircraft cable assemblies
3. describe how aircraft wiring is installed and secured in place
4. describe how aircraft wiring is inspected and maintained in-service
5. describe techniques used in the repair of aircraft cable assemblies.

**Range/Scope/Unit content**

**List 1**

Eg: reduced heat dissipation, interacting fields, creating capacitive interference between power and signals, chemical interaction between insulation materials

Methods of eliminating or minimising adverse effects eg: screening, separation of cable and signal types

**List 2**

Eg: wrapping, lacing, sleeving, potting, crimping, profiling, strain relief, testing of crimp joints

**List 3**

Precautions when working with aircraft wiring, safe handling of wiring and electrical assemblies

Methods of protection and support for aircraft wiring assemblies

Carry out typical installation work in a real or simulated environment

**List 4**

Inspection methods, typical defects, causes of typical defects and their remedies

Inspect a typical installation and report findings

Describe repair criteria and methods

**List 5**

Describe typical regulatory requirements for cable repair eg: CAA, EASA, Mil

Repair typical defects by in-line crimp and wire replacement

# Unit 208 Maintaining aircraft electrical cables

## Outcome 8 Understand the electrical bonding of aircraft structure

**Assessment Criteria**

The learner can:

1. explain why aircraft structure needs to be electrically bonded
2. describe methods used to electrically bond metal airframe structure
3. describe methods used to electrically bond composite aircraft structure
4. describe methods used to test and inspect electrical bonding.

**Range/Scope/Unit content**

**List 1**

Eg: prevention of static build-up and arcing (eg: in fuel tanks), reduction of signal noise, lightning protection, provide earthing points for refuelling, ground power etc.

**List 2**

Including: locations, accessibility, fasteners, bonding straps, materials, protection of bonding points

**List 3**

Including: locations, accessibility, fasteners, bonding straps, materials, bonding of external antennae (eg: use of backplanes), protection of bonding points

**List 4**

Inspection including: broken or damaged bonding straps, corrosion of terminations and surrounding areas, potential for damage of newly installed bonding, typical bonding resistance values

Testing including: intrinsically safe test equipment, dangerous environments such as fuel tanks, removal of electrical power, disconnection of sensitive equipment.

# Unit 208 Maintaining aircraft electrical cables

## Outcome 9 Be able to use electrical wiring and testing techniques

**Assessment Criteria**

The learner can:

1. demonstrate workplace emergency procedures
2. demonstrate workshop procedures
3. demonstrate how aircraft cable is prepared and terminated
4. demonstrate how aircraft wiring is installed and secured in place
5. interpret wiring diagrams, tables and other schematic diagrams used in aircraft electrical and avionics systems
6. demonstrate techniques used in the manufacture of aircraft cable assemblies
7. inspect aircraft cable looms
8. demonstrate fault finding techniques
9. demonstrate techniques used in the repair of aircraft cable assemblies
10. test wiring installations using approved test equipment
11. install and test electrical bonding on structural components
12. test avionic equipment.

**Range/Scope/Unit content**

**List 1**

Simulation/walk-through of eg:
Fire evacuation
Fuel, oil, chemical spillage
Electrical emergency

**List 2**

Safety
Tool selection
Tool control
Materials and spares control

**List 3**

Eg:
Crimping (cutting, stripping, fitting terminations)
Soldering (cutting, stripping, fitting terminations)
Fibre Optic cables and terminations (cutting, polishing, fitting connectors)
Preparation and assembly of a range of electrical connectors eg:
HT
Power
Signal
Data

**List 4**

Eg:
Troughs
Conduits
Cable ties

**List 5**

Conforming to one or more standards

Military or Civil

**List 6**

Construct sample cable looms using a range of cable types, terminations and connectors eg:

Electrical

Signal

Data

Communications

**List 7**

Eg:

Visual

Testing

**List 8**

Using standard fault finding methods and equipment eg:

Wiring faults

Basic electrical system faults

Basic avionic system faults

Using eg: pitot-static leak tester, digital and analogue multi-meters, bonding and insulation tester, continuity tester, VSWR meter, Time Domain Reflectometer (TDR), manually set special-to-type test equipment

**List 9**

Eg:

In-line crimps

Replacement of one cable in a bundle

**List 10**

Eg:

Continuity tester

Insulation tester

Programmable loom tester

**List 11**

Demonstrate the electrical bonding of aircraft metal or composite structure

Select and use correct fasteners, locking devices, bonding straps, protective coatings

Prepare surfaces, holes etc

Install bonding and apply protective coating

**List 12**

On or off aircraft

Avionic or electrical system or component eg:

Altimeter, ASI, VSI

Transformer/rectifier unit

Lighting systems

# Unit 208 Maintaining aircraft electrical cables

## 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 syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 7 – Maintenance Principles. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the B2 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 (9 – EASA Level 1)
Outcome 2: EASA Level 2
Outcome 3: EASA Level 2
Outcome 4: EASA Level 2
Outcome 5: EASA Level 2
Outcome 6: EASA Level 2
Outcome 7: EASA Level 2
Outcome 8: EASA Level 2
Outcome 9: EASA Level 3

Note: the above list equates to the EASA requirement for category B2 licences and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject.

This unit covers the fundamentals of aircraft wiring installation and is generic enough for providers to adapt to their own particular resources and local employer requirements. It should be taught according to the current regulatory requirements, and is flexible enough to take account of new materials, equipment and methods that will be introduced and approved from time-to-time. The vast range of equipment and associated test gear make it impossible to define a list of equipment to train on, similarly the cable and connector types are numerous. The knowledge 'range' should include typical avionics and electrical equipment that is relevant to the learner's possible future employment, plus added items to give a broad range where necessary. The practical 'range' should be both relevant and feasible and, because of the high value of many items, will depend upon accessibility.

# Unit 209 Electronics in aircraft

**Level:** **3**
**Credit value:** **9**
**UAN:** **J/503/1110**

### Unit aim

This unit aims to give the learner a comprehensive knowledge of electrical and electronic principles in order to understand complex aircraft electrical and electronic systems.

### Learning outcomes

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

1. understand electrical and electronic components
2. understand transformers, filters and integrated circuits
3. understand printed circuit boards
4. understand servomechanisms
5. understand DC circuits and components
6. understand AC circuits and components
7. understand DC generators and motors
8. understand AC generators and motor
9. be able to construct and test working electronic circuits

### Guided learning hours

It is recommended that **70** 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 132, 214 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:

- an assignment covering practical skills and underpinning knowledge.

# Unit 209 Electronics in aircraft

## Outcome 1 Understand electrical and electronic components

**Assessment Criteria**

The learner can:

1. describe the properties of resistors
2. describe the properties of capacitors
3. explain the fundamental laws of magnetism
4. explain the fundamental principles of electromagnetic induction
5. describe the properties of inductors
6. describe the properties of semi-conductor devices.

**Range/Scope/Unit content**

**List 1**

Including: variable resistors, thermistors, carbon, wire-wound,

How they are constructed

Operating principles including temperature coefficients, conductance, tolerances, limits,

Markings and values: colour coding, preferred values, wattage ratings, specific resistance

How they are used in circuits; series, parallel, series-parallel including calculations using Ohms and Kirchhoff's Laws

Construction of a Wheatstone bridge

**List 2**

How they are constructed: plates, dielectric, types of capacitor

Operating principles, factors affecting capacitance (area of plates, distance between plates, number of plates, dielectric constant, working voltage, voltage rating

Markings and values: colour coding

How they are used in circuits, including EHTU, calculations of capacitance in series and parallel circuits, charge and discharge, time constants, testing

**List 3**

Basic magnetism: materials, bi-poles, magnetic fields, forces, field around a conductor, action of a magnet in the Earth's magnetic field

Sufficient to understand inductors and transformers

**List 4**

Sufficient to understand inductors and transformers:

**List 5**

How they are constructed

Operating principles

Markings and values

How they are used in circuits

**List 6**

Including:

Diodes, Zener diodes, thyristors, LEDs, photo-electric cells, simple transistors

How they are constructed

Operating principles

Markings and values

How they are used in circuits eg: diodes: clippers, clampers, full and half-wave rectifiers, bridge rectifiers, voltage multipliers. Transistors: amplifiers, bias, de-coupling, stabilisation, feedback, multi-stage circuits

How they are tested

Vulnerabilities, eg: ESD, heat

# Unit 209 Electronics in aircraft

Outcome 2 Understand transformers, filters and integrated circuits

**Assessment Criteria**

The learner can:

1. describe how transformers are constructed
2. explain the operation of transformers
3. use transformer theory to solve simple design problems
4. describe simple filter circuits
5. use filter theory to solve design problems
6. describe how integrated circuits are constructed
7. explain the different types of integrated circuit.

**Range/Scope/Unit content**

**List 1**

Core materials and shapes

Windings – materials, primary and secondary coils, turns ratio, voltage tapping

**List 2**

Including:

Frequency range and the effects of operating close to or outside limits

Power transfer

Efficiency,

Single and three-phase calculations

Auto transformers

How outputs can be adjusted to suit specific circuits

**List 3**

Eg: power supplies to specific equipment

**List 4**

High-pass

Low-pass

Band-pass

Band stop

**List 5**

Simple problems eg: isolation of power supplies from sensitive signal sources

**List 6**

Construction: overview of materials, construction methods and conditions, scale of integration

**List 7**
Including:
Operational amplifier
Microprocessor
Mixed signal
EPROM
Logic circuits
Vulnerabilities eg: ESD, heat, extreme cold, EMP, excess voltages.

# Unit 209 Electronics in aircraft
Outcome 3 Understand printed circuit boards

**Assessment Criteria**

The learner can:

1. explain the reason for using printed circuit boards
2. describe the construction of printed circuit boards
3. describe ways in which components can be attached to printed circuit boards
4. describe typical damage and faults to be found on printed circuit boards
5. describe applications of printed circuit boards

**Range/Scope/Unit content**

**List 1**

Eg: generally cheap and easy to produce, repeatable, reliable

**List 2**

Overview eg:
Single and double sided
Encapsulated
Dielectric and track materials
Construction methods:
Patterning
Lamination
Drilling
Solder resist etc

**List 3**

Eg: hand soldering, wave soldering, surface mount

**List 4**

Eg: dry joint, cracked dielectric, broken or overheated track

**List 5**

In aircraft equipment

# Unit 209 Electronics in aircraft

## Outcome 4 Understand servomechanisms

**Assessment Criteria**

The learner can:

1. explain terms relating to servomechanisms
2. describe servomechanisms
3. describe representative aircraft control systems
4. describe representative aircraft indication systems.

**Range/Scope/Unit content**

**List 1**

Define: servomechanism,

Explain: open loop, closed loop, feedback (positive and negative), follow-up, analogue, transducer, null, damping, dead band, hunting

Describe typical faults, effect of reversing synchro leads

**List 2**

Resolvers, differential, control and torque, E&I transformers, inductance and capacitance transmitters, synchronous transmitters

**List 3**

Eg: flight control systems, air conditioning and pressurisation, engine controls

**List 4**

Eg: engine, electrical power, flap position, cabin conditioning

# Unit 209 Electronics in aircraft

Outcome 5 Understand DC circuits and components

**Assessment Criteria**

The learner can:

1. explain basic electrical terms
2. explain the relationship between current, voltage and resistance
3. explain the significance of internal resistance in power supplies
4. explain Kirchhoff's Laws of current and voltage
5. explain how power is dissipated in DC circuits.

**Range/Scope/Unit content**

**List 1**

Conductors, insulators, current, voltage, resistance, potential difference, electromotive force, conventional current flow, electron flow, conductance

**List 2**

Using Ohms Law calculations

**List 3**

Using worked examples

**List 4**

Using simple DC circuits

**List 5**

Power, work and energy

Dissipation of power by a resistor

Power formula

Calculations involving power, work and energy

# Unit 209 Electronics in aircraft

Outcome 6 Understand AC circuits and components

**Assessment Criteria**

The learner can:

1. describe the operation of rectifiers
2. describe the effects of reservoir capacitors on output voltages
3. explain the need to reduce output voltage ripple
4. describe the relationship between voltage, current and power in AC circuits
5. explain how three-phase AC waveforms can be produced
6. use AC circuit theory to solve series and parallel network problems

**Range/Scope/Unit content**

**List 1**

Half-wave

Bi-phase full-wave

4 diode bridge

**List 2**

Eg: smoothing DC output voltage

**List 3**

Eg: reduce noise in audio amplifiers; eliminate errors in A-D convertors

**List 4**

Resistive, capacitive and inductive circuits

Phase, period, frequency, cycle, amplitude, peak-to-peak value, rms value, average value

By measurement or calculation

**List 5**

Using phasor diagrams only – no calculations required

**List 6**

Using resistive, capacitive and inductive circuits

# Unit 209 Electronics in aircraft

## Outcome 7 Understand DC generators and motors

**Assessment Criteria**

The learner can:

1. explain the magnetic principles used in motors and generators
2. explain how electromagnetic induction is used in motors and generators
3. explain the operation of series wound generators
4. explain the operation of shunt wound generators
5. explain the operation of DC compound generators
6. explain the requirements for operating DC generators in parallel
7. describe the operation of DC series wound motors
8. describe the operation and control of DC shunt wound motors
9. describe the operation of DC compound motors.

**Range/Scope/Unit content**

**List 1**

Electromagnets, magnetic fields, forces, field around a current-carrying conductor, magnetic shielding

Sufficient to understand generators and motors

**List 2**

Including:

Magneto-motive force, field strength, magnetic flux density, permeability, hysteresis loop, Retentivity, coercive force, reluctance, saturation point, eddy currents, Fleming's Left and Right hand Rules, storage of magnets

Sufficient to understand motors and generators

**List 3**

Sufficient to allow understanding of standard aircraft systems– include circuit diagrams

Eg: field and armature windings in series, output varies directly with load current, little use practically

**List 4**

Sufficient to allow understanding of standard aircraft systems– include circuit diagrams

Eg: field and armature windings in parallel, output varies inversely with load current

Typical aircraft applications

**List 5**

Sufficient to allow understanding of standard aircraft systems – include circuit diagrams

Eg: series and shunt field coils, outputs generally constant in normal operating range

Typical aircraft applications

**List 6**

Sufficient to allow understanding of standard aircraft systems

Eg: equalise voltages before paralleling

Typical aircraft applications

**List 7**

Sufficient to allow understanding of standard aircraft systems

Eg: generates a large torque, good low-speed operation, moves heavy loads slowly, light loads quickly

Typical aircraft applications

**List 8**

Sufficient to allow understanding of standard aircraft systems

Eg: good speed and torque control, decreased torque at higher speeds

Typical aircraft applications

**List 9**

Sufficient to allow understanding of standard aircraft systems

Eg: combines characteristics of series and shunt wound, greater torque than shunt motor, more constant speed with varying load

Typical aircraft applications.

# Unit 209 Electronics in aircraft

Outcome 8 Describe the construction, purpose and function of typical AC generators and motors

**Assessment Criteria**

The learner can:

1. describe AC generators
2. explain the requirements for operating AC generators in parallel
3. describe AC induction motors
4. describe AC synchronous motors.

**Range/Scope/Unit content**

**List 1**

Principles of operation sufficient to allow understanding of standard aircraft systems eg:

Construction: rotor, stator, slip rings, brush, brushless, salient or non-salient pole, damper windings, excitation

Operation: outputs, control of frequency, voltage (frequency, single phase, multi-phase), load

Typical aircraft applications

**List 2**

Sufficient to allow understanding of standard aircraft systems eg:

Synchronisation prior to parallel connection

One generator at a time

Use of a synchroscope

Typical aircraft applications

**List 3**

Construction and operation sufficient to allow understanding of standard aircraft systems eg: rotor, stator

Squirrel cage rotor

Phase splitting (single-phase AC induction motor)

Typical aircraft applications

**List 4**

Construction and operation sufficient to allow understanding of standard aircraft systems eg: stator, rotor, windings, slip rings

The need for a starting device

Field excitation

Typical aircraft applications.

# Unit 209 Electronics in aircraft

Outcome 9 Be able to construct and test working electronic circuits

**Assessment Criteria**

The learner can:

1. construct simple circuits to prove Ohm's and Kirchhoff's Laws
2. demonstrate the relationship between voltage, current and power in AC circuits
3. construct and test smoothed and stabilised power supplies.

**Range/Scope/Unit content**

**List 1**

Using a variety of components, from a circuit diagram, assembled and tested

**List 2**

Using a variety of components, from a circuit diagram, assembled and tested

Demonstrate AC waveforms

Measure a range of parameters (eg: phase, p-p and peak values)

Demonstrate the use of phasor representation of sinusoidal quantities

**List 3**

Using a variety of components, from a circuit diagram, assembled and tested

Demonstrate varying degrees of smoothing

# Unit 209 Electronics in aircraft

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 syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 3 – Electrical Fundamentals (except 3.1-3 and 3.4-5, which are covered in unit 006), and the whole of Module 4 – Electronic Fundamentals. The equivalent EASA knowledge level indicators for each of the above outcomes - required for the B2 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 2 (Advanced resistors – EASA Level 1)
Outcome 2: EASA Level 2 (4 and 5 – EASA Level 1)
Outcome 3: EASA Level 2
Outcome 4: EASA Level 2
Outcome 5: EASA Level 2
Outcome 6: EASA Level 2
Outcome 7: EASA Level 2
Outcome 8: EASA Level 2
Outcome 9: EASA Level 2

Note: the above list equates to the EASA requirement for category B2 licences and is for guidance only. It exceeds the requirement for the B1 category for Modules 3 and 4. It is primarily for those learners wishing to sit the CAA examination in this subject.

# Unit 210 Maintaining aircraft avionic systems

**Level:** 3
**Credit value:** 12
**UAN:** T/503/1216

### Unit aim

This unit aims to give the learner a comprehensive understanding of aircraft electrical and avionic systems, applying basic principles previously learned. The unit has a fixed-wing context.

### Learning outcomes

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

1. understand aircraft instrumentation and air data systems
2. understand fixed-wing flying control systems
3. understand aircraft power distribution systems
4. understand aircraft management, lighting and warning systems
5. understand aircraft engine electrical systems
6. understand aircraft electrical power sources
7. understand aircraft communication systems
8. understand aircraft navigation systems
9. be able to maintain aircraft avionic 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 62-88.

### 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
- Problem Solving
- Working with Others

**Assessment and grading**

This unit will be assessed by:

- an assignment covering practical skills and underpinning knowledge.

# Unit 210 Maintaining aircraft avionic systems

## Outcome 1 Understand aircraft instrumentation and air data systems

**Assessment Criteria**

The learner can:

1. explain the need for aircraft instrumentation
2. explain the operation of pitot-static systems
3. the operation of pitot-static system components
4. describe procedures for pitot-static system functional checks
5. describe stall warning and angle of attack indicating systems
6. explain how outputs are computed within an air data system
7. explain instrumentation system sensors
8. describe the layout of aircraft engine indication systems
9. explain test equipment for a range of indicating systems
10. describe gyroscopic primary flight instruments
11. explain flight data and cockpit voice recorders

**Range/Scope/Unit content**

**List 1**

Eg: in terms of: physiological limitations of a (human) pilot (unable to sense speed, height, altitude etc. accurately or safely), complexity of aircraft requires accurate data for display and to compute control signals

**List 2**

Define pitot and static pressure

Operation eg: outputs required, available quantities to measure, method of measurement of each, method of displaying or otherwise using each parameter (eg: altimeter, mach meter, ASI, VSI)

**List 3**

Precision pressure indicators

Digital pressure indicators

Vacuum and differential pressure chambers

**List 4**

Including: safety precautions, precautions to prevent damage to or contamination of the system, test equipment (manual and automatic), blanks, bungs and adaptors

**List 5**

Sensors (AOA and stall)

Warning – audible, stick shaker

Angle of attack (alpha) limiter

**List 6**

Altitude, vertical speed, indicated airspeed (IAS), true airspeed (TAS), Mach number

**List 7**

Principles of operation of eg:

Pressure transducers, total temperature probe, angle of attack probe, accelerometer

**List 8**

Eg: temperatures (EGT, oil), pressures (EPR, oil), RPM, fuel flow and inlet pressure, oil quantity, filter bypass (oil and fuel), fuel heat, engine start, vibration, reverse thrust

**List 9**

Fluid pressure

Position indication

Engine speed

Cabin temperature

Engine temperature

Fuel contents

Fuel flow

**List 10**

Gyroscopic principles, directional and rate gyros

Instruments eg: turn and slip indicator, artificial horizon, direction indicator

**List 11**

Purpose and legal requirements

Typical inputs, recording media, power supplies, installation, locator beacon.

# Unit 210 Maintaining aircraft avionic systems

## Outcome 2 Understand fixed-wing flying control systems

**Assessment Criteria**

The learner can:

1. explain servomechanisms
2. explain control, indication and positioning systems
3. explain how compensation is applied to RPC servo systems
4. explain how digital and analogue techniques are applied to control systems
5. explain the operation of a fly-by-wire system
6. explain the operation of a basic autopilot
7. explain the how inputs from external systems contribute to autopilot operation

**Range/Scope/Unit content**

**List 1**

Principles and techniques including:

Servomechanism, open loop, closed loop, feedback (positive and negative), follow-up, analogue, transducer, null, damping, dead band, hunting, resolvers, differential, control and torque, E&I transformers, inductance and capacitance transmitters, synchronous transmitters

**List 2**

Principles and operation of eg:

Control: primary and secondary flight controls, trim

Indication: flap/slat position, trim position, autopilot engaged

Positioning: remote position control (RPC) – open and closed loop

**List 3**

Eg: error rate, transient, integral

**List 4**

Nil

**List 5**

Using block and signal flow diagrams

**List 6**

In auto-stab manual reversion and full authority modes

Modes of operation: roll, pitch and yaw channels

**List 7**

Using block and signal flow diagrams

Inputs from: compass, air data, radio, radar, INS

Auto throttle,

Automatic landing systems: principles, modes of operation, approach, glideslope, land, go-around, system monitors, failure conditions.

# Unit 210 Maintaining aircraft avionic systems

## Outcome 3 Understand aircraft electrical power distribution systems

**Assessment Criteria**

The learner can:

1. explain the requirements of aircraft power supply systems
2. explain aircraft electrical system components
3. describe aircraft electrical distribution panels
4. describe aircraft busbars
5. explain circuit breakers and fuses
6. explain manual and automatic switches
7. describe the use of terminal blocks in aircraft electrical circuits.

**Range/Scope/Unit content**

**List 1**

Eg: AC, DC, emergency, redundancy, load shedding, real and apparent power

**List 2**

Need for and function of typical systems eg: generators, cable, panels, batteries, invertors, bus power control unit

**List 3**

Purpose and typical location

**List 4**

Types, classifications and purposes

**List 5**

Purpose and operating principles

**List 6**

Purpose and operating principles of eg:
Micro-switches
Sequence timers
Purpose of caged and guarded switches including purpose of tell-tales

**List 7**

Application and purpose eg: power and signal distribution.

# Unit 210 Maintaining aircraft avionic systems

## Outcome 4 Understand aircraft management, lighting and warning systems

**Assessment Criteria**

The learner can:

1. identify lamp types used on aircraft
2. describe hazards and safety precautions associated with aircraft lamps
3. describe aircraft lighting systems
4. describe safety implications of operating aircraft lighting systems
5. describe aircraft visual and audible warning systems
6. describe on-board maintenance systems
7. explain how on-board maintenance systems are used for structural monitoring.

**Range/Scope/Unit content**

**List 1**

Eg: high intensity strobes, identification lights, miniature bulbs, fibre optics, halogen, LED, fluorescent

**List 2**

Eg: handling, checking ratings; checking power supplies, switches and circuit breakers, disposal

**List 3**

The purpose and operation of typical aircraft internal and external systems eg:

Cabin, cockpit, cargo and equipment bays

External identification

Landing lights

Ice detection

**List 4**

Hazards and safety precautions eg: high intensity, particularly at night, high voltage (strobes), lack of light dangerous to others

**List 5**

Need for and function of eg: advisory, emergency, centralised warning panels, master warning system indicating unseen state of equipment (eg: undercarriage movement, position, locked/unlocked, flaps travelling), proximity, fire

**List 6**

Typical system, purpose and operation

Including: central maintenance computers, data loading system, electronic library system, printing facilities

**List 7**

Overview of sensors (strain gauges etc) and monitoring software to monitor damage tolerance.

# Unit 210 Maintaining aircraft avionic systems

## Outcome 5 Understand aircraft engine electrical systems

**Assessment Criteria**

The learner can:

1. explain Auxiliary Power Units (APU)
2. describe aircraft gas turbine engine starting systems
3. describe aircraft gas turbine engine ignition systems
4. explain aircraft engine control systems.

**Range/Scope/Unit content**

**List 1**

Explain the purpose and describe principles of operation of a typical APU
Requirement for airborne and ground auxiliary power
Outputs (electrical, hydraulic, pneumatic)
Types of motive power eg: ram air, gas turbine engine
Methods of driving generators and obtaining electrical power

**List 2**

Components, function and principles of operation of a typical system
Requirements for a starting system eg: generate large amounts of torque
Types of starting system eg: air, electrical, hydraulic
Basic terms – starter generator dealt with in outcome 7

**List 3**

Components, function and principles of operation of a typical system eg:
How and where fuel is burned, need for reliable ignition source, HEIU, igniters, start sequence

**List 4**

Purpose and principle of operation of a typical system eg:
What the control system is required to do
Sensors, inputs, outputs
What needs to be controlled, how it is controlled
Types of controller including FADEC.

# Unit 210 Maintaining aircraft avionic systems

## Outcome 6 Understand aircraft electrical power sources

**Assessment Criteria**

The learner can:

1. explain single generator systems
2. explain multi-generator/starter systems
3. explain non-paralleling ac generator systems
4. explain paralleling ac generator systems
5. explain ac generator drive systems
6. explain static inverters
7. explain transformer rectifier units.

**Range/Scope/Unit content**

**List 1**

Purpose and principle of operation of a typical system including: typical applications, reasons for using this system, layout, components, inputs, outputs, protection, regulation, switching

**List 2**

Purpose and principle of operation of a typical system including: typical applications, reasons for using this system, layout, components, inputs, outputs, protection, regulation, switching

**List 3**

Purpose and principle of operation of a typical system including: typical applications, reasons for using this system, layout, components, inputs, outputs, protection, regulation, switching

**List 4**

Purpose and principle of operation of a typical system including: typical applications, reasons for using this system, layout, components, inputs, outputs, protection, regulation, switching

**List 5**

Purpose and describe the principle of operation including: requirements of a drive system, constant speed drive, source of motive power, location of drive unit, method of coupling and transmission, safety devices

**List 6**

Purpose and describe the principle of operation including: requirement to convert dc to ac electronically (under what circumstances), how it is done – power source, basic circuit and output waveforms

**List 7**

Purpose and describe the principle of operation including: requirement to convert primary ac to 28vdc, how it is done – power sources, basic circuit, output waveform (stability, low harmonic content, EMI filtering).

# Unit 210 Maintaining aircraft avionic systems

## Outcome 7 Understand aircraft communication systems

**Assessment Criteria**

The learner can:

1. describe the basic principles of electro-magnetic wave propagation
2. describe radio transmitters and receivers
3. explain the basic principles of RF transmission lines
4. explain the principles of operation of radios transmitting in a range of modes
5. describe airborne communication systems
6. describe airborne aerial systems
7. explain satellite communication transmission
8. explain emergency locator beacons
9. Explain the principles of a Time Domain Reflectometer (TDR)

**Range/Scope/Unit content**

**List 1**

For all airborne frequency bands

Antenna

**List 2**

Describe the principles and techniques of basic systems eg: basic components of transmitter and receiver, production of carrier, modulation, tuning

**List 3**

Eg: materials, cables and other media, connectors, screening

**List 4**

HF, VHF, UHF, cabin interphone

Additional equipments eg: mobile telephony, Wi-Fi, Ku band satellite broadband, HF data link, ARINC communication and reporting, secure speech and agile frequency

**List 5**

To block schematic level

AM, FM, CW, SSB,

Benefits and limitations

**List 6**

Eg: antenna footprint, conformal antenna, backplane, propagation pattern, range

**List 7**
Basic principles of eg:
Frequency band
Signal type
Power
Steerable-beam antenna
Limitations

**List 8**
Purpose and operation of eg:
Power supply
Transmission type and frequency
Operation
Testing
Precautions

**List 9**
Describe the equipment
Need for a TDR
Specific methods of use, instead of a conventional continuity tester
Capabilities and limitations.

# Unit 210 Maintaining aircraft avionic systems

## Outcome 8 Understand aircraft navigation systems

**Assessment Criteria**

The learner can:

1. explain basic navigational terms
2. describe radio navigation systems
3. explain the principles of magnetic compasses
4. describe the main components and operating principles of a Magnetic Heading Reference System (MHRS)
5. explain the basics of integration
6. describe motion sensing devices used in navigation
7. explain Inertial Navigation Systems (INS)
8. explain how an IN system's performance is updated using external data
9. explain computing methods used in navigation systems
10. describe airborne surveillance radar systems
11. describe radio and radar height finding systems

**Range/Scope/Unit content**

**List 1**

Including: attitude, heading, track, drift angle, latitude, longitude

**List 2**

Using basic block schematic diagrams

Including: VOR, ILS, MLS, DME, GPS, ADF, emergency locator transmitters

**List 3**

Eg: magnetic principles, the Earth as a magnet, magnetic variation, errors in magnetic systems, construction of magnetic compasses, reading magnetic compasses, adjustments (compass swing)

**List 4**

Eg: sensing, computation, indication, adjustment (compass swing), advantages and limitations

**List 5**

Sufficient only to understand the principles of inertial navigation

**List 6**

Construction and operating principles of typical devices including:

Single degree of freedom rate gyro

Ring laser gyro

Force re-balance accelerometer

Rate integrating gyro

**List 7**

Principles and techniques

Purpose, advantages and disadvantages

Basic construction of an inertial platform eg: accelerometers, gyros, mounting frame, suspension bearings (conventional, fluid)

Measurements, calculations (basic to understand process), errors and error correction (eg: basic explanation of Coriolis effect, Schuler tuning)

Typical IN alignment sequence, calibration alignments

System block diagram of a typical IN system

Explain 'strap-down' IN systems

**List 8**

Eg: updating using GPS or other references, Kalman filtering, integrated systems

**List 9**

Analogue and digital

Examples of use of each in typical systems

How each type contributes to the system

Decline of analogue methods

**List 10**

Including: weather radar, SSR

**List 11**

Additional systems eg: TCAS, airborne intercept radar, Ground Proximity Warning Systems, radio and radar altimeters, other radar sensing and transmitting equipment.

# Unit 210 Maintaining aircraft avionic systems

## Outcome 9 Be able to maintain aircraft avionic systems

**Assessment Criteria**

The learner can:

1. carry out maintenance activities on aircraft instrumentation
2. carry out maintenance activities on aircraft communication and navigation equipment
3. operation an aircraft flying control system
4. undertake maintenance activities on an aircraft flying control system
5. test an auto-stabilisation system
6. carry out maintenance activities on an aircraft electrical system.

**Range/Scope/Unit content**

**List 1**

Identify aircraft instrumentation
Connect and operate test equipment
Read and interpret instruments
Remove and refit system components

**List 2**

Identify aircraft communication and navigation system components
Maintenance activities eg:
Use functional test, BITE
Connect and operate test equipment
Read and interpret instruments
Identify symptoms, likely causes
Use appropriate trouble-shooting methods to identify faulty LRU
Remove and refit system components

**List 3**

Assist in the system operation

**List 4**

Eg:
Inspection
Replacement of components

**List 5**

Eg:
Fixed wing auto-stabilisation

**List 6**

Identify, operate and maintain aircraft electrical system components

Connect and operate electrical test equipment eg: multimeter, insulation tester, TDR

Read and interpret instruments

Remove and refit system components.

# Unit 210 Maintaining aircraft avionic systems

## 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 parts of the syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 13 (13.3-5, 13.8-10) and Module 14.

The equivalent EASA knowledge level indicators for each of the above outcomes - required for the B2 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 3
Outcome 4: EASA Level 3
Outcome 5: EASA Level 2
Outcome 6: EASA Level 3
Outcome 7: EASA Level 3
Outcome 8: EASA Level 3
Outcome 9: EASA Level 2

Note: the above list equates to the EASA requirement for category B2 licences and is for guidance only. It is primarily for those learners wishing to sit the CAA examination in this subject.

# Unit 215 Aviation mathematics and science for technicians

**Level:** 3
**Credit value:** 8
**UAN:** D/503/1128

### Unit aim

This unit aims to give the learner the maths and science knowledge in an aviation context to allow further study of aircraft manufacturing and maintenance practices.

### Learning outcomes

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

1. be able to use principles of arithmetic
2. be able to use SI, Imperial and US customary units
3. be able to manipulate algebraic expressions and formulae using standard techniques
4. be able to calculate physical properties of common two and three dimensional shapes
5. be able to use graphs to determine values and solve engineering problems
6. understand the nature of matter
7. understand principles of statics
8. understand principles of types of motion related to aircraft in flight
9. understand principles of dynamics related to aircraft in flight
10. understand principles of fluid motion related to aircraft in flight

### Guided learning hours

It is recommended that **70** 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 155, 177 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:

- An online multiple choice test.

# Unit 215 Aviation mathematics and science for technicians

## Outcome 1 Be able to use principles of arithmetic

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

Including: positive, negative and real numbers

**List 2**

Add, subtract, multiply, divide

A range of first degree expressions in an aeronautical context

**List 3**

Expressions with at least four component values

**List 4**

Basic rules of fractions

Proper and improper fractions

**List 5**

Standard fractions found in engineering (eg: imperial sizes)

Non-standard 'awkward' fractions

Proper and improper fractions

**List 6**

Suitable proper and improper fractions

**List 7**
Nil

**List 8**
Eg:
Engine thrust
Voltage variation
Fuel tank contents

**List 9**
Nil

**List 10**
Nil

**List 11**
Nil

**List 12**
Recurring
Terminating
Non-terminating

**List 13**
Definitions and examples

**List 14**
Using more complex expressions than in '2.' with all basic operators

**List 15**
Rules of estimation
Practice with and without calculator
The implications of erroneous estimation in an engineering context.

# Unit 215 Aviation mathematics and science for technicians

## Outcome 2 Be able to use SI, Imperial and US customary units

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

Metre, kilogram, second, ampere, Kelvin, Pascal, Newton Joule

Names and symbols for preferred prefixes:

Giga G), mega (M), kilo (k), nano (n), pico (p)

Include their typical uses

**List 2**

Foot (ft), pound (lb), minute (min), Fahrenheit (F)

Include their typical uses

**List 3**

All those commonly used in engineering

With and without a calculator

Derived SI units eg: Hertz, Newton, Pascal, Joule, Watt, Volt, Ohm, °Celsius, Kelvin

Compound derived units eg:

Metres per second

Newton metre

Relevant US Imperial measures eg: US gallons

Imperial: feet, inches, yards, pounds (lb), Imp gallons,

**List 4**

Using both arithmetical means and standard reference tables/graphs/calculators

For Imperial and SI systems

**List 5**
Explanation of the definition
Using suitable examples from engineering

**List 6**
Relevant to engineering
Tolerance

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

**List 8**
Eg:
Pascal
Bar
Atmosphere
Psi
$Nm^{-2}$
Explain the reasons for doing this accurately

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

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

**List 10**
Eg: oxygen, nitrogen, air, fuel

**List 11**
Eg: oxygen, nitrogen, air, fuel

# Unit 215 Aviation mathematics and science for technicians

## Outcome 3 Be able to manipulate algebraic expressions and formulae using standard techniques

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

By grouping and extracting common factors

**List 2**

Basic definitions with examples

**List 3**

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

**List 4**

Simple equations using basic methods

**List 5**

With one unknown

**List 6**

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

**List 7**

Eg:
Specific gravity
Pressure
Temperature and heat.

# Unit 215 Aviation mathematics and science for technicians

## Outcome 4 Be able to calculate physical properties of common two and three dimensional shapes

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

Radius
Diameter
Circumference
Arc
Chord

**List 2**

Radius
Diameter
Circumference

**List 3**

Simple constructions on paper eg:
Triangle
Square
Rectangle
Parallelogram
Circle

**List 4**

Rectangular
Polar

**List 5**
Using:
sine, cosine and tangent relationships
Triangle
Square
Rectangle
Parallelogram

**List 6**
Cube
Cylinder
Cone
Sphere

# Unit 215 Aviation mathematics and science for technicians

## Outcome 5 Be able to use graphs to determine values and solve engineering problems

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

By examining experimental data using various origins

**List 2**

Including interpolate between known points

**List 3**

Extrapolate Graph Trends

**List 4**

Graphically and by calculation

**List 5**

First order equations

**List 6**

Recognise peak values and phase difference

**List 7**

Pressure
Density
Relative density
Temperature

**List 8**

Eg:
ICAO tables
Take-off performance graphs
Fuel data.

# Unit 215 Aviation mathematics and science for technicians

## Outcome 6 Understand the nature of matter

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

Explanation including:

Random motion of particles

Brownian motion

Gas properties of pressure, temperature and volume

Conduction, Convection, Radiation, Adiabetic compression

**List 2**

Eg carbon, iron, aluminium, copper

**List 3**

Solid, liquid, gas

Include all state changes: solid > liquid > gas >liquid > gas

Basic explanation of latent heat

Common features of state changes such as the expansion of water when frozen.

**List 4**

Metallic

Ionic

Covalent

Relative strengths of each bond

Reasons for forming each type

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

**List 6**
Engineering explanation using aircraft related examples

**List 7**
Kelvin
Degrees Fahrenheit
Degrees Celsius
Thermometers

**List 8**
Kelvin
Degrees Fahrenheit
Degrees Celsius

**List 9**
Eg:
Altitude
Temperature
Density.

# Unit 215 Aviation mathematics and science for technicians

## Outcome 7 Understand principles of statics

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

Define 'vector'

Draw vector lines to represent forces in a system

**List 2**

With respect to mechanical systems

**List 3**

Basic principle of moments

**List 4**

Explain the meaning

Examples of position in common objects including aircraft

**List 5**

Relate problems to aircraft eg:

Bell crank on control cables

Aircraft balance about main undercarriage on the ground

Aircraft loading to adjust C of G

**List 6**

Including some aircraft-related problems

**List 7**

Including some aircraft-related problems

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

**List 9**
Aircraft-related examples

**List 10**
Aircraft related

**List 11**
Measuring height
Applying ρ  p = þ gh

# Unit 215 Aviation mathematics and science for technicians

## Outcome 8 Understand principles of linear, angular and oscillating motion related to aircraft in flight

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

Including acceleration due to gravity and its approximate value

**List 2**

In standard form

Include aircraft-related examples

**List 3**

Including aircraft-related examples

**List 4**

$s = ut + \frac{1}{2}at^2$

$v = u + at$

$v^2 = u^2 + 2as$

**List 5**

Using:

Newton's Laws of Motion

Linear motion equations

**List 6**

Centripetal acceleration

Centrifugal force

Angular velocity

Calculations

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

**List 8**
Applying definitions in (7.)

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

# Unit 215 Aviation mathematics and science for technicians

## Outcome 9 Understand principles of dynamics related to aircraft in flight

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

Velocity ratio
Mechanical advantage
Efficiency

**List 2**

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

**List 3**

Momentum
Inertia
Rigidity
Precession
Gimbal Lock, Degrees of freedom

**List 4**

Calculations

**List 5**
Potential
Kinetic
Heat
Electrical
Chemical

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

**List 7**
Related to aircraft where possible

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

**List 9**
Applying definitions in 8

# Unit 215 Aviation mathematics and science for technicians

## Outcome 10 Understand principles of fluid motion related to aircraft in flight

**Assessment Criteria**

The learner can:

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

**Range/Scope/Unit content**

**List 1**

Including practical examples eg: fuel

**List 2**

Changes with altitude of air properties:

Density

Pressure

Temperature

**List 3**

In terms of:

Resistance to fluid flow

Shear stresses close to the system boundary

**List 4**

Velocity of the air

Resistance of the air

**List 5**

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

**List 6**

Simplified explanation.

# Unit 215 Aviation mathematics and science for technicians

## Notes for guidance

This unit contains the complete syllabus of EASA 2042/2003 part 66 Basic Knowledge Requirements Module 1 – Mathematics and Module 2 – Physics, for Category A Licences but is taught to the depth for Category B1. B1 syllabus paragraphs not covered are:

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

The equivalent EASA knowledge level indicators for each of the above outcomes are listed below with an abridged description of each level:

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

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

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

Outcome 1: EASA Level 2
Outcome 2: EASA Level 2
Outcome 3: EASA Level 2 (3.1-3) EASA Level 2 (3.4-7)
Outcome 4: EASA Level 2 (except 4.3 – EASA Level 1)
Outcome 5: EASA Level 2
Outcome 6: EASA Level 1 (except 6.6-8 – EASA Level 2)
Outcome 7: EASA Level 2
Outcome 8: EASA Level 2
Outcome 9: EASA Level 2
Outcome 10: EASA Level 2

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

# 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.

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# Useful contacts

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



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

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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.

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



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