Civil Aviation Authority of Singapore

Singapore Airworthiness Requirements

Part 66

Aircraft Maintenance Licensing

Issue 2, Amendment 4 8 March 2013

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SECTION 1 – REQUIREMENTS

SAR-66.1 General

(a) SAR-145 permits appropriately authorised certifying staff to issue a certificate of release to service on behalf of the SAR-145 approved maintenance organisation when satisfied that all required maintenance has been completed.

(b) Certifying staff responsible for issuing the certificate of release to service for Singapore aircraft shall be qualified in accordance with the appropriate requirements of :

(1) Section 7 of the Singapore Airworthiness Requirements; or

(2) SAR-66 Aircraft Maintenance Licensing requirements.

(c) Pursuant to paragraph 17A of the Air Navigation Order (ANO), the SAR-66 prescribes the requirements for the issue of a SAR-66 aircraft maintenance licence and conditions of its validity and use, for aeroplanes and helicopters of the following categories:

— Category A
— Category B1
— Category B2
— Category C

(d) Categories A and B1 are subdivided into subcategories relative to combinations of aeroplanes, helicopters, turbine and piston engines. The subcategories are:

— A1 and B1.1 Aeroplanes Turbine
— A2 and B1.2 Aeroplanes Piston
— A3 and B1.3 Helicopters Turbine
— A4 and B1.4 Helicopters Piston

SAR-66.3 Effectivity

(a) The SAR-66 was first issued on 4 June 2004. SAR-66 Issue 2 was issued and effective on 15 August 2006. Amendment 1 is issued and effective on 23 July 2010. Amendment 2 is issued and effective on 18 June 2011. Amendment 3 is issued and effective on 11 April 2012.

(b) Amendment 4 is issued and effective on 8 March 2013.

SAR-66.5 Definitions

For the purpose of this SAR-66, the following definitions shall apply:

'Aircraft' means any machine that can derive support in the atmosphere from the reactions of the air other than reactions of the air against the earth's surface.

'Aircraft maintenance licence' or *'AML'* means a document issued as evidence of qualification confirming that the person to whom it refers has met the SAR-66 knowledge and experience requirements for any aircraft basic category and aircraft type rating, if appropriate, specified in the document.

'Approved maintenance organisation' means an organisation approved in accordance with paragraph 8A of the Air Navigation Order.

Approved training' means training conducted under special curricula and supervision approved by the Chief Executive, that is conducted within an approved maintenance training organisation.

'Certification' means the issuance of a certificate of release to service.

'Certifying staff' means those personnel who are authorised by the SAR-145 approved maintenance organisation or other approved organisation in accordance with a procedure acceptable to the Authority to certify aircraft or aircraft components for release to service.

'Credit' means recognition of alternative means or prior qualifications.

'Large aircraft' means an aircraft, classified as an aeroplane with a maximum take-off mass of more than 5,700 kg, or a multi-engined helicopter.

'The Authority' means the Civil Aviation Authority of Singapore (CAAS) established under Section 4 of the Civil Aviation Authority of Singapore Act.

'Organisation procedures' means the procedures applied by the SAR-145 approved maintenance organisation in accordance with the maintenance organisation exposition within the scope of the approval.

'SAR Section 7' means Section 7 of the Singapore Airworthiness Requirements.

'SAR-7 aircraft maintenance engineer licence' or 'SAR-7 AMEL' means an aircraft maintenance engineer licence issued in accordance with the requirements of Section 7 of the Singapore Airworthiness Requirements.

SAR-66.10 Application and Issue

(a) An application for a SAR-66 aircraft maintenance licence or amendment to such licence must be made on a form and in a manner prescribed by the Authority.

(b) An applicant who meets the appropriate requirements of SAR-66 and has paid all charges prescribed by the Authority may be granted a SAR-66 aircraft maintenance licence.

(c) Upon receiving a SAR-66 aircraft maintenance licence, the holder shall forthwith sign his name thereon in ink with his ordinary signature.

(d) A SAR-66 aircraft maintenance licence is valid for a period of not more than 2 years from the date of issue or renewal unless suspended or revoked by the Authority.

(e) An applicant for the grant of a SAR-66 aircraft maintenance licence must:

(1) be at least 21 years of age;

(2) be able to read, write and communicate to an understandable level in English in which technical documentation and procedures necessary to support the issue of certificate of release to service are written; and

(3) be able to demonstrate a need to hold the licence.

SAR-66.20 Privileges

(a) A SAR-66 aircraft maintenance licence may be granted in one or more of the following categories:

(1) Category A – an aircraft maintenance licence which permits the holder to issue certificates of release to service following minor scheduled line maintenance and completion of simple tasks in line and base maintenance, as specified in SAR-145, within the limits of tasks specifically endorsed on the certification authorisation. The certification privileges are restricted to work that the authorisation holder has personally performed.

(2) Category B1 – an aircraft maintenance licence which permits the holder to issue certificates of release to service and to act as B1 support staff following maintenance of the aircraft structure, powerplant, mechanical and electrical systems. Certification of work on avionics systems requiring only simple tests to prove their serviceability are also included in the privileges. Troubleshooting on avionics systems is not allowed. Category B1 shall automatically include the appropriate A subcategory.

(3) Category B2 – an aircraft maintenance licence which permits the holder to issue certificates of release to service and to act as B2 support staff following:

— maintenance of avionics and electrical systems; and

— performance of electrical and avionics tasks within powerplant and mechanical systems, requiring only simple tests to prove their serviceability.

(4) Category C – an aircraft maintenance licence which permits the holder to issue certificates of release to service following base maintenance on aircraft. The privileges apply to the aircraft in its entirety in a SAR-145 organisation.

(5) Notwithstanding sub-paragraph (3), the holder of a category B2 aircraft maintenance licence issued or renewed before 8 March 2013 shall have his privileges limited to the issuance of a certificate of release to service and to act as B2 support staff following maintenance of avionics and electrical systems. The limitations on the privileges may be removed at the next licence renewal or variation.

(b) The holder of an aircraft maintenance licence may not exercise certification privileges

unless:

(1) he or she is in compliance with the applicable requirements of SAR-145; and

(2) in the preceding 2-year period, he or she has had 6 months of maintenance experience relevant to the privileges of his or her aircraft maintenance licence.

Note: The aircraft maintenance licence alone does not permit the holder to issue certificates of release to service in respect of aircraft. To issue a certificate of release to service for such aircraft, the aircraft maintenance licence holder must in addition hold a SAR-145 certification authorisation with the appropriate privileges issued by the SAR-145 approved maintenance organisation.

(c) Certifications shall be made in accordance with the procedures of the approved organisation and within the scope of the certification authorisation.

SAR-66.25 Basic knowledge requirements

(a) An applicant for an aircraft maintenance licence or the addition of a category or subcategory to such an aircraft maintenance licence shall demonstrate, by examination, a level of knowledge in the appropriate subject modules in accordance with Appendix 1 to this SAR-66. The basic knowledge requirements in Appendices 1 and 2, as amended on 8 March 2013, shall be effective from 1 July 2013.

(b) *- deleted -*

(c) Full or partial credit against the basic knowledge requirements and associated examination may be given for any other technical qualification considered by the Authority to be equivalent to the SAR-66 knowledge standard.

(ca) A basic knowledge examination for each module comprises of a Multiple Choice Question (MCQ) examination paper with the exception of Module M07, Modules M09 and M10, which comprise an MCQ examination paper each and a combined essay examination paper (the M50 paper).

(d) For the purpose of an application for an aircraft maintenance licence or the addition of a category or subcategory to such an aircraft maintenance licence, a pass in a basic knowledge examination paper for all subject modules is valid for a period of 10 years, except for passes in the examination papers for Human Factors (Module M09) and Aviation Legislation (Module M10), where a pass in the MCQ examination paper and the M50 essay examination paper are each valid for 5 years.

(e) A person who fails a basic knowledge examination twice within a 3-month period shall be ineligible to reapply for that examination for 3 months.

SAR-66.30 Experience requirements

(a) An applicant for an aircraft maintenance licence shall have acquired:

(1) for category A and subcategories B1.2 and B1.4:

(i) 3 years of practical maintenance experience on operating aircraft if the applicant has no previous relevant technical training; or

(ii) 2 years of practical maintenance experience on operating aircraft and completion of training considered relevant by the Authority as a skilled worker in a technical trade; or

(iii) 1 year of practical maintenance experience on operating aircraft and completion of a SAR-147 approved basic training course.

(2) for category B2 and subcategories B1.1 and B1.3:

(i) 5 years of practical maintenance experience on operating aircraft if the applicant has no previous relevant technical training; or

(ii) 3 years of practical maintenance experience on operating aircraft and completion of training considered relevant by the Authority as a skilled worker, in a technical trade; or

(iii) 2 years of practical maintenance experience on operating aircraft and completion of a SAR-147 approved basic training course.

(3) for category C with respect to large aircraft:

(i) 3 years of experience exercising category B1.1, B1.3 or B2 privileges on large aircraft or as SAR-145 B1.1, B1.3 or B2 support staff working on large aircraft, or, a combination of both; or

(ii) 5 years of experience exercising category B1.2 or B1.4 privileges on large aircraft or as SAR-145 B1.2 or B1.4 support staff working on large aircraft, or a combination of both.

(4) for category C with respect to aircraft other than large aircraft: 3 years of experience exercising category B1 or B2 privileges on aircraft other than large aircraft or as SAR-145 B1 or B2 support staff working on aircraft other than large aircraft, or a combination of both.

(5) for category C obtained through the academic route: an academic degree in a technical discipline, from a university recognised by the Authority, and 3 years of experience working in a civil aircraft maintenance environment on a representative selection of tasks directly associated with aircraft maintenance, including 6 months of observation of base maintenance tasks.

(b) An applicant for an addition of a category or subcategory to an aircraft maintenance licence shall have a minimum civil aircraft maintenance experience requirement appropriate to the additional category or subcategory of licence applied for as defined in Appendix 4 to this SAR-66.

(c) For categories A, B1 and B2, the experience must be practical which means being involved with a representative cross section of maintenance tasks on operating aircraft.

(d) For category A and subcategories B1.2 and B1.4, at least 1 year of the required practical maintenance experience must be recent maintenance experience on aircraft of the category/subcategory for which the initial aircraft maintenance licence is sought. For category B2 and subcategories B1.1 and B1.3, at least 2 years of the required practical maintenance experience must be recent maintenance experience on aircraft of the category/subcategory for which the initial aircraft maintenance licence is sought. For subsequent category/subcategory addition to an existing aircraft maintenance licence, the entire duration of maintenance experience as required in Appendix 4 to this SAR-66 must be recent. The required practical maintenance experience must be dependent upon the difference between the licence category/subcategory held and applied for. All recent practical maintenance experience must be demonstrated in a manner acceptable to the Authority.

(e) For category C to be obtained through academic route, the 6 months of observation of base maintenance tasks as required in SAR-66.30(a)(5) must be demonstrated in a manner acceptable to the Authority.

(f) Notwithstanding paragraph (a), aircraft maintenance experience gained outside a civil aircraft maintenance environment may be accepted by the Authority when satisfied that such experience is equivalent to that required by SAR-66. Additional recent practical maintenance experience on the maintenance of civil aircraft shall, however, be required to ensure understanding of the civil aircraft maintenance environment.

SAR-66.40 Continuity of the aircraft maintenance licence

(a) The SAR-66 aircraft maintenance licence holder shall inform the Authority of any change in the particulars which will affect the information contained in the licence.

(b) The SAR-66 aircraft maintenance licence holder shall apply to the Authority to renew his licence at least 1 month, but not more than 3 months, before the date of expiry of the licence.

(c) A SAR-66 aircraft maintenance licence will be renewed provided the applicant is not suffering from any disability likely to adversely affect his or her technical skill or judgment.

(d) Notwithstanding sub-paragraph (c), a SAR-66 aircraft maintenance licence held by a person who is not a Singapore citizen or permanent resident may not be renewed unless the licence holder is working for a CAAS approved organisation.

(e) Failure to renew the SAR-66 aircraft maintenance licence shall invalidate any certification authorisation issued on the basis of such SAR-66 aircraft maintenance licence and may require recent aircraft maintenance experience and/or the re-sit of some examinations before re-issue of the licence. The Authority will decide for each particular case.

SAR-66.45 Type/task training and ratings

(a) The holder of a category A aircraft maintenance licence may only exercise certification privileges on a specific aircraft type following the satisfactory completion of the relevant category A aircraft task training carried out by an appropriately approved SAR-145 or SAR-147 organisation. The training shall include theoretical training and

practical hands-on training as appropriate for each task authorised. Satisfactory completion of training shall be demonstrated by an examination and/or by workplace assessment carried out by an appropriately approved SAR-145 or SAR-147 organisation.

(b) Except as otherwise specified in paragraph (g), the holder of a category B1, B2 or C aircraft maintenance licence shall only exercise certification privileges on a specific aircraft type when the aircraft maintenance licence is endorsed with the appropriate aircraft type rating.

(c) Except as otherwise specified in paragraph (h), ratings shall be granted following satisfactory completion of the relevant category B1, B2 or C aircraft type training accepted by the Authority, or conducted by an appropriately approved SAR-147 maintenance training organisation.

(d) Category B1 and B2 approved type training shall include theoretical and practical elements and consist of the appropriate course in relation to the 66.20(a) privileges. Theoretical and practical training shall comply with Appendix 3 to this SAR-66.

(e) The first type training for a holder of an academic degree seeking a category C licence as specified in 66.30(a)(5) must include both theoretical and practical training at either category B1 or B2 level.

(f) Completion of approved aircraft type training, as required by paragraphs (b) to (e), shall be demonstrated by an examination. The examination shall comply with Appendix 3 to this SAR-66. The examinations in respect of category B1 or B2 or C aircraft type ratings shall be conducted by training organisations appropriately approved under SAR-147, the Authority, or the training organisation accepted by the Authority to conduct the approved type training course.

(g) Notwithstanding paragraph (b), for aircraft other than large aircraft, the holder of a category B1, B2 or C aircraft maintenance licence may also exercise certification privileges, when the aircraft maintenance licence is endorsed with the appropriate group ratings, or manufacturer group ratings, unless the Authority has determined that the complexity of the aircraft in question requires a type rating.

(1) Manufacturer group ratings may be granted after complying with the type rating requirements of 2 aircraft types representative of the group from the same manufacturer.

(2) Full group ratings may be granted after complying with the type rating requirements of 3 aircraft types representative of the group from different manufacturers. However, no full group rating may be granted to B1 multiple turbine engine aeroplanes, where only manufacturer group rating applies.

(3) The groups shall consist the following:

(i) for category B1 or C:

— helicopter piston engine

— helicopter turbine engine

— aeroplane single piston engine - metal structure

— aeroplane multiple piston engines - metal structure

— aeroplane single piston engine - wooden structure

— aeroplane multiple piston engines - wooden structure

— aeroplane single piston engine - composite structure

— aeroplane multiple piston engines - composite structure

— aeroplane turbine - single engine

— aeroplane turbine - multiple engine

(ii) for category B2 or C:

— aeroplane

— helicopter

(h) Notwithstanding paragraph (c), ratings on aircraft other than large aircraft may also be granted, subject to satisfactory completion of the relevant category B1, B2 or C aircraft type examination and demonstration of practical experience on the aircraft type, unless the Authority has determined that the aircraft is complex, where paragraph (c) approved type training is required. In the case of category C ratings on aircraft other than large aircraft, for a person qualified by holding an academic

degree as specified in 66.30(a)5, the first relevant aircraft type examination shall be at the category B1 or B2 level.

(1) Category B1, B2 and C approved type examinations must consist of a mechanical examination for category B1 and an avionics examination for category B2 and both mechanical and avionics examination for category C.

(2) The examination shall comply with Appendix 3 to this SAR-66. The examination may be conducted by the Authority, approved training organisations, or organisations accepted by the Authority.

(3) Aircraft type practical experience shall include a representative cross section of maintenance activities relevant to the category.

SAR-66.50 Medical fitness

Certifying staff must not exercise the privileges of their certification authorisation if they know or suspect that their physical or mental condition renders them unfit to exercise such privileges.

SAR-66.55 Evidence of qualification

Certifying staff qualified in accordance with this SAR-66 may be issued with an aircraft maintenance licence by the Authority as evidence of one of the qualifications necessary for the grant of a SAR-145 certification authorisation. Certifying staff must be able to produce their licence if requested by an authorised person within a reasonable time.

SAR-66.60 Equivalent safety cases

The Authority may exempt any person, required to be qualified in accordance with SAR-66, from any requirement in SAR-66 when satisfied that a situation exists not covered by SAR-66 and subject to compliance with any supplementary condition(s) the Authority considers necessary to ensure equivalent safety.

SAR-66.65 Revocation, suspension or limitation of the SAR-66 aircraft maintenance licence

(a) The Authority may, on reasonable grounds after due enquiry, revoke, suspend or limit the SAR-66 aircraft maintenance licence or direct the SAR-145 approved maintenance organisation to revoke, suspend or limit the SAR-145 certification authorisation if the Authority is not satisfied that the holder of the licence and authorisation is a fit and proper person to hold such licence and authorisation.

(b) In the case where the Authority has determined that the safe operation of the aircraft is adversely affected the Authority may provisionally suspend the SAR-66 aircraft maintenance licence without prior notice.

(c) The holder of a SAR-66 aircraft maintenance licence that has been suspended or revoked shall forthwith forward the licence to the Authority.

SAR-66.70 Conversion provisions

(a) Subject to sub-paragraph (b), a SAR-7 aircraft maintenance engineer licence issued prior to the effective date of this SAR-66 shall be replaced with a SAR-66 aircraft maintenance licence upon renewal without further examination.

(b) Where necessary, the replacement SAR-66 aircraft maintenance licence and the rating(s) therein shall contain technical limitation(s) in relation to the scope of the pre-existing qualification.

(c) Persons taking examinations under the SAR-7 requirements prior to the effective date of this SAR-66 may continue to be qualified in accordance with SAR-7 requirements but will be issued a SAR-66 aircraft maintenance licence subject to limitations where applicable upon qualifying.

(d) Limitations on SAR-66 aircraft maintenance licence may be removed when the licence holder successfully applies to the Authority for their removal after fulfilling the necessary theoretical and practical requirements, or any experience as required by the Authority.

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APPENDIX 1

BASIC KNOWLEDGE REQUIREMENTS

1. KNOWLEDGE LEVELS — CATEGORY A, B1, B2 AND C AIRCRAFT MAINTENANCE LICENCE

Basic knowledge for categories A, B1 and B2 are indicated by the allocation of knowledge levels indicators (1, 2 or 3) against each applicable subject. Category C applicants must meet either the category B1 or the category B2 basic knowledge levels. The knowledge level indicators are defined as follows:

LEVEL 1 ***A familiarisation with the principal elements of the subject.***

Objectives: The applicant should be:

(i) familiar with the basic elements of the subject;
(ii) able to give a simple description of the whole subject, using common words and examples; and
(iii) able to use typical terms.

LEVEL 2 ***A general knowledge of the theoretical and practical aspects of the subject. An ability to apply that knowledge.***

Objectives: The applicant should be able to:

(i) understand the theoretical fundamentals of the subject;
(ii) give a general description of the subject using, as appropriate, typical examples;
(iii) use mathematical formulae in conjunction with physical laws describing the subject;
(iv) read and understand sketches, drawings and schematics describing the subject; and
(v) apply his or her knowledge in a practical manner using detailed procedures.

LEVEL 3 ***A detailed knowledge of the theoretical and practical aspects of the subject. A capacity to combine and apply the separate elements of knowledge in a logical and comprehensive manner.***

Objectives: The applicant should:

(i) know the theory of the subject and interrelationships with other subjects;
(ii) be able to give a detailed description of the subject using theoretical fundamentals and specific examples;
(iii) understand and be able to use mathematical formulae related to the subject;
(iv) be able to read, understand and prepare sketches, simple drawings and schematics describing the subject;
(v) be able to apply his knowledge in a practical manner using manufacturer's instructions; and
(vi) be able to interpret results from various sources and measurements and apply corrective action where appropriate.

2. MODULARISATION

Qualification on basic subjects for each SAR-66 aircraft maintenance licence category or subcategory should be in accordance with the following matrix. Applicable subjects are indicated by an 'X':

Module No.	Module Name	Cat A or B1 Aeroplanes with:		Cat A or B1 Helicopters with:		Cat B2
		Turbine Engine	Piston Engine	Turbine Engine	Piston Engine	Avionics
M01	Mathematics	X	X	X	X	X
M02	Physics	X	X	X	X	X
M03	Electrical Fundamentals	X	X	X	X	X
M04	Electronic Fundamentals	X	X	X	X	X
M05	Digital Techniques / Electronic Instrument Systems	X	X	X	X	X
M06	Materials and Hardware	X	X	X	X	X
M07	Maintenance Practices	X	X	X	X	X
M08	Basic Aerodynamics	X	X	X	X	X
M09	Human Factors	X	X	X	X	X
M10	Aviation Legislation	X	X	X	X	X
M11A	Turbine Aeroplane Aerodynamics, Structures and Systems	X				
M11B	Piston Aeroplane Aerodynamics, Structures and Systems		X			
M12	Helicopter Aerodynamics, Structures and Systems			X	X	
M13	Aircraft Aerodynamics, Structures and Systems					X
M14	Propulsion					X

Module No.	Module Name	Cat A or B1 Aeroplanes with:		Cat A or B1 Helicopters with:		Cat B2
		Turbine Engine	Piston Engine	Turbine Engine	Piston Engine	Avionics
M15	Gas Turbine Engine	X		X		
M16	Piston Engine		X		X	
M17[1]	Propeller	X	X			
M60[2]	Bridging Paper for Category A	X	X	X	X	

[1] Candidates who do not have examination credit in Module 17 may be considered for the grant of a SAR-66 Category A1 or B1.1 licence with limitation against propeller.

[2] M60 is a bridging paper for applicants seeking to qualify for SAR-66 category A after having passed the following subjects under SAR-7: B11, B12, B13, A11, A12, A14, A16 and A17.

MODULE 1. MATHEMATICS

		Level		
		A	B1	B2
1.1	**Arithmetic** Arithmetical terms and signs, methods of multiplication and division, fractions and decimals, factors and multiples, weights, measures and conversion factors, ratio and proportion, averages and percentages, areas and volumes, squares, cubes, square and cube roots.	1	2	2
1.2	**Algebra**			
	(a) Evaluating simple algebraic expressions, addition, subtraction, multiplication and division, use of brackets, simple algebraic fractions.	1	2	2
	(b) Linear equations and their solutions; Indices and powers, negative and fractional indices; Binary and other applicable numbering systems; Simultaneous equations and second degree equations with one unknown; Logarithms.	-	1	1
1.3	**Geometry**			
	(a) Simple geometrical constructions.	-	1	1
	(b) Graphical representation; nature and uses of graphs, graphs of equations/functions.	2	2	2
	(c) Simple trigonometry; trigonometrical relationships, use of tables and rectangular and polar co-ordinates.	-	2	2

MODULE 2. PHYSICS

Students should become conversant with Metric, Imperial (British) and US units and measurements.

		Level		
		A	B1	B2
2.1	**Matter**	**1**	**1**	**1**
	Nature of matter: the chemical elements, structure of atoms, molecules			
	Chemical compounds.			
	States: solid, liquid and gaseous;			
	Changes between states.			
2.2	**Mechanics**			
2.2.1	***Statics***	**1**	**2**	**1**
	Forces, moments and couples, representation as vectors;			
	Centre of gravity;			
	Elements of theory of stress, strain and elasticity: tension, compression, shear and torsion;			
	Nature and properties of solid, fluid and gas;			
	Pressure and buoyancy in liquids (barometers).			
2.2.2	***Kinetics***	**1**	**2**	**1**
	Linear movement: uniform motion in a straight line, motion under constant acceleration (motion under gravity);			
	Rotational movement: uniform circular motion (centrifugal/ centripetal forces);			
	Periodic motion: pendular movement;			
	Simple theory of vibration, harmonics and resonance;			
	Velocity ratio, mechanical advantage and efficiency.			
2.2.3	***Dynamics***			
	(a)	**1**	**2**	**1**
	Mass;			
	Force, inertia, work, power, energy (potential, kinetic and total energy), heat, efficiency.			
	(b)	**1**	**2**	**2**
	Momentum, conservation of momentum;			
	Impulse;			
	Gyroscopic principles;			
	Friction: nature and effects, coefficient of friction (rolling resistance).			
2.2.4	***Fluid dynamics***			
	(a) Specific gravity and density.	**2**	**2**	**2**
	(b)	**1**	**2**	**1**
	Viscosity, fluid resistance, effects of streamlining;			
	Effects of compressibility on fluids;			
	Static, dynamic and total pressure: Bernoulli's Theorem, venturi.			

MODULE 2. PHYSICS (Continued)

		Level		
		A	B1	B2
2.3	**Thermodynamics**			
	(a)	**2**	**2**	**2**
	Temperature: thermometers and temperature scales: Celsius, Fahrenheit and Kelvin;			
	Heat definition.			
	(b)	**-**	**2**	**2**
	Heat capacity, specific heat;			
	Heat transfer: convection, radiation and conduction;			
	Volumetric expansion;			
	First and second law of thermodynamics;			
	Gases: ideal gases laws; specific heat at constant volume and constant pressure, work done by expanding gas;			
	Isothermal, adiabatic expansion and compression, engine cycles, constant volume and constant pressure, refrigerators and heat pumps;			
	Latent heats of fusion and evaporation, thermal energy, heat of combustion.			
2.4	**Optics (Light)**	**-**	**2**	**2**
	Nature of light; speed of light;			
	Laws of reflection and refraction: reflection at plane surfaces, reflection by spherical mirrors, refraction, lenses;			
	Fibre optics.			
2.5	**Wave Motion and Sound**	**-**	**2**	**2**
	Wave motion: mechanical waves, sinusoidal wave motion, interference phenomena, standing waves;			
	Sound: speed of sound, production of sound, intensity, pitch and quality, Doppler effect.			

MODULE 3. ELECTRICAL FUNDAMENTALS

		Level		
		A	B1	B2
3.1	**Electron Theory** Structure and distribution of electrical charges within: atoms, molecules, ions, compounds; Molecular structure of conductors, semiconductors and insulators.	**1**	**1**	**1**
3.2	**Static Electricity and Conduction** Static electricity and distribution of electrostatic charges; Electrostatic laws of attraction and repulsion; Units of charge, Coulomb's Law; Conduction of electricity in solids, liquids, gases and a vacuum.	**1**	**2**	**2**
3.3	**Electrical Terminology** The following terms, their units and factors affecting them: potential difference, electromotive force, voltage, current, resistance, conductance, charge, conventional current flow, electron flow.	**1**	**2**	**2**
3.4	**Generation of Electricity** Production of electricity by the following methods: light, heat, friction, pressure, chemical action, magnetism and motion.	**1**	**1**	**1**
3.5	**DC Sources of Electricity** Construction and basic chemical action of: primary cells, secondary cells, lead acid cells, nickel cadmium cells, other alkaline cells; Cells connected in series and parallel; Internal resistance and its effect on a battery; Construction, materials and operation of thermocouples; Operation of photo-cells.	**1**	**2**	**2**
3.6	**DC Circuits** Ohms Law, Kirchoff's Voltage and Current Laws; Calculations using the above laws to find resistance, voltage and current; Significance of the internal resistance of a supply.	**-**	**2**	**2**
3.7	**Resistance / Resistor**			
	(a) Resistance and affecting factors; Specific resistance; Resistor colour code, values and tolerances, preferred values, wattage ratings; Resistors in series and parallel; Calculation of total resistance using series, parallel and series parallel combinations; Operation and use of potentiometers and rheostats; Operation of Wheatstone Bridge.	**-**	**2**	**2**

MODULE 3. ELECTRICAL FUNDAMENTALS (Continued)

		Level		
		A	B1	B2
3.7 (cont)	**(b)** Positive and negative temperature coefficient conductance; Fixed resistors, stability, tolerance and limitations, methods of construction; Variable resistors, thermistors, voltage dependent resistors; Construction of potentiometers and rheostats; Construction of Wheatstone Bridge.	-	1	1
3.8	**Power** Power, work and energy (kinetic and potential); Dissipation of power by a resistor; Power formula; Calculations involving power, work and energy.	-	2	2
3.9	**Capacitance / Capacitor** Operation and function of a capacitor; Factors affecting capacitance area of plates, distance between plates, number of plates, dielectric and dielectric constant, working voltage, voltage rating; Capacitor types, construction and function; Capacitor colour coding; Calculations of capacitance and voltage in series and parallel circuits; Exponential charge and discharge of a capacitor, time constants; Testing of capacitors.	-	2	2
3.10	**Magnetism**			
	(a) Theory of magnetism; Properties of a magnet; Action of a magnet suspended in the Earth's magnetic field; Magnetisation and demagnetisation; Magnetic shielding; Various types of magnetic material; Electromagnets construction and principles of operation; Hand clasp rules to determine: magnetic field around current carrying conductor.	-	2	2
	(b) Magnetomotive force, field strength, magnetic flux density, permeability, hysteresis loop, retentivity, coercive force reluctance, saturation point, eddy currents; Precautions for care and storage of magnets.	-	2	2

MODULE 3. ELECTRICAL FUNDAMENTALS (Continued)

		Level		
		A	B1	B2
3.11	**Inductance / Inductor** Faraday's Law; Action of inducing a voltage in a conductor moving in a magnetic field; Induction principles; Effects of the following on the magnitude of an induced voltage: magnetic field strength, rate of change of flux, number of conductor turns; Mutual induction; The effect the rate of change of primary current and mutual inductance has on induced voltage; Factors affecting mutual inductance: number of turns in coil, physical size of coil, permeability of coil, position of coils with respect to each other; Lenz's Law and polarity determining rules; Back emf, self induction; Saturation point; Principal uses of inductors.	-	2	2
3.12	**DC Motor / Generator Theory** Basic motor and generator theory; Construction and purpose of components in DC generator; Operation of, and factors affecting output and direction of current flow in DC generators; Operation of, and factors affecting output power, torque, speed and direction of rotation of DC motors; Series wound, shunt wound and compound motors; Starter Generator construction.	-	2	2
3.13	**AC Theory** Sinusoidal waveform: phase, period, frequency, cycle; Instantaneous, average, root mean square, peak, peak to peak current values and calculations of these values, in relation to voltage, current and power; Triangular/Square waves; Single / 3 phase principles.	1	2	2
3.14	**Resistive (R), Capacitive (C) and Inductive (L) Circuits** Phase relationship of voltage and current in L, C and R circuits, parallel, series and series parallel; Power dissipation in L, C and R circuits; Impedance, phase angle, power factor and current calculations; True power, apparent power and reactive power calculations.	-	2	2

MODULE 3. ELECTRICAL FUNDAMENTALS (Continued)

		Level		
		A	B1	B2
3.15	**Transformers** Transformer construction principles and operation; Transformer losses and methods for overcoming them; Transformer action under load and no-load conditions; Power transfer, efficiency, polarity markings; Calculation of line and phase voltages and currents; Calculation of power in a three phase system; Primary and Secondary current, voltage, turns ratio, power, efficiency; Auto transformers.	-	2	2
3.16	**Filters** Operation, application and uses of the following filters: low pass, high pass, band pass, band stop.	-	1	1
3.17	**AC Generators** Rotation of loop in a magnetic field and waveform produced; Operation and construction of revolving armature and revolving field type AC generators; Single phase, two phase and three phase alternators; Three phase star and delta connections advantages and uses; Permanent Magnet Generators.	-	2	2
3.18	**AC Motors** Construction, principles of operation and characteristics of: AC synchronous and induction motors both single and polyphase; Methods of speed control and direction of rotation; Methods of producing a rotating field: capacitor, inductor, shaded or split pole.	-	2	2

MODULE 4. ELECTRONIC FUNDAMENTALS

		Level		
		A	B1	B2
4.1	**Semiconductors**			
4.1.1	***Diodes***			
	(a)	**-**	**2**	**2**
	Diode symbols;			
	Diode characteristics and properties;			
	Diodes in series and parallel;			
	Main characteristics and use of silicon controlled rectifiers (thyristors), light emitting diode, photo conductive diode, varistor, rectifier diodes;			
	Functional testing of diodes.			
	(b)	**-**	**-**	**2**
	Materials, electron configuration, electrical properties;			
	P and N type materials: effects of impurities on conduction, majority and minority characters;			
	PN junction in a semiconductor, development of a potential across a PN junction in unbiased, forward biased and reverse biased conditions;			
	Diode parameters: peak inverse voltage, maximum forward current, temperature, frequency, leakage current, power dissipation;			
	Operation and function of diodes in the following circuits: clippers, clampers, full and half wave rectifiers, bridge rectifiers, voltage doublers and triplers;			
	Detailed operation and characteristics of the following devices: silicon controlled rectifier (thyristor), light emitting diode, Schottky diode, photo conductive diode, varactor diode, varistor, rectifier diodes, Zener diode.			
4.1.2	***Transistors***			
	(a)	**-**	**1**	**2**
	Transistor symbols;			
	Component description and orientation;			
	Transistor characteristics and properties.			
	(b)	**-**	**-**	**2**
	Construction and operation of PNP and NPN transistors;			
	Base, collector and emitter configurations;			
	Testing of transistors;			
	Basic appreciation of other transistor types and their uses;			
	Application of transistors: classes of amplifier (A, B, C);			
	Simple circuits including: bias, decoupling, feedback and stabilisation;			
	Multistage circuit principles: cascades, push-pull, oscillators, multivibrators, flip-flop circuits.			
4.1.3	***Integrated Circuits***			
	(a)	**-**	**1**	**-**
	Description and operation of logic circuits and linear circuits/operational amplifiers.			

MODULE 4. ELECTRONIC FUNDAMENTALS (Continued)

		Level		
		A	**B1**	**B2**
4.1.3	**(b)**	**-**	**-**	**2**
	Description and operation of logic circuits and linear circuits; Introduction to operation and function of an operational amplifier used as: integrator, differentiator, voltage follower, comparator; Operation and amplifier stages connecting methods: resistive capacitive, inductive (transformer), inductive resistive (IR), direct; Advantages and disadvantages of positive and negative feedback.			
4.2	**Printed Circuit Board**	**-**	**1**	**2**
	Description and use of printed circuit boards.			
4.3	**Servomechanisms**			
	(a)	**-**	**1**	**-**
	Understanding of the following terms: Open and closed loop systems, feedback, follow up, analogue transducers; Principles of operation and use of the following synchro system components/features: resolvers, differential, control and torque, transformers, inductance and capacitance transmitters.			
	(b)	**-**	**-**	**2**
	Understanding of the following terms: Open and closed loop, follow up, servomechanism, analogue, transducer, null, damping, feedback, deadband; Construction operation and use of the following synchro system components: resolvers, differential, control and torque, E and I transformers, inductance transmitters, capacitance transmitters, synchronous transmitters; Servomechanism defects, reversal of synchro leads, hunting.			

MODULE 5. DIGITAL TECHNIQUES / ELECTRONIC INSTRUMENT SYSTEMS

		Level			
		A	B1.1 B 1.3	B1.2 B1.4	B2
5.1	**Electronic Instrument Systems** Typical systems arrangements and cockpit layout of electronic instrument systems.	**1**	**2**	**2**	**3**
5.2	**Numbering Systems** Numbering systems: binary, octal and hexadecimal; Demonstration of conversions between the decimal and binary, octal and hexadecimal systems and vice versa.	**-**	**1**	**-**	**2**
5.3	**Data Conversion** Analogue Data, Digital Data; Operation and application of analogue to digital, and digital to analogue converters, inputs and outputs, limitations of various types.	**-**	**1**	**-**	**2**
5.4	**Data Buses** Operation of data buses in aircraft systems, including knowledge of ARINC and other specifications. Aircraft Network / Ethernet	**-**	**2**	**-**	**2**
5.5	**Logic Circuits**				
	(a) Identification of common logic gate symbols, tables and equivalent circuits; Applications used for aircraft systems, schematic diagrams.	**-**	**2**	**-**	**2**
	(b) Interpretation of logic diagrams.	**-**	**-**	**-**	**2**
5.6	**Basic Computer Structure**				
	(a) Computer terminology (including bit, byte, software, hardware, CPU, IC, and various memory devices such as RAM, ROM, PROM); Computer technology (as applied in aircraft systems).	**1**	**2**	**-**	**-**
	(b) Computer related terminology; Operation, layout and interface of the major components in a micro computer including their associated bus systems; Information contained in single and multiaddress instruction words; Memory associated terms; Operation of typical memory devices; Operation, advantages and disadvantages of the various data storage systems.	**-**	**-**	**-**	**2**

MODULE 5. DIGITAL TECHNIQUES / ELECTRONIC INSTRUMENT SYSTEMS (Continued)

		Level			
		A	B1.1 B 1.3	B1.2 B1.4	B2
5.7	**Microprocessors** Functions performed and overall operation of a microprocessor; Basic operation of each of the following microprocessor elements: control and processing unit, clock, register, arithmetic logic unit.	-	-	-	2
5.8	**Integrated Circuits** Operation and use of encoders and decoders; Function of encoder types; Uses of medium, large and very large scale integration.	-	-	-	2
5.9	**Multiplexing** Operation, application and identification in logic diagrams of multiplexers and demultiplexers.	-	-	-	2
5.10	**Fibre Optics** Advantages and disadvantages of fibre optic data transmission over electrical wire propagation; Fibre optic data bus; Fibre optic related terms; Terminations; Couplers, control terminals, remote terminals; Application of fibre optics in aircraft systems.	-	1	1	2
5.11	**Electronic Displays** Principles of operation of common types of displays used in modern aircraft, including Cathode Ray Tubes, Light Emitting Diodes and Liquid Crystal Display.	-	2	1	2
5.12	**Electrostatic Sensitive Devices** Special handling of components sensitive to electrostatic discharges; Awareness of risks and possible damage, component and personnel anti-static protection devices.	1	2	2	2
5.13	**Software Management Control** Awareness of restrictions, airworthiness requirements and possible catastrophic effects of unapproved changes to software programmes.	-	2	1	2
5.14	**Electromagnetic Environment** Influence of the following phenomena on maintenance practices for electronic system: EMC – Electromagnetic Compatibility EMI – Electromagnetic Interference HIRF – High Intensity Radiated Field Lightning / lightning protection	-	2	2	2

MODULE 5. DIGITAL TECHNIQUES / ELECTRONIC INSTRUMENT SYSTEMS (Continued)

		Level			
		A	B1.1 B 1.3	B1.2 B1.4	B2
5.15	**Typical Electronic / Digital Aircraft Systems**	**-**	**2**	**2**	**2**
	General arrangement of typical electronic/digital aircraft systems and associated BITE				
	(Built In Test Equipment) testing such as:				
	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				
	Note: Different manufacturers may use different terminology for similar systems.				

MODULE 6. MATERIALS AND HARDWARE

		Level		
		A	B1	B2
6.1	**Aircraft Materials – Ferrous**			
	(a)	**1**	**2**	**1**
	Characteristics, properties and identification of common alloy steels used in aircraft; Heat treatment and application of alloys steels.			
	(b)	**-**	**1**	**1**
	Testing of ferrous materials for hardness, tensile strength, fatigue strength and impact resistance.			
6.2	**Aircraft Materials – Non-Ferrous**			
	(a)	**1**	**2**	**1**
	Characteristics, properties and identification of common non-ferrous materials used in aircraft; Heat treatment and application of non-ferrous materials;			
	(b)	**-**	**1**	**1**
	Testing of non-ferrous material for hardness, tensile strength, fatigue strength and impact resistance.			
6.3	**Aircraft Materials – Composite and Non-Metallic**			
6.3.1	***Composite and non-metallic other than wood and fabric***			
	(a)	**1**	**2**	**2**
	Characteristics, properties and identification of common composite and non-metallic materials, other than wood, used in aircraft; Sealant and bonding agents.			
	(b)	**1**	**2**	**-**
	The detection of defects/deterioration in composite and non-metallic material; Repair of composite and non-metallic material.			
6.3.2	***Wooden structures***	**-**	**-**	**-**
	Reserved			
6.3.3	***Fabric covering***	**-**	**-**	**-**
	Reserved			
6.4	**Corrosion**			
	(a)	**1**	**1**	**1**
	Chemical fundamentals; Formation by, galvanic action process, microbiological, stress.			
	(b)	**2**	**3**	**2**
	Types of corrosion and their identification; Causes of corrosion; Material types, susceptibility to corrosion.			

MODULE 6. MATERIALS AND HARDWARE (Continued)

		Level		
		A	B1	B2
6.5	**Fasteners**			
6.5.1	***Screw Threads***	**2**	**2**	**2**
	Screw nomenclature; Thread forms, dimensions and tolerances for standard threads used in aircraft; Measuring screw threads.			
6.5.2	***Bolts, studs and screws***	**2**	**2**	**2**
	Bolt types: specification, identification and marking of aircraft bolts, international standards; Nuts: self locking, anchor, standard types; Machine screws: aircraft specifications; Studs: types and uses, insertion and removal; Self tapping screws, dowels.			
6.5.3	***Locking Devices***	**2**	**2**	**2**
	Tab and spring washers, locking plates, split pins, pal-nuts, wire locking, quick release fasteners, keys, circlips, cotter pins.			
6.5.4	***Aircraft Rivets***	**1**	**2**	**1**
	Types of solid and blind rivets: specifications and identification, heat treatment.			
6.6	**Pipes and Unions**			
	(a)	**2**	**2**	**2**
	Identification of, and types of rigid and flexible pipes and their connectors used in aircraft.			
	(b)	**2**	**2**	**1**
	Standard unions for aircraft hydraulic, fuel, oil, pneumatic and air system pipes.			
6.7	**Springs**	**-**	**2**	**1**
	Types of springs, materials, characteristics and applications.			
6.8	**Bearings**	**1**	**2**	**2**
	Purpose of bearings, loads, material, construction; Types of bearings and their application.			
6.9	**Transmissions**	**1**	**2**	**2**
	Gear types and their application; Gear ratios, reduction and multiplication gear systems, driven and driving gears, idler gears, mesh patterns; Belts and pulleys, chains and sprockets.			

MODULE 6. MATERIALS AND HARDWARE (Continued)

		Level		
		A	B1	B2
6.10	**Control Cables** Types of cables; End fittings, turnbuckles and compensation devices; Pulleys and cable system components; Bowden cables; Aircraft flexible control systems.	**1**	**2**	**1**
6.11	**Electrical Cables and Connectors** Cable types, construction and characteristics; High tension and co-axial cables; Crimping; Connector types, pins, plugs, sockets, insulators, current and voltage rating, coupling, identification codes.	**1**	**2**	**2**

MODULE 7. MAINTENANCE PRACTICES

		Level		
		A	B1	B2
7.1	**Safety Precautions – Aircraft and Workshop** Aspects of safe working practices including precautions to take when working with electricity, gases especially oxygen, oils and chemicals. Also, instruction in the remedial action to be taken in the event of a fire or another accident with one or more of these hazards including knowledge on the extinguishing agents.	**3**	**3**	**3**
7.2	**Workshop Practices** Care of tools, control of tools, use of workshop materials; Dimensions, allowances and tolerances, standards of workmanship; Calibration of tools and equipment, calibration standards.	**3**	**3**	**3**
7.3	**Tools** Common hand tool types; Common power tool types; Operation and use of precision measuring tools; Lubrication equipment and methods; Operation, function and use of electrical general test equipment.	**3**	**3**	**3**
7.4	**Avionic General Test Equipment** Operation, function and use of avionic general test equipment.	**-**	**2**	**3**
7.5	**Engineering Drawings, Diagrams and Standards** Drawing types and diagrams, their symbols, dimensions, tolerances and projections; Identifying title block information; Microfilm, microfiche and computerised presentations; Specification 100 of the Air Transport Association (ATA) of America; Aeronautical and other applicable standards including ISO, AN, MS, NAS and MIL; Wiring diagrams and schematic diagrams.	**1**	**2**	**2**
7.6	**Fits and Clearances** Drill sizes for bolt holes, classes of fits; Common system of fits and clearances; Schedule of fits and clearances for aircraft and engines; Limits for bow, twist and wear; Standard methods for checking shafts, bearings and other parts.	**1**	**2**	**1**

MODULE 7. MAINTENANCE PRACTICES (Continued)

		Level		
		A	B1	B2
7.7	**Electrical Wiring Interconnection System (EWIS)** Continuity, insulation and bonding techniques and testing; Use of crimp tools: hand and hydraulic operated; Testing of crimp joints; Connector pin removal and insertion; Co-axial cables: testing and installation precautions; Identification of wire types, their inspection criteria and damage tolerance. Wiring protection techniques : Cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding. EWIS installations, inspection, repair, maintenance and cleanliness standards.	**1**	**3**	**3**
7.8	**Riveting** Riveted joints, rivet spacing and pitch; Tools used for riveting and dimpling; Inspection of riveted joints.	**1**	**2**	**-**
7.9	**Pipes and Hoses** Bending and belling/flaring aircraft pipes; Inspection and testing of aircraft pipes and hoses; Installation and clamping of pipes.	**1**	**2**	**-**
7.10	**Springs** Inspection and testing of springs.	**1**	**2**	**-**
7.11	**Bearings** Testing, cleaning and inspection of bearings; Lubrication requirements of bearings; Defects in bearings and their causes.	**1**	**2**	**-**
7.12	**Transmissions** Inspection of gears, backlash; Inspection of belts and pulleys, chains and sprockets; Inspection of screw jacks, lever devices, push-pull rod systems.	**1**	**2**	**-**
7.13	**Control Cables** Swaging of end fittings; Inspection and testing of control cables; Bowden cables; aircraft flexible control systems.	**1**	**2**	**-**

MODULE 7. MAINTENANCE PRACTICES (Continued)

		Level		
		A	B1	B2
7.14	**Material Handling**			
7.14.1	***Sheet Metal Work***	**-**	**2**	**-**
	Marking out and calculation of bend allowance;			
	Sheet metal working, including bending and forming;			
	Inspection of sheet metal work.			
7.14.2	***Composite and non-metallic***	**-**	**2**	**-**
	Bonding practices;			
	Environmental conditions;			
	Inspection methods.			
7.15	**Welding, Brazing, Soldering and Bonding**			
	(a)	**-**	**2**	**2**
	Soldering methods; inspection of soldered joints.			
7.15	**(b)**	**-**	**2**	**-**
	Welding and brazing methods;			
	Inspection of welded and brazed joints;			
	Bonding methods and inspection of bonded joints.			
7.16	**Aircraft Weight and Balance**			
	(a)	**-**	**2**	**2**
	Centre of Gravity / Balance limits calculation: use of relevant documents.			
	(b)	**-**	**2**	**-**
	Preparation of aircraft for weighing;			
	Aircraft weighing.			
7.17	**Aircraft Handling and Storage**	**2**	**2**	**2**
	Aircraft towing and associated safety precautions;			
	Aircraft jacking, chocking, securing and associated safety precautions;			
	Aircraft storage methods;			
	Refuelling / defuelling procedures;			
	De-icing/anti-icing procedures;			
	Electrical, hydraulic and pneumatic ground supplies;			
	Effects of environmental conditions on aircraft handling and operation.			

MODULE 7. MAINTENANCE PRACTICES (Continued)

		Level		
		A	B1	B2
7.18	**Disassembly, Inspection, Repair and Assembly Techniques**			
	(a) Types of defects and visual inspection techniques; Corrosion removal, assessment and reprotection.	**2**	**3**	**3**
	(b) General repair methods, Structural Repair Manual; Ageing, fatigue and corrosion control programmes.	**-**	**2**	**-**
	(c) Non-destructive inspection techniques including, penetrant, radiographic, eddy current, ultrasonic and boroscope methods.	**-**	**2**	**1**
	(d) Disassembly and re-assembly techniques.	**2**	**2**	**2**
	(e) Troubleshooting techniques.	**-**	**2**	**2**
7.19	**Abnormal Events**			
	(a) Inspections following lightning strikes and HIRF penetration.	**2**	**2**	**2**
	(b) Inspections following abnormal events such as heavy landings and flight through turbulence.	**2**	**2**	**-**
7.20	**Maintenance Procedures** Maintenance planning; Modification procedures; Stores procedures; Certification/release procedures; Interface with aircraft operation; Maintenance Inspection/Quality Control/Quality Assurance; Additional maintenance procedures; Control of life limited components.	**1**	**2**	**2**
7.14	**Material Handling**			
7.14.1	***Sheet Metal Work*** Marking out and calculation of bend allowance; Sheet metal working, including bending and forming; Inspection of sheet metal work.	**-**	**2**	**-**

MODULE 8. BASIC AERODYNAMICS

		Level		
		A	B1	B2
8.1	**Physics of the Atmosphere**	**1**	**2**	**2**
	International Standard Atmosphere (ISA), application to aerodynamics.			
8.2	**Aerodynamics**	**1**	**2**	**2**
	Airflow around a body;			
	Boundary layer, laminar and turbulent flow, free stream flow, relative airflow, upwash and downwash, vortices, stagnation;			
	The terms: camber, chord, mean aerodynamic chord, profile (parasite) drag, induced drag, centre of pressure, angle of attack, wash in and wash out, fineness ratio, wing shape and aspect ratio;			
	Thrust, Weight, Aerodynamic Resultant;			
	Generation of Lift and Drag: Angle of Attack, Lift coefficient, Drag coefficient, polar curve, stall;			
	Aerofoil contamination including ice, snow, frost.			
8.3	**Theory of Flight**	**1**	**2**	**2**
	Relationship between lift, weight, thrust and drag;			
	Glide ratio;			
	Steady state flights, performance;			
	Theory of the turn;			
	Influence of load factor: stall, flight envelope and structural limitations;			
	Lift augmentation.			
8.4	**Flight Stability and Dynamics**	**1**	**2**	**2**
	Longitudinal, lateral and directional stability (active and passive).			

MODULE 9. HUMAN FACTORS

		Level		
		A	B1	B2
9.1	**General**	**2**	**2**	**2**
	The need to take human factors into account;			
	Incidents attributable to human factors / human error;			
	'Murphy's' law.			
9.2	**Human Performance and Limitations**	**2**	**2**	**2**
	Vision;			
	Hearing;			
	Information processing;			
	Attention and perception;			
	Memory;			
	Claustrophobia and physical access.			
9.3	**Social Psychology**	**1**	**1**	**1**
	Responsibility: individual and group;			
	Motivation and de-motivation;			
	Peer pressure;			
	'Culture' issues;			
	Team working;			
	Management, supervision and leadership.			
9.4	**Factors Affecting Performance**	**2**	**2**	**2**
	Fitness / health;			
	Stress: domestic and work related;			
	Time pressure and deadlines;			
	Workload: overload and underload;			
	Sleep and fatigue, shiftwork;			
	Alcohol, medication, drug abuse.			
9.5	**Physical Environment**	**1**	**1**	**1**
	Noise and fumes;			
	Illumination;			
	Climate and temperature;			
	Motion and vibration;			
	Working environment.			
9.6	**Tasks**	**1**	**1**	**1**
	Physical work;			
	Repetitive tasks;			
	Visual inspection;			
	Complex systems.			

MODULE 9. HUMAN FACTORS (Continued)

		Level		
		A	B1	B2
9.7	**Communication** Within and between teams; Work logging and recording; Keeping up to date, currency; Dissemination of information.	**2**	**2**	**2**
9.8	**Human Error** Error models and theories; Types of error in maintenance tasks; Implications of errors (i.e accidents); Avoiding and managing errors.	**2**	**2**	**2**
9.9	**Hazards in the Workplace** Recognising and avoiding hazards; Dealing with emergencies.	**2**	**2**	**2**

MODULE 10. AVIATION LEGISLATION

		Level		
		A	B1	B2
10.1	**Regulatory Framework**	**1**	**1**	**1**
	Role of International Civil Aviation Organisation			
	Role and responsibilities contracting states			
	Air Navigation Order			
	Singapore Airworthiness Requirements			
	Air Operator Certificate Requirements			
	Airworthiness Notices			
	Advisory Circulars			
	Notices of Amendment and Information Circulars			
10.2	**SAR-21 Certification of Products and Design and Production Organisations**	**1**	**1**	**1**
	Familiarisation and understanding of SAR-21			
10.3	**SAR-39 Airworthiness Directive**	**1**	**1**	**1**
	Familiarisation and understanding of SAR-39			
10.4	**SAR-66 Certifying Staff – Maintenance**			
	Detailed understanding of SAR-66	**2**	**2**	**2**
10.5	**SAR-145 Approved Maintenance Organisation**			
	Detailed understanding of SAR-145	**2**	**2**	**2**
10.6	**SAR-147 Approval of Maintenance Training Organisation**			
	Familiarisation and understanding of SAR-147	**1**	**1**	**1**
10.7	**Air Operator Certificate Requirements**			
	(a) General understanding of the AOCR	**1**	**1**	**1**
	(b) Aircraft Maintenance	**2**	**2**	**2**
	Maintenance Responsibility			
	Maintenance Management			
	Aircraft Maintenance Programme (including CMR)			
	Aircraft Technical Log			
	Maintenance Records and Log Books			
	Accident / Occurrence Reporting			

MODULE 10. AVIATION LEGISLATION (Continued)

		Level		
		A	**B1**	**B2**
10.8	**Others** Airworthiness Notices Airworthiness Circulars Minimum Equipment List / Master Minimum Equipment List Dispatch Deviation List Airworthiness Notices Services Bulletins / Manufacturer Service Information Modifications and Repairs Continuing Airworthiness Test Flights ETOPS – Maintenance and dispatch requirements Any new aircraft maintenance related requirements published by CAAS	**2**	**2**	**2**

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS

		Level		
		A1	B1.1	B2
11.1	**Theory of Flight**			
11.1.1	***Aeroplane Aerodynamics and Flight Controls***	**1**	**2**	**-**
	Operation and effect of: – roll control: ailerons and spoilers; – pitch control: elevators, stabilators, variable incidence stabilisers and canards; – yaw control, rudder limiters; Control using elevons, ruddervators; High lift devices, slots, slats, flaps, flaperons; Drag inducing devices, spoilers, lift dumpers, speed brakes; Effects of wing fences, saw tooth leading edges; Boundary layer control using, vortex generators, stall wedges or leading edge devices; Operation and effect of trim tabs, balance and antibalance (leading) tabs, servo tabs, spring tabs, mass balance, control surface bias, aerodynamic balance panels;			
11.1.2	***High Speed Flight***	**1**	**2**	**-**
	Speed of sound, subsonic flight, transonic flight, supersonic flight, Mach number, critical Mach number, compressibility buffet, shock wave, aerodynamic heating, area rule; Factors affecting airflow in engine intakes of high speed aircraft; Effects of sweepback on critical Mach number.			
11.2	**Airframe Structures – General Concepts**			
	(a)	**2**	**2**	**-**
	Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary; Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions; Lightning strike protection provision; Aircraft bonding.			
	(b)	**1**	**2**	**-**
	Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning, anti-corrosive protection, wing, empennage and engine attachments; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; Surface cleaning; Airframe symmetry: methods of alignment and symmetry checks.			

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A1	B1.1	B2
11.3	**Airframe Structures – Aeroplanes**			
11.3.1	***Fuselage (ATA 52 / 53 / 56)***	**1**	**2**	**-**
	Construction and pressurisation sealing; Wing, stabiliser, pylon and undercarriage attachments; Seat installation and cargo loading system; Doors and emergency exits: construction, mechanisms, operation and safety devices; Windows and windscreen construction and mechanisms.			
11.3.2	***Wings (ATA 57)***	**1**	**2**	**-**
	Construction; Fuel storage; Landing gear, pylon, control surface and high lift/drag attachments.			
11.3.3	***Stabilisers (ATA 55)***	**1**	**2**	**-**
	Construction; Control surface attachment.			
11.3.4	***Flight Control Surfaces (ATA 55 / 57)***	**1**	**2**	**-**
	Construction and attachment; Balancing – mass and aerodynamic.			
11.3.5	***Nacelles / Pylons (ATA 54)***	**1**	**2**	**-**
	Construction; Firewalls; Engine mounts.			
11.4	**Air Conditioning and Cabin Pressurisation (ATA 21)**			
11.4.1	***Air Supply***	**1**	**2**	**-**
	Sources of air supply including engine bleed, APU and ground cart.			
11.4.2	***Air Conditioning***	**1**	**3**	**-**
	Air conditioning systems; Air cycle and vapour cycle machines; Distribution systems; Flow, temperature and humidity control system.			
11.4.3	***Pressurisation***	**1**	**3**	**-**
	Pressurisation systems; Control and indication including control and safety valves; Cabin pressure controllers.			
11.4.4	***Safety and Warning Devices***	**1**	**3**	**-**
	Protection and warning devices.			

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A1	B1.1	B2
11.5	**Instrument / Avionic Systems**			
11.5.1	***Instrument Systems (ATA 31)***	**1**	**2**	**-**
	Pitot static: altimeter, air speed indicator, vertical speed indicator;			
	Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn co-ordinator;			
	Compasses: direct reading, remote reading;			
	Angle of attack indication, stall warning systems;			
	Glass cockpit;			
	Other aircraft system indication.			
11.5.2	***Avionic Systems***	**1**	**1**	**-**
	Fundamentals of system lay-outs and operation of:			
	– Auto Flight (ATA 22);			
	– Communications (ATA 23);			
	– Navigation Systems (ATA 34).			
11.6	**Electrical Power (ATA 24)**	**1**	**3**	**-**
	Batteries Installation and Operation;			
	DC power generation;			
	AC power generation;			
	Emergency power generation;			
	Voltage regulation;			
	Power distribution;			
	Inverters, transformers, rectifiers;			
	Circuit protection;			
	External/Ground power.			
11.7	**Equipment and Furnishings (ATA 25)**			
	(a)	**2**	**2**	**-**
	Emergency equipment requirements;			
	Seats, harnesses and belts.			
	(b)	**1**	**1**	**-**
	Cabin lay-out;			
	Equipment lay-out;			
	Cabin Furnishing Installation;			
	Cabin entertainment equipment;			
	Galley installation;			
	Cargo handling and retention equipment;			
	Airstairs.			

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A1	**B1.1**	**B2**
11.8	**Fire Protection (ATA 26)**			
	(a)	**1**	**3**	**-**
	Fire and smoke detection and warning systems; Fire extinguishing systems; System tests.			
11.8	**(b)**	**1**	**1**	**-**
	Portable fire extinguisher.			
11.9	**Flight Controls (ATA 27)**	**1**	**3**	**-**
	Primary controls: aileron, elevator, rudder, spoiler; Trim control; Active load control; High lift devices; Lift dump, speed brakes; System operation: manual, hydraulic, pneumatic, electrical, fly-by-wire; Artificial feel, Yaw damper, Mach trim, rudder limiter, gust lock systems; Balancing and rigging; Stall protection system.			
11.10	**Fuel Systems (ATA 28)**	**1**	**3**	**-**
	System lay-out; Fuel tanks; Supply systems; Dumping, venting and draining; Cross-feed and transfer; Indications and warnings; Refuelling and defuelling; Longitudinal balance fuel systems.			
11.11	**Hydraulic Power (ATA 29)**	**1**	**3**	**-**
	System lay-out; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical, pneumatic; Emergency pressure generation; Filters; Pressure Control; Power distribution; Indication and warning systems; Interface with other systems.			

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A1	B1.1	B2
11.12	**Ice and Rain Protection (ATA 30)** Ice formation, classification and detection; Anti-icing systems: electrical, hot air and chemical; De-icing systems: electrical, hot air, pneumatic and chemical; Rain repellant and removal; Probe and drain heating; Wiper systems.	**1**	**3**	**-**
11.13	**Landing Gear (ATA 32)** Construction, shock absorbing; Extension and retraction systems: normal and emergency; Indications and warning; Wheels, brakes, antiskid and autobraking; Tyres; Steering; Air-ground sensing.	**2**	**3**	**-**
11.14	**Lights (ATA 33)** External: navigation, anti-collision, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	**2**	**3**	**-**
11.15	**Oxygen (ATA 35)** System lay-out: cockpit, cabin; Sources, storage, charging and distribution; Supply regulation; Indications and warnings.	**1**	**3**	**-**
11.16	**Pneumatic/Vacuum (ATA 36)** System lay-out; Sources: engine / APU, compressors, reservoirs, ground supply; Pressure control; Distribution; Indications and warnings; Interfaces with other systems.	**1**	**3**	**-**
11.17	**Water/Waste (ATA 38)** Water system lay-out, supply, distribution, servicing and draining; Toilet system lay-out, flushing and servicing; Corrosion aspects.	**2**	**3**	**-**

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A1	B1.1	B2
11.18	**On Board Maintenance Systems (ATA 45)** Central maintenance computers; Data loading system; Electronic library system; Printing; Structure monitoring (damage tolerance monitoring).	**1**	**2**	**-**
11.19	**Integrated Modular Avionics (ATA 42)** Functions that may be typically integrated in the Integrated Modular Avionic (IMA) modules are, among others: Bleed Management, Air Pressure Control, Air Ventilation and Control, Avionics and Cockpit Ventilation Control, Temperature Control, Air Traffic Communication, Avionics Communication Router, Electrical Load Management, Circuit Breaker Monitoring, Electrical System BITE, Fuel Management, Braking Control, Steering Control, Landing Gear Extension and Retraction, Tyre Pressure Indication, Oleo Pressure Indication, and Brake Temperature Monitoring. Core System; Network Components.	**1**	**2**	**-**
11.20	**Cabin Systems (ATA 44)** The units and components which furnish a means of entertaining the passengers and providing communication within the aircraft (Cabin Intercommunication Data System) and between the aircraft cabin and ground stations (Cabin Network Service). These include voice, data, music and video transmissions. The Cabin Intercommunication Data System provides an interface between cockpit/cabin crew and cabin systems. These systems support data exchange of the different related LRUs and they are typically operated via Flight Attendant Panels. The Cabin Network Service typically consists on a server, typically interfacing with, among others, the following systems: (a) Data/Radio Communication; and (b) In-Flight Entertainment System. The Cabin Network Service may host functions such as: (a) Access to pre-departure/departure reports; (b) E-mail/intranet/internet access; and (c) Passenger database. Cabin Core System; In-flight Entertainment System; External Communication System; Cabin Mass Memory System; Cabin Monitoring System; Miscellaneous Cabin System.	**1**	**2**	**-**

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A1	B1.1	B2
11.21	**Information Systems (ATA 46)** The units and components which furnish a means of storing, updating and retrieving digital information traditionally provided on paper, microfilm or microfiche. Includes units that are dedicated to the information storage and retrieval function such as the electronic library mass storage and controller. Does not include units or components installed for other uses and shared with other systems, such as flight deck printer or general use display. Typical examples include Air Traffic and Information Management Systems and Network Server Systems; Aircraft General Information System; Flight Deck Information System; Maintenance Information System; Passenger Cabin Information System; Miscellaneous Information System.	**1**	**2**	**-**

MODULE 11B. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS

Note: The scope of this module should reflect the technology of aeroplanes pertinent to the A2 and B1.2 subcategory

		Level		
		A2	B1.2	B2
11.1	**Theory of Flight**			
11.1.1	***Aeroplane Aerodynamics and Flight Controls***	**1**	**2**	**-**
	Operation and effect of: – roll control: ailerons and spoilers; – pitch control: elevators, stabilators, variable incidence stabilisers and canards; – yaw control, rudder limiters; Control using elevons, ruddervators; High lift devices, slots, slats, flaps, flaperons; Drag inducing devices, spoilers, lift dumpers, speed brakes; Effects of wing fences, saw tooth leading edges; Boundary layer control using, vortex generators, stall wedges or leading edge devices; Operation and effect of trim tabs, balance and antibalance (leading) tabs, servo tabs, spring tabs, mass balance, control surface bias, aerodynamic balance panels;			
11.1.2	***High Speed Flight – N/A***	**-**	**-**	**-**
11.2	**Airframe Structures – General Concepts**			
	(a)	**2**	**2**	**-**
	Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary; Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions; Lightning strike protection provision; Aircraft bonding.			
	(b)	**1**	**2**	**-**
	Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning, anti-corrosive protection, wing, empennage and engine attachments; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; Surface cleaning; Airframe symmetry: methods of alignment and symmetry checks.			

MODULE 11B. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A2	B1.2	B2
11.3	**Airframe Structures – Aeroplanes**			
11.3.1	***Fuselage (ATA 52 / 53 / 56)***	**1**	**2**	**-**
	Construction and pressurisation sealing;			
	Wing, stabiliser, pylon and undercarriage attachments;			
	Seat installation;			
	Doors and emergency exits: construction, mechanisms, operation and safety devices;			
	Windows and windscreen construction and mechanisms.			
11.3.2	***Wings (ATA 57)***	**1**	**2**	**-**
	Construction;			
	Fuel storage;			
	Landing gear, pylon, control surface and high lift/drag attachments.			
11.3.3	**Stabilisers (ATA 55)**	**1**	**2**	**-**
	Construction;			
	Control surface attachment.			
11.3.4	***Flight Control Surfaces (ATA 55 / 57)***	**1**	**2**	**-**
	Construction and attachment;			
	Balancing – mass and aerodynamic.			
11.3.5	***Nacelles / Pylons (ATA 54)***	**1**	**2**	**-**
	Construction;			
	Firewalls;			
	Engine mounts.			
11.4	**Air Conditioning and Cabin Pressurisation (ATA 21)**	**1**	**3**	**-**
	Pressurisation and air conditioning systems;			
	Cabin pressure controllers, protection and warning devices;			
	Heating systems.			
11.5	**Instrument / Avionic Systems**			
11.5.1	***Instrument Systems (ATA 31)***	**1**	**2**	**-**
	Pitot static: altimeter, air speed indicator, vertical speed indicator;			
	Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn co-ordinator;			
	Compasses: direct reading, remote reading;			
	Angle of attack indication, stall warning systems;			
	Glass cockpit;			
	Other aircraft system indication.			
11.5.2	***Avionic Systems***	**1**	**1**	**-**
	Fundamentals of system lay-outs and operation of:			
	Auto Flight (ATA 22);			
	Communications (ATA 23);			
	Navigation Systems (ATA 34).			

MODULE 11B. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A2	B1.2	B2
11.6	**Electrical Power (ATA 24)**	**1**	**3**	**-**
	Batteries Installation and Operation;			
	DC power generation;			
	Voltage regulation;			
	Power distribution;			
	Circuit protection;			
	Inverters, transformers;			
11.7	**Equipment and Furnishings (ATA 25)**			
	(a)	**2**	**2**	**-**
	Emergency equipment requirements;			
	Seats, harnesses and belts.			
	(b)	**1**	**1**	**-**
	Cabin lay-out;			
	Equipment lay-out;			
	Cabin Furnishing Installation;			
	Cabin entertainment equipment;			
	Galley installation;			
	Cargo handling and retention equipment;			
	Airstairs.			
11.8	**Fire Protection (ATA 26)**			
	(a)	**1**	**3**	**-**
	Fire and smoke detection and warning systems;			
	Fire extinguishing systems;			
	System tests.			
	(b)	**1**	**3**	**-**
	Portable fire extinguisher			
11.9	**Flight Controls (ATA 27)**	**1**	**3**	**-**
	Primary controls: aileron, elevator, rudder;			
	Trim tabs;			
	High lift devices;			
	System operation: manual, Gust locks;			
	Balancing and rigging;			
	Stall warning system.			
11.10	**Fuel Systems (ATA 28)**	**1**	**3**	**-**
	System lay-out;			
	Fuel tanks;			
	Supply systems;			
	Cross-feed and transfer;			
	Indications and warnings;			
	Refuelling and defuelling.			

MODULE 11B. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A2	B1.2	B2
11.11	**Hydraulic Power (ATA 29)** System lay-out; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical; Filters; Pressure Control; Power distribution; Indication and warning systems.	**1**	**3**	**-**
11.12	**Ice and Rain Protection (ATA 30)** Ice formation, classification and detection; De-icing systems: electrical, hot air, pneumatic and chemical; Probe and drain heating; Wiper systems.	**1**	**3**	**-**
11.13	**Landing Gear (ATA 32)** Construction, shock absorbing; Extension and retraction systems: normal and emergency; Indications and warning; Wheels, brakes, antiskid and autobraking; Tyres; Steering; Air-ground sensing.	**2**	**3**	**-**
11.14	**Lights (ATA 33)** External: navigation, anti-collision, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	**2**	**3**	**-**
11.15	**Oxygen (ATA 35)** System lay-out: cockpit, cabin; Sources, storage, charging and distribution; Supply regulation; Indications and warnings.	**1**	**3**	**-**
11.16	**Pneumatic/Vacuum (ATA 36)** System lay-out; Sources: engine / APU, compressors, reservoirs, ground supply; Pressure control; Distribution; Indications and warnings; Interfaces with other systems.	**1**	**3**	**-**
11.17	**Water/Waste (ATA 38)** Water system lay-out, supply, distribution, servicing and draining; Toilet system lay-out, flushing and servicing; Corrosion aspects.	**2**	**3**	**-**

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS

		Level		
		A3 A4	B1.3 B1.4	B2
12.1	**Theory of Flight – Rotary Wing Aerodynamics** Terminology; Effects of gyroscopic precession; Torque reaction and directional control; Dissymmetry of lift, Blade tip stall; Translating tendency and its correction; Coriolis effect and compensation; Vortex ring state, power settling, overpitching; Auto-rotation; Ground effect.	**1**	**2**	**-**
12.2	**Flight Control Systems** Cyclic control; Collective control; Swashplate; Yaw control: Anti-Torque Control, Tail rotor, bleed air; Main Rotor Head: Design and Operation features; Blade Dampers: Function and construction; Rotor Blades: Main and tail rotor blade construction and attachment; Trim control, fixed and adjustable stabilisers; System operation: manual, hydraulic, electrical and fly-by-wire; Artificial feel; Balancing and Rigging.	**2**	**3**	**-**
12.3	**Blade Tracking and Vibration Analysis** Rotor alignment; Main and tail rotor tracking; Static and dynamic balancing; Vibration types, vibration reduction methods; Ground resonance.	**1**	**3**	**-**
12.4	**Transmissions** Gear boxes, main and tail rotors; Clutches, free wheel units and rotor brake; Tail rotor drive shafts, flexible coupling, bearing, vibration dampers and bearing hangers.	**1**	**3**	**-**
12.5	**Airframe Structures**			
	(a) Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary; Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions;Lightning strike protection provision.	**2**	**2**	**-**

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A3 A4	B1.3 B1.4	B2
12.5	**(b)** Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning and anti-corrosive protection; Pylon, stabiliser and undercarriage attachments; Seat installation; Doors: construction, mechanisms, operation and safety devices; Windows and windscreen construction; Fuel storage; Firewalls; Engine mounts; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; Surface cleaning; Airframe symmetry: methods of alignment and symmetry checks.	**1**	**2**	**-**
12.6	**Air Conditioning (ATA 21)**			
12.6.1	**Air supply** Sources of air supply including engine bleed and ground cart.	**1**	**2**	**-**
12.6.2	**Air Conditioning** Air conditioning systems; Distribution systems; Flow and temperature control systems; Protection and warning devices.	**1**	**3**	**-**
12.7	**Instruments/Avionic Systems**			
12.7.1	**Instrument Systems (ATA 31)** Pitot static: altimeter, air speed indicator, vertical speed indicator; Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn co-ordinator; Compasses: direct reading, remote reading; Vibration indicating systems – HUMS; Glass cockpit; Other aircraft system indication.	**1**	**2**	**-**

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A3 A4	B1.3 B1.4	B2
12.7.2	**Avionic Systems** Fundamentals of system layouts and operation of; Auto Flight (ATA 22); Communications (ATA 23); Navigation Systems (ATA 34).	**1**	**1**	**-**
12.8	**Electrical Power (ATA 24)** Batteries Installation and Operation; DC power generation, AC power generation; Emergency power generation; Voltage regulation, Circuit protection; Power distribution; Inverters, transformers, rectifiers; External/Ground power.	**1**	**3**	**-**
12.9	**Equipment and Furnishings (ATA 25)**			
	(a) Emergency equipment requirements; Seats, harnesses and belts; Lifting systems.	**2**	**2**	**-**
	(b) Emergency flotation systems; Cabin lay-out, cargo retention; Equipment lay-out; Cabin Furnishing Installation.	**1**	**1**	**-**
12.10	**Fire Protection (ATA 26)** Fire and smoke detection and warning systems; Fire extinguishing systems; System tests.	**1**	**3**	**-**
12.11	**Fuel Systems (ATA 28)** System lay-out; Fuel tanks; Supply systems; Dumping, venting and draining; Cross-feed and transfer; Indications and warnings; Refuelling and defuelling.	**1**	**3**	**-**

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A3 A4	B1.3 B1.4	B2
12.12	**Hydraulic Power (ATA 29)** System lay-out; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical, pneumatic; Emergency pressure generation; Filters; Pressure Control; Power distribution; Indication and warning systems; Interface with other systems.	**1**	**3**	**-**
12.13	**Ice and Rain Protection (ATA 30)** Ice formation, classification and detection; Anti-icing and De-icing systems: electrical, hot air and chemical; Rain repellant and removal; Probe and drain heating; Wiper system.	**1**	**3**	**-**
12.14	**Landing Gear (ATA 32)** Construction, shock absorbing; Extension and retraction systems: normal and emergency; Indications and warning; Wheels, tyres, brakes; Steering; Air-ground sensing; Skids, floats.	**2**	**3**	**-**
12.15	**Lights (ATA 33)** External: navigation, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	**2**	**3**	**-**
12.16	**Pneumatic/Vacuum (ATA 36)** System lay-out; Sources: engine, compressors, reservoirs, ground supply; Pressure control; Distribution; Indications and warnings; Interfaces with other systems.	**1**	**3**	**-**

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A3 A4	B1.3 B1.4	B2
12.17	**Integrated Modular Avionics (ATA 42)** Functions that may be typically integrated in the Integrated Modular Avionic (IMA) modules are, among others: Bleed Management, Air Pressure Control, Air Ventilation and Control, Avionics and Cockpit Ventilation Control, Temperature Control, Air Traffic Communication Avionics Communication Router, Electrical Load Management, Circuit Breaker Monitoring, Electrical System BITE, Fuel Management, Braking Control, Steering Control, Landing Gear Extension and Retraction, Tyre Pressure Indication, Oleo Pressure Indication and Brake Temperature Monitoring. Core System; Network Components.	**1**	**2**	**-**
12.18	**On Board Maintenance Systems (ATA 45)** Central maintenance computers; Data loading system; Electronic library system; Printing; Structure monitoring (damage tolerance monitoring)	**1**	**2**	**-**
12.19	**Information Systems (ATA 46)** The units and components which furnish a means of storing, updating and retrieving digital information traditionally provided on paper, microfilm or microfiche. Includes units that are dedicated to the information storage and retrieval function such as the electronic library mass storage and controller. Does not include units or components installed for other uses and shared with other systems, such as flight deck printer or general use display. Typical examples include Air Traffic and Information Management Systems and Network Server Systems. Aircraft General Information System; Flight Deck Information System; Maintenance Information System; Passenger Cabin Information System; Miscellaneous Information System.	**1**	**2**	**-**

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS

		Level		
		A	B1	B2
13.1	**Theory of Flight**			
	(a) Aeroplane Aerodynamics and Flight Controls Operation and effect of: – roll control: ailerons and spoilers; – pitch control: elevators, stabilators, variable incidence stabilisers and canards; – yaw control, rudder limiters; Control using elevons, ruddervators; High lift devices: slots, slats, flaps; Drag inducing devices: spoilers, lift dumpers, speed brakes; Operation and effect of trim tabs, servo tabs, control surface bias.	-	-	1
	(b) High Speed Flight Speed of sound, subsonic flight, transonic flight, supersonic flight; Mach number, critical Mach number.	-	-	1
	(c) Rotary Wing Aerodynamics Terminology; Operation and effect of cyclic, collective and anti-torque controls.	-	-	1
13.2	**Structures – General Concepts**			
	(a) Fundamentals of structural systems.	-	-	1
	(b) Zonal and station identification systems; Electrical bonding; Lightning strike protection provision.	-	-	2
13.3	**Autoflight (ATA 22)** Fundamentals of automatic flight control including working principles and current terminology; Command signal processing; Modes of operation: roll, pitch and yaw channels; Yaw dampers; Stability Augmentation System in helicopters; Automatic trim control; Autopilot navigation aids interface; Autothrottle systems; Automatic Landing Systems: principles and categories, modes of operation, approach, glideslope, land, go-around, system monitors and failure conditions.	-	-	3

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A	B1	B2
13.4	**Communication/Navigation (ATA 23/34)** Fundamentals of radio wave propagation, antennas, transmission lines, communication, receiver and transmitter; Working principles of following systems: – Very High Frequency (VHF) communication; – High Frequency (HF) communication; – Audio; – Emergency Locator Transmitters; – Cockpit Voice Recorder; – Very High Frequency omnidirectional range (VOR); – Automatic Direction Finding (ADF); – Instrument Landing System (ILS); – Microwave Landing System (MLS); – Flight Director systems; – Distance Measuring Equipment (DME); – Very Low Frequency and hyperbolic navigation (VLF/Omega); – Doppler navigation; – Area navigation, RNAV systems; – Flight Management Systems; – Global Positioning System (GPS), Global Navigation Satellite Systems (GNSS); – Inertial Navigation System; – Air Traffic Control transponder, secondary surveillance radar; – Traffic Alert and Collision Avoidance System (TCAS); – Weather avoidance radar; – Radio altimeter; – ARINC communication and reporting.	-	-	3
13.5	**Electrical Power (ATA 24)** Batteries Installation and Operation; DC power generation; AC power generation; Emergency power generation; Voltage regulation; Power distribution; Inverters, transformers, rectifiers; Circuit protection; External/Ground power.	-	-	3
13.6	**Equipment and Furnishing (ATA 25)** Electronic emergency equipment requirements; Cabin entertainment equipment.	-	-	3

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A	B1	B2
13.7	**Flight Controls (ATA 27)**			
	(a)	-	-	**2**
	Primary controls: aileron, elevator, rudder, spoiler; Trim control; Active load control; High lift devices; Lift dump, speed brakes; System operation: manual, hydraulic, pneumatic; Artificial feel, Yaw damper, Mach trim, rudder limiter, gust locks; Stall protection systems.			
	(b)	-	-	**3**
	System operation: electrical, fly by wire.			
13.8	**Instrument Systems (ATA 31)**	-	-	**3**
	Classification; Atmosphere; Terminology; Pressure measuring devices and systems; Pitot static systems; Altimeters; Vertical speed indicators; Airspeed indicators; Machmeters; Altitude reporting/alerting systems; Air data computers; Instrument pneumatic systems; Direct reading pressure and temperature gauges; Temperature indicating systems; Fuel quantity indicating systems; Gyroscopic principles; Artificial horizons; Slip indicators; Directional gyros; Ground Proximity Warning Systems; Compass systems; Flight Data Recording systems; Electronic Flight Instrument Systems; Instrument warning systems including master warning systems and centralised warning panels; Stall warning systems and angle of attack indicating systems; Vibration measurement and indication; Glass cockpit.			

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A	B1	B2
13.9	**Lights (ATA 33)** External: navigation, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	-	-	**3**
13.10	**On board Maintenance Systems (ATA 45)** Central maintenance computers; Data loading system; Electronic library system; Printing; Structure monitoring (damage tolerance monitoring).	-	-	**3**
13.11	**Air Conditioning and Cabin Pressurisation (ATA 21)**			
13.11.1	**Air supply** Sources of air supply including engine bleed, APU and ground cart;	-	-	**2**
13.11.2	**Air Conditioning**			
	Air conditioning systems;	-	-	**2**
	Air cycle and vapour cycle machines;	-	-	**3**
	Distribution systems;	-	-	**1**
	Flow, temperature and humidity control system;	-	-	**3**
13.11.3	**Pressurisation** Pressurisation systems; Control and indication including control and safety valves; Cabin pressure controllers;	-	-	**3**
13.11.4	**Safety and warning devices** Protection and warning devices.	-	-	**3**
13.12	**Fire Protection (ATA 26)**			
	(a) Fire and smoke detection and warning systems; Fire extinguishing systems; System tests.	-	-	**3**
	(b) Portable fire extinguisher	-	-	**1**

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A	B1	B2
13.13	**Fuel Systems (ATA 28)**			
	System lay-out;	-	-	1
	Fuel tanks;	-	-	1
	Supply systems;	-	-	1
	Dumping, venting and draining;	-	-	1
	Cross-feed and transfer;	-	-	2
	Indications and warnings;	-	-	3
	Refuelling and defuelling;	-	-	2
	Longitudinal balance fuel systems.	-	-	3
13.14	**Hydraulic Power (ATA 29)**			
	System lay-out;	-	-	1
	Hydraulic fluids;	-	-	1
	Hydraulic reservoirs and accumulators;	-	-	1
	Pressure generation: electrical, mechanical, pneumatic;	-	-	3
	Emergency pressure generation;	-	-	3
	Filters;	-	-	1
	Pressure control;	-	-	3
	Power distribution;	-	-	1
	Indication and warning systems;	-	-	3
	Interface with other systems.	-	-	3
13.15	**Ice and Rain Protection (ATA 30)**			
	Ice formation, classification and detection;	-	-	2
	Anti-icing systems: electrical, hot air and chemical;	-	-	2
	De-icing systems: electrical, hot air, pneumatic, chemical;	-	-	3
	Rain repellent;	-	-	1
	Probe and drain heating;	-	-	3
	Wiper Systems.	-	-	1
13.16	**Landing Gear (ATA 32)**			
	Construction, shock absorbing;	-	-	1
	Extension and retraction systems: normal and emergency;	-	-	3
	Indications and warnings;	-	-	3
	Wheels, brakes, antiskid and autobraking;	-	-	3
	Tyres;	-	-	1
	Steering;	-	-	3
	Air-ground sensing.	-	-	3
13.17	**Oxygen (ATA 35)**			
	System lay-out: cockpit, cabin;	-	-	3
	Sources, storage, charging and distribution;	-	-	3
	Supply regulation;	-	-	3
	Indications and warnings.	-	-	3

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A	B1	B2
13.18	**Pneumatic/Vacuum (ATA 36)**			
	System lay-out;	-	-	2
	Sources: engine/APU, compressors, reservoirs, ground supply;	-	-	2
	Pressure control;	-	-	3
	Distribution;	-	-	1
	Indications and warnings;	-	-	3
	Interfaces with other systems.	-	-	3
13.19	**Water/Waste (ATA 38)**	-	-	2
	Water system lay-out, supply, distribution, servicing and draining;			
	Toilet system lay-out, flushing and servicing.			
13.20	**Integrated Modular Avionics (ATA42)**	-	-	3
	Functions that may be typically integrated in the Integrated Modular Avionic (IMA) modules are, among others:			
	Bleed Management, Air Pressure Control, Air Ventilation and Control,			
	Avionics and Cockpit Ventilation Control, Temperature Control,			
	Air Traffic Communication, Avionics Communication Router,			
	Electrical Load Management, Circuit Breaker Monitoring, Electrical System BITE, Fuel Management, Braking Control, Steering Control,			
	Landing Gear Extension and Retraction, Tyre Pressure Indication,			
	Oleo Pressure Indication and Brake Temperature Monitoring.			
	Core System;			
	Network Components.			

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS (Continued)

		Level		
		A	B1	B2
13.21	**Cabin Systems (ATA44)** The units and components which furnish a means of entertaining the passengers and providing communication within the aircraft (Cabin Intercommunication Data System) and between the aircraft cabin and ground stations (Cabin Network Service). Includes voice, data, music and video transmissions. The Cabin Intercommunication Data System provides an interface between cockpit/cabin crew and cabin systems. These systems support data exchange of the different related LRU's and they are typically operated via Flight Attendant Panels. The Cabin Network Service typically consists on a server, typically interfacing with, among others, the following systems: (a) Data/Radio Communication; and (b) In-Flight Entertainment System. The Cabin Network Service may host functions such as: (a) Access to pre-departure/departure reports; (b) E-mail/intranet/internet access; and (c) Passenger database. Cabin Core System; In-flight Entertainment System; External Communication System; Cabin Mass Memory System; Cabin Monitoring System; Miscellaneous Cabin System.	-	-	3
13.22	**Information Systems (ATA46)** The units and components which furnish a means of storing, updating and retrieving digital information traditionally provided on paper, microfilm or microfiche. Includes units that are dedicated to the information storage and retrieval function such as the electronic library mass storage and controller. Does not include units or components installed for other uses and shared with other systems, such as flight deck printer or general use display. Typical examples include: Air Traffic and Information Management Systems and Network Server Systems; Aircraft General Information System; Flight Deck Information System; Maintenance Information System; Passenger Cabin Information System; Miscellaneous Information System.	-	-	3

MODULE 14. PROPULSION

		Level		
		A	B1	B2
14.1	**Turbine Engines**			
	(a)	-	-	**1**
	Constructional arrangement and operation of turbojet, turbofan, turboshaft and turbopropeller engines.			
	(b)	-	-	**2**
	Electronic Engine control and fuel metering systems (FADEC).			
14.2	**Engine Indicating Systems**	-	-	**2**
	Exhaust gas temperature/Interstage turbine temperature systems; Engine speed; Engine Thrust Indication: Engine Pressure Ratio, engine turbine discharge pressure or jet pipe pressure systems; Oil pressure and temperature; Fuel pressure, temperature and flow; Manifold pressure; Engine torque; Propeller speed.			
14.3	**Starting and Ignition Systems** Operation of engine start systems and components; Ignition systems and components; Maintenance safety requirements.	-	-	**2**

MODULE 15. GAS TURBINE ENGINE

		Level		
		A1 A3	B1.1 B1.3	B2
15.1	**Fundamentals** Potential energy, kinetic energy, Newton's laws of motion, Brayton cycle; The relationship between force, work, power, energy, velocity, acceleration; Constructional arrangement and operation of turbojet, turbofan, turboshaft, turboprop.	**1**	**2**	**-**
15.2	**Engine Performance** Gross thrust, net thrust, choked nozzle thrust, thrust distribution, resultant thrust, thrust horsepower, equivalent shaft horsepower, specific fuel consumption; Engine efficiencies; By-pass ratio and engine pressure ratio; Pressure, temperature and velocity of the gas flow; Engine ratings, static thrust, influence of speed, altitude and hot climate, flat rating, limitations.	**-**	**2**	**-**
15.3	**Inlet** Compressor inlet ducts; Effects of various inlet configurations; Ice protection.	**2**	**2**	**-**
15.4	**Compressors** Axial and centrifugal types; Constructional features and operating principles and applications; Fan balancing; Operation; Causes and effects of compressor stall and surge; Methods of air flow control: bleed valves, variable inlet guide vanes, variable stator vanes, rotating stator blades; Compressor ratio.	**1**	**2**	**-**
15.5	**Combustion Section** Constructional features and principles of operation.	**1**	**2**	**-**
15.6	**Turbine Section** Operation and characteristics of different turbine blade types; Blade to disk attachment; Nozzle guide vanes; Causes and effects of turbine blade stress and creep.	**2**	**2**	**-**
15.7	**Exhaust** Constructional features and principles of operation; Convergent, divergent and variable area nozzles; Engine noise reduction; Thrust reversers.	**1**	**2**	**-**

MODULE 15. GAS TURBINE ENGINE (Continued)

		Level		
		A1 A3	B1.1 B1.3	B2
15.8	**Bearings and Seals** Constructional features and principles of operation.	**-**	**2**	**-**
15.9	**Lubricants and Fuels** Properties and specifications; Fuel additives; Safety precautions.	**1**	**2**	**-**
15.10	**Lubrication Systems** System operation/lay-out and components.	**1**	**2**	**-**
15.11	**Fuel Systems** Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems lay-out and components.	**1**	**2**	**-**
15.12	**Air Systems** Operation of engine air distribution and anti - ice control systems, including internal cooling, sealing and external air services.	**1**	**2**	**-**
15.13	**Starting and Ignition Systems** Operation of engine start systems and components; Ignition systems and components; Maintenance safety requirements.	**1**	**2**	**-**
15.14	**Engine Indication Systems** Exhaust Gas Temperature/Interstage Turbine Temperature; Engine Thrust Indication: Engine Pressure Ratio, engine turbine discharge pressure or jet pipe pressure systems; Oil pressure and temperature; Fuel pressure and flow; Engine speed; Vibration measurement and indication; Torque; Power.	**1**	**2**	**-**
15.15	**Power Augmentation Systems** Operation and applications; Water injection, water methanol; Afterburner systems.	**-**	**1**	**-**

MODULE 15. GAS TURBINE ENGINE (Continued)

		Level		
		A1 A3	B1.1 B1.3	B2
15.16	**Turbo-prop Engines** Gas coupled/free turbine and gear coupled turbines; Reduction gears; Integrated engine and propeller controls; Overspeed safety devices.	**1**	**2**	**-**
15.17	**Turbo-shaft engines** Arrangements, drive systems, reduction gearing, couplings, control systems.	**1**	**2**	**-**
15.18	**Auxiliary Power Units (APUs)** Purpose, operation, protective systems.	**1**	**2**	**-**
15.19	**Powerplant Installation** Configuration of firewalls, cowlings, acoustic panels, engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.	**1**	**2**	**-**
15.20	**Fire Protection Systems** Operation of detection and extinguishing systems.	**1**	**2**	**-**
15.21	**Engine Monitoring and Ground Operation** Procedures for starting and ground run-up; Interpretation of engine power output and parameters; Trend (including oil analysis, vibration and boroscope) monitoring; Inspection of engine and components to criteria, tolerances and data specified by engine manufacturer; Compressor washing/cleaning; Foreign object damage.	**1**	**3**	**-**
15.22	**Engine Storage and Preservation** Preservation and depreservation for the engine and accessories/systems.	**-**	**2**	**-**

MODULE 16. PISTON ENGINE

		Level		
		A2 A4	B1.2 B1.4	B2
16.1	**Fundamentals** Mechanical, thermal and volumetric efficiencies; Operating principles — 2 stroke, 4 stroke, Otto and Diesel; Piston displacement and compression ratio; Engine configuration and firing order.	**1**	**2**	**-**
16.2	**Engine Performance** Power calculation and measurement; Factors affecting engine power; Mixtures/leaning, pre-ignition.	**1**	**2**	**-**
16.3	**Engine Construction** Crank case, crank shaft, cam shafts, sumps; Accessory gearbox; Cylinder and piston assemblies; Connecting rods, inlet and exhaust manifolds; Valve mechanisms; Propeller reduction gearboxes.	**1**	**2**	**-**
16.4	**Engine Fuel Systems**			
16.4.1	***Carburettors*** Types, construction and principles of operation; Icing and heating.	**1**	**2**	**-**
16.4.2	***Fuel injection systems*** Types, construction and principles of operation.	**1**	**2**	**-**
16.4.3	***Electronic engine control*** Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems lay-out and components.	**1**	**2**	**-**
16.5	**Starting and Ignition Systems** Starting systems, pre-heat systems; Magneto types, construction and principles of operation; Ignition harnesses, spark plugs; Low and high tension systems.	**1**	**2**	**-**
16.6	**Induction, Exhaust and Cooling Systems** Construction and operation of: induction systems including alternate air systems; Exhaust systems, engine cooling systems — air and liquid.	**1**	**2**	**-**

MODULE 16. PISTON ENGINE (Continued)

		Level		
		A2 A4	B1.2 B1.4	B2
16.7	**Supercharging/Turbocharging** Principles and purpose of supercharging and its effects on engine parameters; Construction and operation of supercharging/Turbocharging systems; System terminology; Control systems; System protection.	**1**	**2**	**-**
16.8	**Lubricants and Fuels** Properties and specifications; Fuel additives; Safety precautions.	**1**	**2**	**-**
16.9	**Lubrication Systems** System operation/lay-out and components.	**1**	**2**	**-**
16.10	**Engine Indication Systems** Engine speed; Cylinder head temperature; Coolant temperature; Oil pressure and temperature; Exhaust Gas Temperature; Fuel pressure and flow; Manifold pressure.	**1**	**2**	**-**
16.11	**Powerplant Installation** Configuration of firewalls, cowlings, acoustic panels, engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.	**1**	**2**	**-**
16.12	**Engine Monitoring and Ground Operation** Procedures for starting and ground run-up; Interpretation of engine power output and parameters; Inspection of engine and components: criteria, tolerances, and data specified by engine manufacturer.	**1**	**3**	**-**
16.13	**Engine Storage and Preservation** Preservation and depreservation for the engine and accessories/ systems.	**-**	**2**	**-**

MODULE 17. PROPELLER

		Level		
		A1 A2	B1.1 B1.2	B2
17.1	**Fundamentals** Blade element theory; High/low blade angle, reverse angle, angle of attack, rotational speed; Propeller slip; Aerodynamic, centrifugal, and thrust forces; Torque; Relative airflow on blade angle of attack; Vibration and resonance.	**1**	**2**	**-**
17.2	**Propeller Construction** Construction methods and materials used in wooden, composite and metal propellers; Blade station, blade face, blade shank, blade back and hub assembly; Fixed pitch, controllable pitch, constant speeding propeller; Propeller/spinner installation.	**1**	**2**	**-**
17.3	**Propeller Pitch Control** Speed control and pitch change methods, mechanical and electrical/electronic; Feathering and reverse pitch; Overspeed protection.	**1**	**2**	**-**
17.4	**Propeller Synchronising** Synchronising and synchrophasing equipment.	**-**	**2**	**-**
17.5	**Propeller Ice Protection** Fluid and electrical de-icing equipment.	**1**	**2**	**-**
17.6	**Propeller Maintenance** Static and dynamic balancing; Blade tracking; Assessment of blade damage, erosion, corrosion, impact damage, delamination; Propeller treatment/repair schemes; Propeller engine running.	**1**	**3**	**-**
17.7	**Propeller Storage and Preservation** Propeller preservation and depreservation.	**1**	**2**	**-**

SINGAPORE AIRWORTHINESS REQUIREMENTS

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APPENDIX 2

BASIC EXAMINATION STANDARD

1 Standardisation Basis for Examinations

1.1 All basic examinations will be in multiple-choice or essay question format as specified below.

1.2 Each multiple-choice question will have three answers of which only one is correct. The candidate is allowed a total time per module based on a nominal average of 75 seconds per question.

1.3 Each essay question requires the preparation of a written answer and the candidate will be allowed 30 minutes to answer each question.

1.4 The pass mark for each SAR-66 module is 75 %.

1.5 Penalty marking will not be applied on the multiple-choice papers.

1.6 The answer to an essay question is expected to follow a 'report' style that presents a logical progression from introduction to conclusion. The essay will be marked for contents and overall presentation. Contents will account for 60 % of the marks, while overall presentation will account for the remaining 40 %.

1.7 To pass an essay examination paper, besides obtaining an overall score of 75 %, the candidate must also obtain at least 75 % in each question in the paper.

1.8 - *deleted* -

1.9 - *deleted* -

1.10 A pass in the following examination papers obtained before 31 October 2010 under Section 7 of the Singapore Airworthiness Requirements, which would have been valid for 5 years from the date the pass was obtained, shall be deemed to be a valid pass for the corresponding SAR-66 basic knowledge examination paper for the remaining duration of the validity period of the examination papers obtained under Section 7 of the Singapore Airworthiness Requirements:

Examination paper under Section 7 of Singapore Airworthiness Requirements	**Corresponding SAR-66 basic knowledge examination paper**
H11	M09
L11	M10

2. Number of multiple choice questions for the SAR-66 Appendix 1 Modules

Module No.	Module Name	Cat A		Cat B1		Cat B2	
		No. of Questions	Time Allowed	No. of Questions	Time Allowed	No. of Questions	Time Allowed
M01	Mathematics	16	20 mins	32	40 mins	32	40 mins
M02	Physics	32	40 mins	52	65 mins	52	65 mins
M03	Electrical Fundamentals	20	25 mins	52	65 mins	52	65 mins
M04	Electronic Fundamentals	-	-	20	25 mins	40	50 mins
M05	Digital Techniques / Electronic Instrument Systems	16	20 mins	40 (B1.1 & B1.3)	50 mins	72	90 mins
				20 (B1.2 & B1.4)	25 mins		
M06	Materials and Hardware	52	65 mins	72	90 mins	60	75 mins
M07	Maintenance Practices	72	90 mins	80	100 mins	60	75 mins
M08	Basic Aerodynamics	20	25 mins	20	25 mins	20	25 mins
M09	Human Factors	20	25 mins	20	25 mins	20	25 mins
M10	Aviation Legislation	40	50 mins	40	50 mins	40	50 mins
M11A	Turbine Aeroplane Aerodynamics, Structures and Systems	108	135 mins	140	175 mins	-	-
M11B	Piston Aeroplane Aerodynamics, Structures and Systems	72	90 mins	100	125 mins	-	-
M12	Helicopter Aerodynamics, Structures and Systems	100	125 mins	128	160 mins	-	-
M13	Aircraft Aerodynamics, Structures and Systems	-	-	-	-	180	225 mins

Module No.	Module Name	Cat A		Cat B1		Cat B2	
		No. of Questions	Time Allowed	No. of Questions	Time Allowed	No. of Questions	Time Allowed
M14	Propulsion	-	-	-	-	24	30 mins
M15	Gas Turbine Engine	60	75 mins	92	115 mins	-	-
M16	Piston Engine	52	65 mins	72	90 mins	-	-
M17	Propeller	20	25 mins	32	40 mins	-	-
M60	Bridging Paper for Category A	80	100mins	-	-	-	-

3. Essay examination paper for modules M07, M09 and M10

Examination Paper Code.	Examination Paper Name	Cat A		Cat B1		Cat B2	
		No. of Questions	Time Allowed	No. of Questions	Time Allowed	No. of Questions	Time Allowed
M50	Essay Examination Paper	4	120 mins	4	120 mins	4	120 mins

3.1 An essay examination paper (M50) is also required to be passed for the modules M07, M09 and M10. It comprises 2 questions drawn from the syllabus for Module 07, and 1 question each drawn from the syllabus for Module 09 and Module 10. This is a common paper set based on the same syllabus and standard across all SAR-66 aircraft maintenance licence categories.

SINGAPORE AIRWORTHINESS REQUIREMENTS

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APPENDIX 3

TYPE TRAINING AND EXAMINATION STANDARD

1 Type training levels

The three levels listed below define the objectives that a particular level of training is intended to achieve.

LEVEL 1 ***General Familiarisation*** - A brief overview of the airframe, systems and powerplants as outlined in the Systems Description Section of the Aircraft Maintenance Manual.

Objectives: Upon completion of the course, the student will be able to:

1. Identify safety precautions related to the airframe, its systems and powerplant.
2. Identify maintenance practices important to the airframe, its systems and powerplant.
3. Define the general layout of the aircraft's major systems.
4. Define the general layout and characteristics of the powerplant.
5. Identify special tooling and test equipment used with the aircraft.

LEVEL 2 ***Ramp and Transit*** **-** Basic system overview of controls, indicators, principal components including their location and purpose, servicing and minor troubleshooting.

Objectives: In addition to the information contained in the Level 1 General Familiarisation course, at the completion of this Level 2 Ramp and Transit training, the student will be able to:

1. Recall the safety precautions to be observed when working on or near the aircraft, powerplant and systems.
2. Demonstrate knowledge of the main ramp and transit (through-flight) activities of the following:
   (a) Doors, windows and hatches;
   (b) Electrical power supplies;
   (c) Fuel;
   (d) Auxiliary power unit;
   (e) Powerplant;
   (f) Fire protection;
   (g) Environmental Control Systems;
   (h) Hydraulic power;
   (i) Landing gear;
   (j) Flight controls;
   (k) Water/waste;

(l) Oxygen;

(m) Flight and service interphone;

(n) Avionics; and

(o) Cabin equipment/furnishings.

3. Describe systems and aircraft handling particularly access, power availability and sources.

4. Identify the locations of the principal components.

5. Explain the normal functioning of each major system, including terminology and nomenclature.

6. Perform the procedures for ramp and transit servicing associated with the aircraft for the following systems: Fuel, Power Plants, Hydraulics, Landing Gear, Water/Waste, and Oxygen.

7. Demonstrate proficiency in use of crew reports and on-board reporting systems (minor troubleshooting) and determine aircraft airworthiness per the MEL/CDL.

8. Identify and use appropriate documentation.

9. Locate those procedures for replacement of components for ramp and transit activities identified in objective 2.

LEVEL 3 ***Line and Base Maintenance Training*** **-** Detailed description, operation, component location, removal/installation, BITE and troubleshooting procedures to maintenance manual level.

Objectives: In addition to the information contained in Level 1 and Level 2 training, at the completion of Level III Line and Base Maintenance training, the student will be able to:

1. Perform system, engine, component and functional checks as specified in the maintenance manual.

2. Correlate information for the purpose of making decisions in respect of fault diagnosis and rectification to maintenance manual level.

3. Describe procedures for replacement of components unique to aircraft type.

2 Type training standard

Type training must include a theoretical and practical element.

2.1 Theoretical element

As a minimum, the elements in the syllabus below that are specific to the aircraft type must be covered. Additional elements introduced due to technological changes shall also be included.

Training levels are those levels defined in paragraph 1 above.

After the first type course for category C certifying staff all subsequent courses need only be to Level 1.

Introduction Module Title	
General Time limits/maintenance checks Levelling and weighing Towing and taxiing Parking/mooring Servicing Standard practices-only type particular B2 module-safety items/mechanical interface B1 module-safety items/avionics interface Aircraft(dimensions/weights MTOW etc)	

	Aeroplanes turbine		**Aeroplanes piston**		**Helicopters turbine**		**Helicopters piston**		**Avionics**
	B1	C	B1	C	B1	C	B1	C	B2
Blade tracking and vibration analysis	-	-	-	-	3	1	3	1	-
Transmissions	-	-	-	-	3	1	3	1	-
Airframe structure	-	-	-	-	3	1	3	1	1
Main rotor	-	-	-	-	3	1	3	1	-
Tail rotor/rotor drive	-	-	-	-	3	1	3	1	-
Rotor flight control	-	-	-	-	3	1	3	1	-
Airframe Structure	3	1	3	1	-	-	-	-	1
Fuselage Doors	3	1	3	1	-	-	-	-	-
Fuselage	3	1	3	1	-	-	-	-	-
Fuselage Windows	3	1	3	1	-	-	-	-	-
Wings	3	1	3	1	-	-	-	-	-
Stabilisers	3	1	3	1	-	-	-	-	-
Flight Control Surfaces	3	1	3	1	-	-	-	-	-
Nacelles/Pylons	3	1	3	1	-	-	-	-	-
Zonal & Station Identification Systems	1	1	1	1	1	1	1	1	1
Air Supply	3	1	3	1	3	1	3	1	1
Air Conditioning	3	1	3	1	3	1	3	1	1
Pressurisation	3	1	-	-	-	-	-	-	1
Safety & Warning Devices	3	1	-	-	-	-	-	-	1
Instrument Systems	3	1	3	1	3	1	3	1	3
Avionics Systems	2	1	2	1	2	1	2	1	3
Electrical Power	3	1	3	1	3	1	3	1	3
Equipment & Furnishings	3	1	3	1	3	1	3	1	-
Electronic Emergency Equip. Requirement & Cabin Entertainment Equipment	-	1	-	-	-	-	-	-	3
Fire Protection	3	1	3	1	3	1	3	1	1
Flight Controls	3	1	3	1	3	1	3	1	2
Sys. Operation: Electrical/Fly-by-Wire	3	1	-	-	-	-	-	-	3
Fuel Systems	3	1	3	1	3	1	3	1	1
Hydraulic Power	3	1	3	1	3	1	3	1	1
Ice & Rain Protection	3	1	3	1	3	1	3	1	1

	Aeroplanes turbine		Aeroplanes piston		Helicopters turbine		Helicopters piston		Avionics
	B1	C	B1	C	B1	C	B1	C	B2
Landing Gear	3	1	3	1	3	1	3	1	1
Lights	3	1	3	1	3	1	3	1	3
Oxygen	3	1	3	1	-	-	-	-	1
Pneumatic/Vacuum	3	1	3	1	3	1	3	1	1
Water/Waste	3	1	3	1	-	-	-	-	1
On-board Maintenance Systems	3	1	3	1	-	-	-	-	3
Turbine Engines:									
Constructional arrangement and operation	-	-	-	-	-	-	-	-	1
Engine Performance	3	1	-	-	3	1	-	-	1
Inlet	3	1	-	-	3	1	-	-	-
Compressors	3	1	-	-	3	1	-	-	-
Combustion Section	3	1	-	-	3	1	-	-	-
Turbine Section	3	1	-	-	3	1	-	-	-
Exhaust	3	1	-	-	3	1	-	-	-
Bearings and Seals	3	1	-	-	3	1	-	-	-
Lubricants and Fuels	3	1	-	-	3	1	-	-	-
Lubrication Systems	3	1	-	-	3	1	-	-	-
Fuel Systems	3	1	-	-	3	1	-	-	1
Engine controls	3	1	-	-	3	1	-	-	1
FADEC	2	1	-	-	2	1	-	-	3
Air Systems	3	1	-	-	3	1	-	-	-
Starting & Ignition Systems	3	1	-	-	3	1	-	-	-
Engine Indicating Systems	3	1	-	-	3	1	-	-	3
Power Augmentation Systems	3	1	-	-	-	-	-	-	-
Turbo-prop Engines	3	1	-	-	-	-	-	-	-
Turbo-shaft Engines	-	-	-	-	3	1	-	-	-
Auxiliary Power Units (APUs)	3	1	-	-	-	-	-	-	1
Powerplant Installation	3	1	-	-	3	1	-	-	-
Fire Protection Systems	3	1	-	-	3	1	-	-	1
Engine Monitoring and Ground Operation	3	1	-	-	3	1	-	-	-
Engine Storage and Preservation	3	1	-	-	3	1	-	-	-
Piston Engines:									
Engine Performance	-	-	3	1	-	-	3	1	1
Engine Construction	-	-	3	1	-	-	3	1	1
Engine Fuel Systems	-	-	3	1	-	-	3	1	1
Carburettors	-	-	3	1	-	-	3	1	-
Fuel injection systems	-	-	3	1	-	-	3	1	-
Engine Controls	3	1	-	-	3	1	-	-	1
FADEC	-	-	2	1	-	-	2	1	3
Starting and Ignition Systems	-	-	3	1	-	-	3	1	-
Induction, Exhaust and Cooling Systems	-	-	3	1	-	-	3	1	-
Supercharging/Turbocharging	-	-	3	1	-	-	3	1	-
Lubricants and Fuels	-	-	3	1	-	-	3	1	-
Lubrication Systems	-	-	3	1	-	-	3	1	-
Engine Indication Systems	-	-	3	1	-	-	3	1	3
Powerplant Installation	-	-	3	1	-	-	3	1	-
Engine Monitoring and Ground Operation	-	-	3	1	-	-	3	1	-
Engine Storage and Preservation	-	-	3	1	-	-	3	1	-
Propellers:									
Propeller — General	3	1	3	1	-	-	-	-	1
Propeller Construction	3	1	3	1	-	-	-	-	-
Propeller Pitch Control	3	1	3	1	-	-	-	-	-

	Aeroplanes turbine		Aeroplanes piston		Helicopters turbine		Helicopters piston		Avionics
	B1	C	B1	C	B1	C	B1	C	B2
Propeller Synchronising	3	1	3	1	-	-	-	-	-
Propeller Electronic Control	2	1	2	1	-	-	-	-	3
Propeller Ice Protection	3	1	3	1	-	-	-	-	-
Propeller Maintenance	3	1	3	1	-	-	-	-	-

2.2 Practical element

The practical training element must consist of the performance of representative maintenance tasks and their assessment in order to meet the following objectives:

(a) Ensure safe performance of maintenance, inspections and routine work according to the maintenance manual and other relevant instructions and tasks as appropriate for the type of aircraft, for example troubleshooting, repairs, adjustments, replacements, rigging and functional checks such as engine run, etc, if required.

(b) Correctly use all technical literature and documentation for the aircraft.

(c) Correctly use specialist/special tooling and test equipment, perform removal and replacement of components and modules unique to type, including any on-wing maintenance activity.

3 Type training examination standard

Where aircraft type training is required, the examination must be written and complies with the following:

(a) Format of the examination is of the multiple-choice type. Each multiple-choice question must have three alternative answers of which only one must be the correct answer. The time for answering is based upon a nominal average of 120 seconds per level 3 question and 75 seconds per level 1 or 2 question.

(b) The examination must be of the closed book type. No reference material is permitted. An exception will be made or the case of examining a B1 or B2 candidate's ability to interpret technical documents.

(c) The number of questions must be at least one question per hour of instruction subject to a minimum of two questions per syllabus subject. The Authority will assess the number and level of questions on a sampling basis when approving the course.

(d) The examination pass mark is 75 %.

(e) Penalty marking will not to be used to determine whether a candidate has passed.

(f) End of module phase examinations cannot be used as part of the final examination unless they contain the correct number and level of questions required.

4. Type examination standard

Where type training is not required, the examination must be oral, written or practical assessment based, or a combination thereof.

Oral examination questions must be open.

Written examination questions must be essay type or multiple-choice questions.

Practical assessment must determine a person's competence to perform a task.

Examination subjects must be on a sample of subjects drawn from paragraph 2 type training/examination syllabus, at the indicated level.

The examination must ensure that the following objectives are met:

(a) Properly discuss with confidence the aircraft and its systems.

(b) Ensure safe performance of maintenance, inspections and routine work according to the maintenance manual and other relevant instructions and tasks as appropriate for the type of aircraft, for example troubleshooting, repairs, adjustments, replacements, rigging and functional checks such as engine run, etc, if required.

(c) Correctly use all technical literature and documentation for the aircraft.

(d) Correctly use specialist/special tooling and test equipment, perform removal and replacement of components and modules unique to type, including any on-wing maintenance activity.

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APPENDIX 4

EXPERIENCE REQUIREMENTS FOR EXTENDING A SAR-66 AIRCRAFT MAINTENANCE LICENCE

(1) The table below shows the experience requirements for adding a new category or subcategory to an existing SAR-66 licence.

(2) The experience must be recent practical maintenance experience on operating aircraft in the category or subcategory relevant to the application.

(3) The experience requirement will be reduced by 50 % if the applicant has completed an approved SAR-147 course relevant to the category or subcategory.

To: From:	A1	A2	A3	A4	B1.1	B1.2	B1.3	B1.4	B2
A1		6 months	6 months	6 months	2 years	6 months	2 years	1 year	2 years
A2	6 months		6 months	6 months	2 years	6 months	2 years	1 year	2 years
A3	6 months	6 months		6 months	2 years	1 year	2 years	6 months	2 years
A4	6 months	6 months	6 months		2 years	1 year	2 years	6 months	2 years
B1.1	None	6 months	6 months	6 months		6 months	6 months	6 months	1 year
B1.2	6 months	None	6 months	6 months	2 years		2 years	6 months	2 years
B1.3	6 months	6 months	None	6 months	6 months	6 months		6 months	1 year
B1.4	6 months	6 months	6 months	None	2 years	6 months	2 years		2 years
B2	6 months	6 months	6 months	6 months	1 year	1 year	1 year	1 year	

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APPENDIX 5

PRACTICAL EXPERIENCE FOR AIRCRAFT OTHER THAN LARGE AIRCRAFT

LIST OF TASKS

Time limits/Maintenance checks
100 hour check (general aviation aircraft).
'B' or 'C' check (transport category aircraft).
Review records for compliance with airworthiness directives.
Review records for compliance with component life limits.
Procedure for inspection following heavy landing.
Procedure for inspection following lightning strike.

Dimensions/Areas
Locate component(s) by station number.
Perform symmetry check.

Lifting and Shoring
Assist in:
Jack aircraft nose or tail wheel.
Jack complete aircraft.
Sling or trestle major component.

Levelling/Weighing
Level aircraft.
Weigh aircraft.
Prepare weight and balance amendment.
Check aircraft against equipment list.

Towing and Taxiing
Tow aircraft.
Be part of aircraft towing team.

Parking and mooring
Tie down aircraft.
Park, secure and cover aircraft.
Position aircraft in dock.
Secure rotor blades.

Placards and Markings
Check aircraft for correct placards.
Check aircraft for correct markings.

Servicing
Refuel aircraft.
Defuel aircraft.
Check tyre pressures.
Check oil level.
Check hydraulic fluid level.
Check accumulator pressure.
Charge pneumatic system.
Grease aircraft.
Connect ground power.
Service toilet/water system.
Perform pre-flight/daily check.

Vibration and Noise Analysis
Analyse helicopter vibration problem.
Analyse noise spectrum.

Air Conditioning
Replace combustion heater.
Replace outflow valve.
Replace vapour cycle unit.
Replace air cycle unit.
Replace cabin blower.
Replace heat exchanger.
Replace pressurisation controller.
Clean outflow valves.
Check operation of air conditioning/heating system.
Check operation of pressurisation system.
Troubleshoot faulty system.

Auto flight
Install servos.
Rig bridle cables.
Replace controller.
Replace amplifier.
Check operation of auto-pilot.
Check operation of auto-throttle.
Check operation of yaw damper.
Check and adjust servo clutch.
Perform autopilot gain adjustments.
Perform mach trim functional check.
Troubleshoot faulty system.
Check autoland system.
Check flight management systems.
Check stability augmentation system.

Communications
Replace VHF com unit.
Replace HF com unit.
Replace existing antenna.
Replace static discharge wicks.
Check operation of radios.
Perform antenna VSWR check.
Perform Selcal operational check.
Perform operational check of passenger address system.
Functionally check audio integrating system.
Repair co-axial cable.
Troubleshoot faulty system.

Electrical Power
Charge lead/acid battery.
Charge ni-cad battery.
Check battery capacity.
Deep-cycle ni-cad battery.
Replace generator/alternator.

Replace switches.
Replace circuit breakers.
Adjust voltage regulator.
Amend electrical load analysis report.
Repair/replace electrical feeder cable.
Troubleshoot faulty system.

Equipment/Furnishings
Replace carpets.
Replace crew seats.
Replace passenger seats.
Check inertia reels.
Check seats/belts for security.
Check emergency equipment.
Check ELT for compliance with regulations.
Repair toilet waste container.
Repair upholstery.
Change cabin configuration.

Fire protection
Check fire bottle contents.
Check operation of warning system.
Check cabin fire extinguisher contents.
Check lavatory smoke detector system.
Install new fire bottle.
Replace fire bottle squib.
Troubleshoot faulty system.
Inspect engine fire wire detection systems.

Flight Controls
Replace horizontal stabiliser.
Replace elevator.
Replace aileron.
Replace rudder.
Replace trim tabs.
Install control cable and fittings.
Replace flaps.
Replace powered flying control unit.
Replace flat actuator.
Adjust trim tab.
Adjust control cable tension.
Check control range and sense of movement.
Check for correct assembly and locking.
Troubleshoot faulty system.

Fuel
Replace booster pump.
Replace fuel selector.
Replace fuel tank cells.
Check filters.
Flow checks system.
Check calibration of fuel quantity gauges.
Check operation feed/selectors.
Troubleshoot faulty system.

Hydraulics
Replace engine driven pump.
Replace standby pump.
Replace accumulator.
Check operation of shut off valve.
Check filters.
Check indicating systems.
Perform functional checks.
Troubleshoot faulty system.

Ice and rain protection
Replace pump.
Replace timer.
Install wiper motor.
Check operation of systems.
Troubleshoot faulty system.

Indicating/recording systems
Replace flight data recorder.
Replace cockpit voice recorder.
Replace clock.
Replace master caution unit.
Replace FDR.
Perform FDR data retrieval.
Troubleshoot faulty system.
Implement ESDS procedures.
Inspect for HIRF requirements.

Landing Gear
Build up wheel.
Replace main wheel.
Replace nose wheel.
Replace shimmy damper.
Rig nose wheel steering.
Replace shock strut seals.
Replace brake unit.
Replace brake control valve.
Bleed brakes.
Test anti skid unit.
Test gear retraction.
Change bungees.
Adjust micro switches.
Charge struts.
Troubleshoot faulty system.
Test out brake system.

Lights
Repair/replace rotating beacon.
Repair/replace landing lights.
Repair/replace navigation lights.
Repair/replace interior lights.
Repair/replace emergency lighting system.
Perform emergency lighting system checks.
Troubleshoot faulty system.

Navigation
Calibrate magnetic direction indicator.
Replace airspeed indicator.
Replace altimeter.
Replace air data computer.
Replace VOR unit.
Replace ADI.
Replace HIS.
Check pitot static system for leaks.
Check operation of directional gyro.
Functional check weather radar.
Functional check Doppler.
Functional check TCAS.
Functional check DME.
Functional check ATC Transponder.
Functional check flight director system.
Functional check inertial navigation system.

Complete quadrantal error correction of ADF system.
Update flight management system database.
Check calibration of pitot staticinstruments.
Check calibration of pressure altitude reporting system.
Troubleshoot faulty system.
Check marker systems.
Compass replacement direct/indirect.
Check Satcom.
Check GPS.
Test AVM.

Oxygen
Inspect on board oxygen equipment.
Purge and recharge oxygen system.
Replace regulator.
Replace oxygen generator.
Test crew oxygen system.
Perform auto oxygen system deployment check.
Troubleshoot faulty system.

Pneumatic systems
Replace filter.
Replace compressor.
Recharge dessicator.
Adjust regulator.
Check for leaks.
Troubleshoot faulty system.

Vacuum systems
Replace vacuum pump
Check/replace filters
Adjust regulator
Troubleshoot faulty system

Water/Waste
Replace water pump.
Replace tap.
Replace toilet pump.
Troubleshoot faulty system.

Central Maintenance System
Retrieve data from CMU.
Replace CMU.
Perform BITE check.
Troubleshoot faulty system.

Airborne Auxiliary power
Install APU.
Inspect hot section.
Troubleshoot faulty system.

Structures
Sheet metal repair.
Fibre glass repair.
Wooden repair.
Fabric repair.
Recover fabric control surface.
Treat corrosion.
Apply protective treatment.

Doors
Rig/adjust locking mechanism.
Adjust air stair system.
Check operation of emergency exits.
Test door warning system.
Troubleshoot faulty system.

Windows
Replace windshield.
Replace window.
Repair transparency.

Wings
Skin repair.
Recover fabric wing.
Replace tip.
Replace rib.
Check incidence/rig.

Propeller
Assemble prop after transportation.
Replace propeller.
Replace governor.
Adjust governor.
Perform static functional checks.
Check operation during ground run.
Check track.
Check setting of micro switches.
Dress out blade damage.
Dynamically balance prop.
Troubleshoot faulty system.

Main Rotors
Install rotor assembly.
Replace blades.
Replace damper assembly.
Check track.
Check static balance.
Check dynamic balance.
Troubleshoot.

Rotor Drive
Replace mast.
Replace drive coupling.
Replace clutch/freewheel unit.
Replace drive belt.
Install main gearbox.
Overhaul main gearbox.
Check gearbox chip detectors.

Tail Rotors
Install rotor assembly.
Replace blades.
Troubleshoot.

Tail Rotor Drive
Replace bevel gearbox.
Replace universal joints.
Overhaul bevel gearbox.
Install drive assembly.
Check chip detectors.

Rotorcraft flight controls
Install swash plate.
Install mixing box.
Adjust pitch links.

Rig collective system.
Rig cyclic system.
Rig anti-torque system.
Check controls for assembly and locking.
Check controls for operation and sense.
Troubleshoot faulty system.

Power Plant
Build up ECU.
Replace engine.
Repair cooling baffles.
Repair cowling.
Adjust cowl flaps.
Repair faulty wiring.
Troubleshoot.

Piston Engines
Remove/install reduction gear.
Check crankshaft run-out.
Check tappet clearance.
Check compression.
Extract broken stud.
Install helicoil.
Perform ground run.
Establish/check reference RPM.
Troubleshoot.

Turbine Engines
Replace module.
Hot section inspection.
Engine ground run.
Establish reference power.
Trend monitoring/gas path analysis.
Troubleshoot.

Fuel and control, piston
Replace engine driven pump.
Adjust AMC.
Adjust ABC.
Install carburettor/injector.
Adjust carburettor/injector.
Clean injector nozzles.
Replace primer line.
Check carburettor float setting.
Troubleshoot faulty system.

Fuel and control, turbine
Replace FCU.
Replace engine driven pump.
Clean/test fuel nozzles.
Clean/replace filters.
Adjust FCU.
Troubleshoot faulty system.

Ignition systems, piston
Change magneto.
Change ignition vibrator.
Change plugs.
Test plugs.
Check H T leads.
Install new leads.
Check timing.
Check system bonding.
Troubleshoot faulty system.

Ignition systems, turbine
Check glow plugs/ignitors.
Check H T leads.
Check ignition unit.
Replace ignition unit.
Troubleshoot faulty system.

Engine Controls
Rig thrust lever.
Rig RPM control.
Rig mixture HP cock lever.
Rig power lever.
Check control sync (multi-eng).
Check controls for correct assembly and locking.
Check controls for range and sense of operation.
Adjust pedestal micro-switches.
Troubleshoot faulty system.

Engine Indicating
Replace engine instruments(s).
Replace oil temperature bulb.
Replace thermocouples.
Check calibration.
Troubleshoot faulty system.

Exhaust, piston
Replace exhaust gasket.
Inspect welded repair.
Pressure check cabin heater muff.
Troubleshoot faulty system.

Exhaust, turbine
Change jet pipe.
Change shroud assembly.
Install trimmers.

Oil
Change oil.
Check filter(s).
Adjust pressure relief valve.
Replace oil tank.
Replace oil pump.
Replace oil cooler.
Replace firewall shut off valve.
Perform oil dilution.
Troubleshoot faulty system.

Starting
Replace starter.
Replace start relay.
Replace start control valve.
Check cranking speed.
Troubleshoot faulty system.

Turbines, piston engines
Replace PRT.
Replace turbo-blower.
Replace heat shields.
Replace waste gate.
Adjust density controller.

Engine water injection
Replace water/methanol pump.
Flow checks water/methanol system.
Adjust water/methanol control unit.
Check fluid for quality.
Troubleshoot faulty system.

Accessory gear boxes
Replace gearbox.
Replace drive shaft.
Check chip detector.

SINGAPORE AIRWORTHINESS REQUIREMENTS

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SECTION 2 - ACCEPTABLE MEANS OF COMPLIANCE (AMC) AND INTERPRETATIVE/EXPLANATORY MATERIAL (IEM)

1 GENERAL

1.1 This section contains Acceptable Means of Compliance (AMC) and Interpretative/Explanatory Material (IEM) that have been included in the SAR-66 to assist holders of or applicants for an aircraft maintenance licence in meeting the necessary requirements.

1.2 Where a particular SAR paragraph does not have an Acceptable Means of Compliance or any Interpretative/Explanatory Material, it is considered that no supplementary material is required.

1.3 In addition, Advisory Circulars issued by the Authority may contain further Acceptable Means of Compliance and/or Interpretative/Explanatory Material.

2 PRESENTATION

2.1 The Acceptable Means of Compliance and Interpretative/Explanatory Material are presented in full-page width on loose pages, each page being identified by the date of issue or the change number under which it is amended or re-issued.

2.2 A numbering system has been used in which the Acceptable Means of Compliance and Interpretative Material uses the same number as the paragraph in SAR to which it refers. The number is preceded by the letters AMC or IEM to distinguish the material from the SAR itself.

2.3 The acronyms AMC and IEM also indicate the nature of the material and for this purpose the two types of material are defined as follows:

(a) Acceptable Means of Compliance (AMC) illustrate a means, or several alternative means, but not necessarily the only possible means by which a requirement can be met. It should however, be noted that where a new AMC is developed, any such AMC (which may be additional to an existing AMC) may be amended into the document or issued as a separate Advisory Circular.

(b) Interpretative/Explanatory Material (IEM) helps to illustrate the meaning of a requirement.

2.4 Explanatory notes not forming part of the AMC text appear in a smaller typeface.

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IEM 66.1 General

The privileges of aircraft maintenance engineers licensed under SAR Section 7 will remain valid until 31 December 2008.

AMC 66.10 Application and Issue

1 Applications for SAR-66 aircraft maintenance licence must be submitted to the Authority using Form CAAS(AW)66-1.

2 To demonstrate a need to hold a SAR-66 aircraft maintenance licence, the applicant must show that he or she is working for, or will be working for, a SAR-145 approved maintenance organisation.

AMC 66.20 (a) Privileges

1 Certifying staff may be granted a SAR-145 certification authorisation in relation to the SAR-66 category/subcategories held, subject to the SAR-66 aircraft maintenance licence being valid at the time of the issuance of the authorisation.

AMC 66.20 (a) (1) Privileges

1 For the purposes of category A, minor scheduled line maintenance means any scheduled minor check performed during line maintenance which are limited to the following groups of tasks:

(a) Visual inspections that will detect obvious unsatisfactory conditions / discrepancies but do not require extensive in-depth inspection. The scope of these inspections may include internal structure, systems and powerplant items which are visible through quick opening access panels / doors;

(b) Tests that determine the serviceability of aircraft systems using switches, Built-In-Test-Equipment (BITE) or external test equipment not involving special training. The results of such a test must be a clear go-no go indication or parameter, which does not involve interpretations of the test results or is dependent on other test results; and

(c) Routine fluid servicing.

2 In addition to minor scheduled line maintenance, a category A certifying staff may also perform limited tasks in both line and base maintenance. This list of tasks is specified in SAR-145.

3 A category A certifying staff is not permitted to perform defect diagnosis, or supervise individuals and certify for their work.

AMC 66.20 (a) (2) Privileges

The category B1 licence also permits the certification of work involving avionic systems, provided the serviceability of the system can be established by a simple self-test facility, other on-board test systems/equipment or by simple ramp test equipment. Defect rectification involving test equipment which requires an element of decision making in its application - other than a simple go/no-go decision - cannot be certified.

AMC 66.20 (a) (3) Privileges

The category B2 licence holder will need to be qualified as category A in order to carry out simple mechanical tasks and be able to make certifications if he or she was needed to exercise the privileges of a category A licence holder.

AMC 66.20 (a) (4) Privileges

The category C certification authorisation permits the certification of scheduled base maintenance by the issue of a single certificate of release to service for the complete aircraft after the completion of all such maintenance. The basis for this certification is that the maintenance has been carried out by competent technicians and categories A, B1 and B2 staff have signed for the maintenance under their respective specialisations. The principal function of the category C certifying staff is to ensure that all required maintenance has been called up and signed off by the category A, B1 and B2 staff before issue of the certificate of release to service. Category C personnel who also hold category B1 or B2 qualifications may perform both roles in base maintenance.

Note: It should be noted that the category C certifier is to be considered as a maintenance management role. Whilst category C certifying staff may also hold the appropriate category B1 or B2 type rated licences to act within base maintenance to support the category C signatory, the company should adopt procedures to prevent any conflict of interest, clearly stating that for any maintenance input the individual may work as either a category C signatory or a supporting category B1 or B2 signatory but not both. Licence holders should also be aware that such operations are unacceptable. The conflict of interest between doing the task and managing the task has been criticised previously in Air Accident Investigation Reports as a causal factor and companies should take steps to avoid this occurring.

IEM 66.20 (a) Privileges

1 The following titles shown against each category designator below are intended to provide a readily understandable indication of the job function:

Category A:	Certifying technician
Category B1:	Line maintenance certifying engineer - mechanical
Category B2:	Line maintenance certifying engineer - avionic
Category C:	Base maintenance certifying engineer

2 Individual aircraft maintenance licence holders need not be restricted to a single category. Provided that each qualification requirement is satisfied, any combination of categories may be granted.

3 –deleted-

4 Definitions

For the purposes of SAR-66.20(a), unless the context otherwise requires —

Electrical system means the aircraft's electrical power supply source, including the distribution system to the different components contained in the aircraft and relevant connectors and lighting systems

Note: When working on cables and connectors which are part of these electrical systems, the following typical practices are included in the privileges:
(a) Continuity, insulation and bonding techniques and testing;
(b) Crimping and testing of crimped joints;
(c) Connector pin removal and insertion;
(d) Wiring protection techniques.

Avionics system means an aircraft system that transfers, processes, displays or stores analogue or digital data using data lines, data buses, coaxial cables, wireless or other data transmission medium, and includes the system's components and connectors. Examples of avionics systems include the following:
(a) Autoflight;
(b) Communication, Radar and Navigation;
(c) Instruments (see NOTE below);
(d) In-Flight Entertainment Systems;
(e) Integrated Modular Avionics (IMA);

(f) On-Board Maintenance Systems;
(g) Information Systems;
(h) Fly-by-Wire Systems (related to ATA27 “Flight Controls”);
(i) Fibre Optic Control Systems.

Note: Instruments are formally included in the privileges of the B2 licence holders. However, maintenance on electromechanical and pitot-static components may also be released by a B1 license holder.

Simple test means a test described in approved maintenance data and meeting all the following criteria:

(a) The serviceability of the system can be verified using aircraft controls, switches, Built-in Test Equipment (BITE), Central Maintenance Computer (CMC) or external test equipment not involving special training.

(b) The outcome of the test is a unique go–no go indication or parameter, which can be a single value or a value within an interval tolerance. No interpretation of the test result or interdependence of different values is allowed.

(c) The test does not involve more than 10 actions as described in the approved maintenance data (not including those required to configure the aircraft prior to the test, i.e. jacking, flaps down, etc., or to return the aircraft to its initial configuration). Pushing a control, switch or button, and reading the corresponding outcome may be considered as a single step even if the maintenance data shows them separated.

Troubleshooting means the procedures and actions necessary to identify the root cause of a defect or malfunction using approved maintenance data. It may include the use of BITE or external test equipment.

Line maintenance means any maintenance that is carried out before flight to ensure that the aircraft is fit for the intended flight, including:
(a) trouble shooting;

(b) defect rectification;

(c) component replacement with the use of external test equipment, if required.
Component replacement may include components such as engines and propellers;

(d) scheduled maintenance and/or checks including visual inspections that will detect obvious unsatisfactory conditions/discrepancies but do not require extensive in-depth inspection. It may also include internal structure, systems and powerplant items which are visible through quick opening access panels/doors;

(e) minor repairs and modifications which do not require extensive disassembly and can be accomplished by simple means;

(f) for temporary or occasional cases (Airworthiness Directives, hereinafter AD; service bulletins, hereinafter SB) the quality manager may accept base maintenance tasks to be performed by a line maintenance organisation provided all requirements are fulfilled. The Authority will prescribe the conditions under which these tasks may be performed.

Base Maintenance means any task falling outside the criteria are given above for *Line Maintenance*.

5 A holder of a Category B2 licence issued before 8 March 2013 is not permitted to certify electrical and avionics tasks within powerplant and mechanical systems unless he concurrently holds a Category B1 qualification that grants him the privileges to certify such tasks.

From 8 March 2013, a SAR-66 aircraft maintenance licence holder who holds a Category B1 qualification which restricts the holder to certifying electrical and avionics tasks within

powerplant and mechanical systems may be granted a Category B2 licence that will allow the holder to certify electrical and avionics tasks within powerplant and mechanical systems.

AMC 66.20 (b) Categories and Certification Privileges

The required 6-month maintenance experience should be on aircraft structure, powerplant and systems as appropriate to the category or subcategory and relevant to the type or group rating held. Experience should be supported by documentary evidence.

AMC 66.25 (a) Basic Knowledge requirements

1 Basic knowledge examinations may be attempted at the conclusion of each SAR-66 subject module of a CAAS approved basic training course.

2 Basic knowledge examinations are conducted without the use of training notes.

3 Examination subjects required for each category are given in SAR-66 Appendix 1. Candidates may apply for such examinations online at www.caas.gov.sg .

4 A pass in the basic knowledge examination paper obtained before 1 July 2013, which would have been valid for 5 years or 10 years, as the case may be, from the date the pass was obtained, shall be deemed to be a valid pass for an issuance of an aircraft maintenance licence.

IEM 66.25 (a) Basic Knowledge requirements

1 Basic knowledge examinations are conducted by the Authority.

2 – deleted –

3 The levels of knowledge are directly related to the complexity of certifications appropriate to the particular SAR- 66.1 (sub)category, which means that category A must demonstrate a limited but adequate level of knowledge, whereas category B1 and B2 must demonstrate a complete level of knowledge in the appropriate subject modules.

4 Category C certifying staff from the academic route must also meet the relevant level of basic knowledge for category B1 or B2. This can be demonstrated by passing the full complement of the basic knowledge examinations for either category.

AMC 66.25 (c) Basic Knowledge requirements

1 An applicant who obtains Grade B4 or better in the GCE 'O' Levels Elementary Mathematics or Additional Mathematics subjects will be credited with basic knowledge requirements for the subject module Mathematics (M01) for Category A only.

2 An applicant who obtains a pass grade in a Mathematics subject, as part of an engineering course in a polytechnic or university, will be credited with basic knowledge requirements for the subject module Mathematics (M01) for Category B1, Category B2 and Category C.

3 –deleted-

AMC 66.25 (d) Basic Knowledge requirements (Barring period)

A person who fails a basic knowledge examination subject in two consecutive attempts will be ineligible to apply for the same examination for a period of 3 months from the date of the last attempt, unless the period between the two attempts is more than 3 months.

AMC 66.30 Experience requirements

1 For a category C applicant holding an academic degree the representative selection of tasks should include the observation of hangar maintenance, maintenance planning, quality assurance, record-keeping, approved spare parts control and engineering development.

2 While an applicant to a SAR-66 category C licence may be qualified by having 3 years experience as category B1 or B2 certifying staff only in line maintenance, it is however recommended that any applicant to a category C holding a B1 or B2 licence demonstrate at least 12 months experience as a B1 or B2 base maintenance support staff. B1 or B2 support staff are those who ensure that all relevant tasks or inspections have been carried out to the required standard before the category C certifying staff issues the certificate of release to service.

3 All aircraft maintenance licence applicants are required to provide a letter from their employer certifying that they meet the prescribed civil aircraft maintenance experience requirement in accordance with SAR-66.30(a). In addition, the applicant must demonstrate recent practical maintenance experience on operating aircraft and in the relevant (sub)category by submitting a schedule of experience (SOE) for the minimum number of days as shown below:

(i) for category A or subcategory B1.2 or B1.4 licence – at least 180 days in the 1-year period immediately preceding the date of application of an aircraft maintenance licence.

(ii) for category B2 or subcategory B1.1 or B1.3 licence – at least 360 days in the 2-year period immediately preceding the date of application of an aircraft maintenance licence.

(iii) for category C licence via academic route – at least 180 days, including a minimum of 90 days on observation of base maintenance tasks in the 1-year period immediately preceding the date of application of an aircraft maintenance licence.
Note: Non-base maintenance tasks may be demonstrated with records of such tasks in a logbook which must be countersigned by the supervisor.

(iv) for category C licence via B1 or B2 route – at least 180 days as a base maintenance support staff in the 1-year period immediately preceding the date of application for the extension of the aircraft maintenance licence. No SOE is necessary but the employer must ensure compliance with this requirement when supporting any application for a category C licence.

(v) for additional category/sub-category – SOE for the necessary duration indicated in Appendix 4 to SAR-66.

IEM 66.30 (a) Experience requirements

1 Practical maintenance experience on operating aircraft means the experience of having actively participated in the carrying out of maintenance tasks on aircraft which are being operated by airlines. The point being to gain sufficient experience in the environment of commercial maintenance as opposed to only the training school environment. Such experience may be combined with approved training so that periods of training can be intermixed with periods of experience rather like the apprenticeship.

2 The time necessary for any additional classroom training should be added to the practical maintenance experience time.

3 A skilled worker is a person who has successfully completed a course of training, acceptable to the Authority, involving the manufacture, repair, overhaul or inspection of mechanical, electrical or electronic equipment. The training would include the use of tools and measuring devices.

IEM 66.30 (d) Experience requirements

Recent practical maintenance experience may be presented in a form of a schedule of experience (SOE). Persons applying for a SAR-66 aircraft maintenance licence should submit a compilation of such a schedule as part of the licence application.

Recent practical maintenance experience is the experience gained in an appropriate (sub)category immediately before the date of application for an initial grant or extension of an aircraft maintenance licence. As a guide, all computations pertaining to the number of minimum working-day necessary to comply with a SOE requirement for a basic licence should be based on 180 days per year. For example, a requirement for a 2-year of recent practical maintenance experience should be interpreted as a requirement to demonstrate such experience in a SOE for a minimum of 360 days (180 days x 2) in the 2-year period immediately preceding the date of application for an aircraft maintenance licence. Similarly, a requirement for a 6-month of practical maintenance experience should be interpreted as a minimum of 90 days (180 days divided by 2) of SOE accumulated in the 6-month period immediately preceding the date application for a SAR-66 aircraft maintenance licence or its extension.

AMC 66.40 Continued validity of the aircraft maintenance licence

1 The SAR-66 aircraft maintenance licence is only valid if issued and/or amended by the Authority and the holder has signed the document in ink after having checked the correctness of the information contained therein.

2 A licence which has lapsed for less than 24 months will only be renewed for the remaining period up to 24 months from the date of last expiry, but the renewal fee for 24 months is payable.

3 Certifying staff should note that the renewal of a licence which has expired cannot be back-dated and consequently any certifications made in the intervening period would be illegal.

4 A licence which has lapsed for more than 24 months may only be revalidated after the licence holder has sat for and passed the examinations as determined necessary by the Authority, but in any case, as a minimum, the applicant must pass modules M09 (Human Factors) and M10 (Aviation Legislation), and pay up the renewal fees in arrears for the elapsed time. The revalidation will only be for the remainder of the last 2-year renewal cycle.

IEM 66.40 Continued validity of the aircraft maintenance licence

1 Validity of the SAR-66 aircraft maintenance licence is not affected by recency of maintenance experience whereas the validity of the SAR-66.20 privileges is affected by maintenance experience as specified in SAR-66.20 (b).

2 The SAR-145 approved maintenance organisation issues the SAR-145 certification authorisation when satisfied that compliance has been established with the appropriate paragraphs of SAR-145 and SAR-66. In granting the SAR-145 certification authorisation the SAR-145 approved maintenance organisation needs to be satisfied that the person holds a valid SAR-66 aircraft maintenance licence. With regard to continued validity of the SAR-145 certification authorisation, due consideration should be given to the currency of maintenance experience and training in accordance with SAR-145.

AMC 66.45 (a) Type/task training and ratings

1 An individual holding a SAR-66 category A licence is eligible to hold an authorisation for one or more tasks. Specific task training on each aircraft type will be required reflecting the authorised task(s) as indicated under SAR-66.20(a)(1). Satisfactory completion of training may be demonstrated by an examination and/or by workplace assessment carried out by an appropriately approved SAR-145 or CAAS approved training organisation. The certification authorisation cannot be granted by the SAR-145 approved maintenance organisation until the individual has undertaken the required task specific training on the aircraft types that the

licence holder is to be authorised upon and has met the additional requirements of SAR-145.35.

2 The category A task training requires both theoretical and practical training as appropriate to the task to be authorised. The theoretical training may require a degree of classroom training on the relevant aircraft systems for a particular type at ATA104 level 3. The theory training is therefore not dissimilar to that required for the full licensed aircraft engineer type training in the relevant systems, but will not extend to any significant level of defect diagnosis. This reflects the category A certifying staff holding responsibility for making the same certifications as a licensed aircraft engineer would within the limits of the licence and corresponding authorisation. The practical training should be relevant to the task and should allow the category A certifying staff to demonstrate that he or she can carry out the task and the associated function checks to permit the aircraft's release to service.

3 Consider the following examples:

(i) Passenger Seat Belt change – given the simplicity of the task, theoretical training in this case would be straightforward and may be limited to the orientation of the belt and the reasons for it. The practical training would need to establish the competence of the individual to correctly perform the required task. This should include the ability to establish the belt to be fitted is the correct part number (and modification standard), that it is serviceable and shows that he or she can fit it and check its security and operation after fitment.

(ii) Brake Unit change – This task is more complex and would require detailed theoretical knowledge in order to accomplish it. It should be noted however that it is not intended that the category A certifying staff replace brake units other than where there is an obvious leak or the unit is worn to limits (as evidenced by a brake wear indicator). If a technical log or other entry states that the aircraft pulls to the left, although a brake change might rectify the problem the category A certifying staff cannot diagnose this fault. A brake change is normally associated with other maintenance tasks. A wheel has to be removed and refitted. Brake fans may have to be disturbed. Anti-skid systems may have to be disturbed. Hydraulic systems have to be disconnected. There may also be a need to disassemble hydraulic pipeline and electrical cabling runs.

The theoretical training required therefore should cover the scope of the operational systems noted above (those shown are not necessarily exhaustive) to the ATA104 level 3 depth to the point where the category A certifying staff understands the systems and their operation and can check them after he or she has completed the task without further reference to a licensed aircraft engineer. If there is a problem with the operational checks a licensed aircraft engineer must be summoned. The practical training needs to reflect the practical ability and competence to do the job.

4 Tasks should be performed three times or more until competence is established. Where the individual wishes to progress onto a similar task on another aircraft the process must be repeated unless it can be demonstrated that the tasks is in all respects the same to that already held, e.g. a brake unit change on several Airbus models may be the same but it does vary significantly to the same task on an aircraft of Boeing manufacture.

5 When the task training is complete, the individual must also demonstrate an understanding of the organisation's procedures and the paperwork control systems that are in use before being authorised. This should cover those procedures that are both general and type specific as relevant to the task authorisation being issued. The task authorisation when issued should show the individual tasks that are authorised as well as the relevant aircraft types.

AMC 66.45 (d) Type/task training and ratings

1 The training should give adequate detailed theoretical knowledge of the aircraft, its main parts, systems, equipment, interior and applicable components, including training in the systems in use for technical manuals and maintenance procedures. The course should also take into account the following:

(a) in service experience on the aircraft type;

(b) feedback from in-service difficulties/occurrence reporting etc;

(c) significant airworthiness directives and/or service bulletins; and

(d) known human factors issues associated with the particular aircraft type.

2 Limited avionics system training should be included in the category B1 type training as the B1 privileges include the replacement of avionic line replaceable units. Electrical systems should be included in the type training for both categories B1 and B2.

3 Theoretical training should be supported by training aids such as aircraft system components. Ground simulator time, engine ground running and computer based training (CBT) etc may also be utilised.

4 Knowledge is also recommended of relevant inspections and limitations as applicable to the effects of environmental factors such as cold and hot climates, wind, moisture, etc.

5 The practical training must comprise a period of 4 months (minimum of 80 working days) for applicants with no recent recorded previous practical experience of aircraft of comparable construction and systems, including the engines, but this can be reduced to a minimum of 2 weeks for applicant with such previous experience.

6 A programme of structured on-job-training (OJT) may be prepared to satisfy the practical training requirement.

Where the practical training element is conducted by or under the responsibility of the training organisation under a SAR-147 approval or a direct type course approval, it should be considered as part of the approved course and as such, its acceptance by the Authority should be supported by a detailed syllabus showing its content and duration. The individual practical training records should be designed in a manner that they demonstrate compliance with the detailed practical training syllabus. Such records may take the form of an individual training logbook. The logbook should be designed such that tasks may be countersigned by the SAR-147 school or other course provider.

Where the practical training element is conducted by a maintenance organisation approved under SAR-145, under its own responsibility, its acceptance by the Authority should be supported by a detailed syllabus showing its content and duration. The individual practical training records should be designed in a manner that they demonstrate compliance with the detailed practical training syllabus. Alternatively, the practical training element may consist of a structured OJT programme. In this case the maintenance organisation approved under SAR-145 should provide applicants for a type rating a logbook indicating a list of tasks to be performed under supervision. The logbook should be designed such that tasks may be countersigned by the supervisor. The list of tasks should be accepted directly for each individual – depending on the individual's previous experience, or indirectly through the acceptance of a procedure giving delegation to the maintenance organisation.

In all cases the practical element should include an acceptable cross section of maintenance tasks, which, in the case of a structured OJT, can be tailored to accommodate the operating profile of the SAR-145 organisation whilst also supplementing the theoretical course elements. The means by which the practical element is supervised and the control of the standard should be acceptable to the Authority. The duration of the practical type training element should take into account significant differences between types and be acceptable to the Authority. These differences will require considerably more practical training for certifying

staff that are not familiar with the new techniques and technologies. Some examples of differences may include, but are not limited to, the following elements: Fly by wire, glass cockpit avionics, significant structural differences, etc.

7 Before grant of the aircraft type, the applicant should be able to:

(a) demonstrate by knowledge examination a detailed understanding of applicable systems, their operation and maintenance;

(b) ensure safe performance of maintenance, inspections and routine work according to the maintenance manual and other relevant instructions and tasks, as appropriate, for the type of aircraft, for example troubleshooting, repairs, adjustments, replacements, rigging and functional checks such as engine run, etc, if required;

(c) correctly use all technical literature and documentation for the aircraft; and

(d) correctly use specialist/special tooling and test equipment, perform removal and replacement of components and modules unique to type, including any on-wing maintenance activity.

IEM 66.45 (d) Type/task training and ratings

1 The required duration of practical training must be accepted on a case by case basis by the Authority prior to the type rating endorsement. The agreement on the practical training contents and duration should be reached before the training starts.

2 While it is not feasible to establish a formula giving the required training duration in all cases, the following may be used as guidelines:

(a) For a first type training course with no recent recorded maintenance experience, 4 months (minimum of 80 working days) of practical training on specific aircraft type is required.

(b) Some factors that may lead to a reduction in the maximum duration of 4 months practical training required are as follows:

- experience on aircraft type of a similar technology, construction and systems including engines;

- recency on type;

- the quantity of the practical experience. For example experience gained will depend upon the environment e.g. line maintenance environment with one aircraft per week would permit limited experience compared with the constant base maintenance check environment;

- the quality of the practical experience. The type of tasks carried out. These tasks should reflect, at a minimum, those tasks specified by the practical training needs matrix developed by the organisation approved under SAR-147.

3 The minimum 2 weeks practical training is normally required for all type training courses. A proportionate amount of practical training should be included in the case of a differences or bridging type course.

It should be noted however that while AMC 66.45(d) specifies a practical training duration between 2 weeks and 4 months, in the case of a structured OJT performed at line stations, due to the occasional unavailability of aircraft, its duration may need to be extended in order to fulfill the required list of supervised tasks.

4 Except in those cases where the SAR-147 organisation determines the practical training required it is the responsibility of the maintenance organisation to determine that the duration of practical training commensurates with the candidates' experience. In either case the organisation must establish an acceptable system to determine and ensure that the practical training is sufficient in content and duration with respect to a particular target population.

AMC 66.45 (e) Type/task training and ratings

Category C certifying staff may not carry out the duties of category B1 or B2, or equivalent within base maintenance, unless they hold the relevant B1 or B2 category and have passed type training corresponding to the relevant B1 or B2 category.

AMC 66.45 (g) Type/task training and ratings

1 "Aircraft types representative of a group" means that:

- for the B1 category the aircraft type should include typical systems and engines relevant to the group (e.g. retractable undercarriage, pressurisation, variable pitch propeller, etc. for the single piston engine metal subgroup) and,

- for the B2 category the aircraft type should include complex avionics systems such as radio coupled autopilot, EFIS (Electronic flight instrument system), full authority digital engine control (FADEC), flight guidance systems, etc.

2 A "multiple engines" group automatically includes the corresponding "single engine" group.

AMC 66.45 (h) Type/task training and ratings

1 Type experience should cover an acceptable cross section of tasks from Appendix 5 to this SAR-66. For the first aircraft type of each manufacturer group, at least 50% of the Appendix 5 tasks, as applicable to the concerned aircraft type and licence category should be performed. For the second aircraft type of each manufacturer group, this may be reduced to 30%. For subsequent aircraft types of each manufacturer group, this should be reduced to 20%.

2 Type experience should be demonstrated by the submission of records of practical experience showing the SAR-66 Appendix 5 tasks performed by the applicant.

IEM 66.50 Medical fitness

1 Medical opinion considers that alcohol present in the blood stream in any quantity affects the ability to make decisions. It is the responsibility of all certifying staff to ensure that they are not adversely affected.

2 The use of any legally administered drug, or medicines, including those used for the treatment of a disease or disorder, which has been shown to exhibit adverse side effects, which affect the decision making ability of the user, should be administered according to medical advice. No other drugs should be used.

3 Certifying staff are responsible for ensuring that their physical condition does not adversely affect their ability to satisfactorily certify the work for which they are responsible. Eyesight, including colour vision, is particularly important in this respect.

4 In the context of this SAR-66, mental condition means psychological integrity, particularly in operational attitudes or any relevant personality factor.

IEM 66.55 Evidence of qualification

Authorised person means any person who is required to establish that the holder has a valid SAR-66 aircraft maintenance licence including the scope of such licence. Authorised persons include

the SAR-145 approved maintenance organisation for qualifying the holder for issue/amendment of the SAR-145 certification authorisation and any officer of the Authority.

Reasonable time means within 2 working days.

AMC 66.60 Equivalent safety cases

All proposed equivalent safety cases should be submitted to the Authority for consideration as an acceptable case.

IEM 66.65 Revocation, suspension or limitation of the SAR-66 aircraft maintenance licence

The Authority may revoke, suspend or limit a SAR-66 aircraft maintenance licence if the person has knowingly carried out or involved in one or more of the following activities:

1 Obtained the SAR-66 aircraft maintenance licence and/or the SAR-145 certification authorisation by falsification of submitted evidence.

2 Failed to carry out requested maintenance combined with failure to report such fact to the organisation that requested the maintenance.

3 Failed to carry out required maintenance resulting from own inspection combined with failure to report such fact to the organisation for whom the maintenance was intended to be carried out.

4 Negligent maintenance.

5 Falsification of maintenance records.

6 Issuing a certificate of release to service knowing that the maintenance specified on the certificate of release to service has not been carried out or without verifying that such maintenance has been carried out.

7 Carrying out maintenance or issuing a certificate of release to service when adversely affected by alcohol or drugs.

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