CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

Advisory Circular
AC66-2-6

Revision 3

10 March 2015

Aircraft Maintenance Engineer Licence—Examination Subject 6 Rotorcraft

General

Civil Aviation authority advisory circulars contain information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rule.

An acceptable means of compliance is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate advisory circular.

An advisory circular may also include **guidance material** to facilitate compliance with the rule requirements. Guidance material must not be regarded as an acceptable means of compliance.

This advisory circular is intended to be read with Part 66 Subpart B of the rule. If there are any conflicts between the advisory circular and the rule, the rule takes precedence.

Purpose

This advisory circular provides acceptable means of compliance for the syllabus content in respect of written examinations for Subject 6 (Rotorcraft).

This advisory circular also provides guidance material for recommended study material in respect of the examination syllabus in this advisory circular.

Related Rules

This advisory circular relates specifically to Civil Aviation Rule Part 66 Subpart B—'Aircraft Maintenance Engineer Licence'.

Change Notice

Revision 3 makes the following changes:

(a) updates the web address for Aviation Services Limited (ASL)

(b) deletes reference to an AME sample question booklet being available for purchase from ASL

(c) removes reference to examination length and number of questions.

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Rule 66.53 Eligibility Requirements

Rule 66.53(a)(2) requires an applicant for an AMEL to have passed written examinations, that are acceptable to the Director, relevant to the duties and responsibilities of an aircraft maintenance engineer in the category of licence sought.

The written examinations acceptable to the Director for Subject 6 (Rotorcraft) should comply with the syllabus contained in this advisory circular. Each examination will cover all topics and may sample any of the sub-topics.

The new syllabus has been developed after extensive industry consultation and the objectives reflect the knowledge required of current technology and international best work practice.

Examination Overview: Subject 6

The pass mark for Subject 6 (Rotorcraft) is 70%.

Application to sit an examination may be made directly to Aviation Services Limited (ASL). Refer to http://caanz.aspeqexams.com for examination information.

General Examining Objective

The objective of the examination is to determine that the applicant for an AMEL has adequate knowledge of Subject 6 to permit the proper performance, supervision and certification of aircraft maintenance at a level commensurate with the privileges of the various AMEL categories.

Knowledge Levels

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

Objectives: The applicant should:

1. be familiar with the basic elements of the subject.
2. be able to give simple descriptions of the whole subject, using common words and examples.
3. be able to use typical terms.

LEVEL 2: A general knowledge of the theoretical and practical aspects of the subject.

An ability to apply the knowledge.

Objectives: The applicant should:

1. be able to understand the theoretical fundamentals of the subject.
2. be able to give a general description of the subject using, as appropriate, typical examples.
3. be able to use mathematical formulae in conjunction with physical laws describing the subject.
4. be able to read and understand sketches, drawings and schematics describing the subject.
5. be able to apply his/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:

1. know the theory of the subject and the interrelationships with other subjects.
2. be able to give a detailed description of the subject using theoretical fundamentals and specific examples.
3. understand and be able to use mathematical formulae related to the subject.
4. be able to read, understand and prepare sketches, simple drawings and schematics describing the subject.
5. be able to apply his/her knowledge in a practical manner using manufacturer's instructions.
6. be able to interpret results and measurements from various sources and apply corrective action where appropriate.

Recommended Study Material

The publication list below provides guidance material for suitable study references for the overall syllabus content. However, applicants may have to conduct further research using other references or sources (including the internet) or attend a formal course in order to gain a comprehensive understanding of all sub-topics in the syllabus.

Where applicable, publication references have been placed below each main topic or sub topic heading in this syllabus.

Publication List

Study Ref	Book Title	Author	ISBN
1	Helicopter Maintenance	Jeppesen	0-89100-281-2
2	Principles of Helicopter Flight	WJ Wagtendonk	1-56027-217-1
3	A&P Technician Airframe Textbook	Jeppesen	0-88487-331-5
4	Aviation Maintenance Technicians Series, Airframe - Volumes 1 Structures & 2 Systems	Dale Crane	1-56027-339-9 1-56027-340-2
5	A & P Technician General Textbook	Jeppesen	0-88487-203-3
6	Dictionary of Aeronautical Terms	Dale Crane	1-56027-287-2

Syllabus Layout

Topic Numbering – left hand column

The syllabus is set out by topics, each of which is identified by a single-digit number. Each topic is divided into a number of sub-topics, which are identified by two-digit numbers: the first and second digits of which refer to the topic and the sub-topic respectively.

Each sub-topic is further sub-divided into one or more sub-sub-topics, which are identified by three-digit numbers. Where applicable, sub-sub-topics may be further subdivided into paragraphs that are identified by four/five digit alphanumeric sequences.

The three-digit sub-sub-topic numbers shown in the left hand column are used in the 'knowledge deficiency reports' to provide feedback on individual examinations.

Objective description – middle column

The middle column objectively describes each sub-sub-topic by stating, in plain language, its subject matter and the type of performance or activity required. The objectives are intended to be simple, unambiguous, and clearly-focussed, outcomes to aid learning.

Knowledge levels – right hand column

The right hand column specifies the knowledge level for each sub-topic heading. The three levels of knowledge used in this syllabus are described above. Note that the knowledge levels indicate the depth of knowledge required NOT its safety importance.

Syllabus: Subject 6 (Rotorcraft)

1	**Theory of Flight**	
1.1	**Airflow** *Study Ref. 1& 2*	
1.1.1	Describe airflow in relation to a body at rest or in motion.	1
1.1.2	Define and describe the following terms as they relate to the aerodynamics of a rotorcraft: a. Airflow over an aerofoil b. Free stream flow c. Laminar and turbulent flow d. Relative airflow e. Stagnation f. Up-wash and down-wash g. Dynamic energy h. Pressure energy	1
1.2	**Aerodynamic Principles** *Study Ref. 1 & 2*	
1.2.1	Define the following terms and specify how each relates to the performance of a rotorcraft. Describe how a change in one factor may affect other factors: a. Aerofoil cross section b. Angle of attack and the pressure distribution around an airfoil c. Aspect ratio d. Autorotation e. Axis of rotation or shaft axis f. Blade area g. Blade lift distribution and loading h. Blade span i. Blade tip stall j. Blade twist k. Camber l. Centre of gravity m. Centre of pressure n. Centrifugal force o. Chord (line) p. Collective pitch q. Coning angle r. Coriolis effect s. Cyclic pitch t. Control of a rotorcraft about the various axis including lateral, longitudinal and vertical u. Disc loading v. Dissymmetry of lift w. Down-wash x. Drag y. Feathering z. Feather axis	1

1.2.2	Define the following terms and specify how each relates to the performance of a rotorcraft. Describe how a change in one factor may affect other factors. a. Flapping b. Forces limiting main rotor RPM c. Ground effect d. Ground resonance e. Gyroscopic precession f. High-inertia blades g. Inflow h. Jack stall (Hydraulic) i. Laminar boundary layer j. Lead-lagging or dragging k. Lift and lift coefficient l. Lift thrust vector resultant m. Node n. Phase lag o. Pitch angle (blade angle) p. Profile/parasite drag q. Retreating blade stall r. Rolling tendency s. Rotorcraft Axis t. Rotor disc u. Rotor thrust v. Rotor drag w. Seesaw system x. Skin friction y. Solidity z. Symmetrical aerofoil shape	1
1.2.3	Define the following terms and describe how each relates to the performance of a rotorcraft. Describe how a change in one factor may affect other factors: a. Stability and control b. Static stability c. Stresses on a rotor blade d. Tail rotor flapping e. Taper f. Tip path plane g. Tip vortices h. Total reaction i. Transition point j. Translating tendency (tail rotor drift) k. Under-slung rotor l. Vortex ring m. Wash-out	1
1.2.4	Define the following terms and relate them to rotorcraft operation: a. Ground speed (GS) b. True air speed (TAS) c. Indicated air speed (IAS) d. VNE	1
1.2.5	Describe the relationship between lift, weight, thrust and drag in respect of a rotorcraft in flight.	2
1.2.6	Describe vortex ring state (settling with power), over-pitching, the relationship of each and how appropriate compensation is made in the control system, or by pilot input.	2
1.2.7	Explain torque reaction and describe its effect on directional control of a rotorcraft.	2

1.2.8	Specify how the effects of gyroscopic precession are used in the control of the main rotor disc to provide forward, sideways and rearward flight.	2
1.2.9	Explain the design feature in a rotor system that is used to control dissymmetry of lift.	2
1.2.10	Describe how the Coriolis effect impacts on main rotor operation.	2
1.2.11	Identify the design features (lead/lag hinges and under-slung rotor) that are used to relieve stresses created by Coriolis effect, and describe how these features achieve that result.	2
1.2.12	Describe the relationship between ground effect and translational lift.	1
1.2.13	Specify the methods of correcting tail rotor drift (translating tendency).	2
1.2.14	Describe how lift dissymmetry is compensated for in a tail rotor system.	2
1.2.15	State the reason why main rotor blades have built in twist.	2
1.2.16	State why blade tip stall results in a nose pitch up of the rotorcraft.	1
1.2.17	Describe the aerodynamic principles of autorotation and how autorotation RPM is adjusted in service.	1
1.2.18	Describe autorotation height limits and define what is meant by the term “dead man’s curve”.	1
1.2.19	Detail the factors that affect auto rotational RPM.	3
1.2.20	Describe the areas of the disc that provide rotor drive and rotor drag during autorotation.	1
1.2.21	Specify how the control of a tandem rotor system is affected in all axis of flight.	1
1.2.22	Describe how engine and rotor RPM are determined and give the cockpit indications of when both systems operating together.	2
1.2.23	Give reasons for both of the above systems not operating together throughout the spectrum of helicopter operation.	2
1.3	**Stability**	
	Study Ref.1 & 2	
1.3.1	Specify why most rotorcraft are considered to be statically stable and dynamically unstable.	2
1.3.2	Describe what is meant by the terms “stick-fixed” and “stick-free” stability.	2
1.3.3	Describe how the following design methods help overcome the inherent dynamic instability of a rotorcraft. Delta three hinges Offset flapping hinges Stabiliser bar	2
1.3.4	State the causes of ground resonance and what corrective maintenance action is necessary to prevent or rectify its happening.	2
1.3.5	Specify the purpose and operation of fixed and adjustable horizontal stabilisers (synchronised elevators).	1

2	Rotorcraft Structure	
	ATA 32,51,52, 53	
2.1	**Configurations of Rotary Wing Aircraft** *Study Ref. 1*	
2.1.1	Outline the basic differences between the following types of rotary wing rotorcraft, why each is different and the advantages and disadvantages of each: a. Autogyro b. Dual-rotor (tandem rotor) c. Single-rotor	1
2.2	**General Structural Concepts** *Study Ref. 1*	
2.2.1	Define the following terms and relate them to rotorcraft metal structure: a. Beam b. Bending c. Compression d. Fatigue e. Stress riser f. Hoop stresses g. Shear h. Strain i. Stress j. Strut k. Tension l. Tie m. Torsion	1
2.2.2	Identify structural defects that may occur in a rotorcraft when subject to the above forces. Describe the source of each force.	2
2.2.3	Define and give examples of primary, secondary and tertiary structure in a helicopter.	2
2.2.4	Define the concept of damage tolerance.	1
2.2.5	Identify airworthiness requirements for structural strength.	2
2.2.6	Describe typical information found in structural repair manuals.	2
2.2.7	Describe the installation requirements and replacement criteria for critically loaded bolts.	2
2.2.8	Specify methods of structural reinforcement including the design of simple repair schemes or modifications to restore or enhance original strength.	2
2.2.9	State how and why residual stresses are removed from structure after the replacement of a structural component.	2
2.2.10	Describe common structural assembly and disassembly techniques and processes.	2

2.3	**Structural Design Concepts** *Study Ref. 1*	
2.3.1	Specify the following methods of fuselage design and construction: a. Monocoque b. Semi monocoque c. Tubular steel	2
2.3.2	Describe the general constructional features of each of these types of structure and identify load-carrying members.	2
2.3.3	Identify structural assemblies likely to be fabricated from the following materials and compare the advantages and disadvantages of each: a. Tubular steel b. Sheet metal c. Glass reinforced plastic d. Bonded honeycomb including metal honeycomb	2
2.3.4	Identify load paths through structural components and specify likely defects resulting from excessive rotor vibration levels.	2
2.3.5	Specify how structural assemblies are inspected for damage resulting from the following: a. Corrosion b. Abnormal flight occurrences c. Operations in adverse conditions d. Vibration e. Mercury spills f. Acid spills	2
2.3.6	Describe the characteristics, cause and rectification of common rivet defects found in rotorcraft structure.	2

2.4	**Structural Components** *Study Ref. 1*	
2.4.1	Describe general construction, function, attachment and maintenance relating to the following airframe assemblies as appropriate to various rotorcraft types: a. Cabin b. Bubble canopy c. Forward section d. Floor pans e. Stressed skin fuselage f. Formers g. Stringers h. Longerons i. Bulkheads j. Frames k. Doublers l. Struts m. Ties n. Centre beams o. Centre section p. Rear section q. Tail boom r. Pressurised tail booms s. Synchronised elevator or horizontal stabiliser t. Upper and lower vertical fin or vertical stabiliser u. Transmission pylon v. Transmission mounts w. Gearbox mounts x. Engine platform y. Engine mounts z. Lift beams aa. Doors bb. Door operating mechanisms cc. Door safety devices dd. Engine nacelles ee. Engine firewalls ff. Floors gg. Fairings hh. Drains and vents ii. Undercarriage attachments jj. Seats, seat rails and seat operating/locking mechanisms kk. Isolation of dissimilar metal components or materials ll. Weighted steel blades used as a fuselage anti-vibration device mm. Winches, cables, supports, lifting hooks and hard points nn. Floatation devices with both explosive and mechanical activation	2
2.4.2	Define the terms as they relate to rotorcraft structures and give examples of the following: a. Approved data b. Major repair c. Major modification	2
2.4.3	Describe zonal and station identification systems.	2
2.4.4	Define fail safe, safe life and damage tolerance concepts.	2
2.4.5	Describe how delamination of honeycomb materials is detected in service.	2

2.4.6	Describe typical repair techniques and procedures for bonded metal honeycomb structures including corrosion proofing of repair sections.	1
2.4.7	Specify how water contamination of the honeycomb structure may be detected and eliminated.	2
2.4.8	State how repair areas on fibreglass components may be cleaned.	1
2.4.9	Outline typical information contained in a structural repair manual for a helicopter.	1
2.4.10	Describe symmetry checks that would be carried out on fuselage and tail boom structure.	2
2.5	**Landing Gear** *Study Ref. 1*	
2.5.1	Describe the construction, operation and maintenance requirements of the following landing gear components: a. Skids b. Oleos or shock struts c. Floats d. Wheels e. Tyres f. Tubes g. Ground handling wheels	2
2.5.2	Detail landing gear construction and shock absorbing.	3
2.5.3	Detail the construction, operation and maintenance of landing gear extension and retraction systems (normal and emergency).	3
2.5.4	Detail the construction, operation and maintenance requirements of landing gear indication and warning systems.	3
2.5.5	Detail the construction, operation and maintenance requirements of landing gear brakes, wheels and tyres.	3
2.5.6	Determine common landing gear defects/damage and rectification actions particularly associated with a heavy landing.	3

3	Rotorcraft Systems	
	ATA 62,64,65,66	
3.1	**Main Rotor Head Types**	
	Study Ref. 1	
3.1.1	Describe the advantages, special features and characteristics of the following types of main rotor head: a. Fully articulated b. Semi-rigid c. Rigid	2
3.1.2	Detail the physical features of the various main rotor head designs and be able to state which features accommodate the flapping, feathering, leading and lagging actions of the main rotor blade.	3
3.2	**Common Main Rotor Head Components**	
	Study Ref. 1	
3.2.1	Describe the location and state the function of the following components that may be found in common types of rotor head: a. Counterweight assembly b. Pendulums or dynamic counterweights c. Drag brace d. Pillow block e. Equaliser link f. Equaliser beam g. Pitch horn h. Blade grip i. Yoke j. Gimbal ring k. Trunnion l. Reservoir m. Static stop n. Blade bolt o. Latch bolt p. Flap restraint q. Flapping hinge r. Dampener s. Droop restraint t. Droop stop u. Pendulum v. Lead lag link w. Feathering hinge x. Strap pack (tension torsion strap) y. Scissors z. Elastomeric flange (frequency damper) aa. Oscillating bearing bb. Elastomeric bearings cc. Control rotor dd. Starflex ee. Frequency adaptor	2
3.2.2	Detail the construction and operation of main rotor head dampeners.	3
3.2.3	Detail the mounting, inspection and maintenance of main rotor heads.	3
3.2.4	Explain how main rotor heads are lubricated.	3

3.2.5	Detail the construction, operation and application of elastomeric bearings in main rotor heads.	3
3.3	**Main Rotor Blades**	
	Study Ref. 1	
3.3.1	Describe the following main rotor blade features, construction methods and components: a. Types of materials used in blade construction including metal, wood and composites b. Blade spars c. Use of honeycomb material d. Nose block e. Grip plate f. Doublers g. Skins h. Drag plates i. Tabs j. Alignment pins k. Abrasion strips l. Box beam m. Box beam doublers n. Blade crack indicator systems o. Balance weights p. Tip caps q. Interchangeability of blades r. Blade attachment systems	2
3.3.2	Detail typical main rotor blade maintenance procedures and diagnose common defects associated with main rotor blades. Determine how these defects may be identified in service and rectified.	3
3.4	**Blade Tracking, Balancing and Rotorcraft Vibration Analysis**	
	Study Ref. 1	
3.4.1	Detail the various methods of tracking main and tail rotor blades and state when tracking should be carried out and adjustments that could be made.	3
3.4.2	Detail the various methods of balancing main rotor systems both statically and dynamically.	3
3.4.3	Determine how and when to carry out hub/main rotor blade alignment checks and/or adjustment on semi-rigid rotor heads.	3
3.4.4	Detail the limitations on main rotor blade sweeping and trim tab bending.	3
3.4.5	State the maintenance requirements of the various types of main rotor head damper.	2
3.4.6	State the effects of either too high or too low autorotation RPM.	2
3.4.7	From given information, derive and determine necessary autorotation RPM corrections.	3
3.4.8	Detail the types of vibration experienced in rotorcraft; determine their probable cause and what maintenance action is required to reduce the level of the vibration.	3
3.4.9	Detail ground resonance, determine its cause and what corrective maintenance is necessary should resonance occur.	3
3.4.10	Describe the damper alignment checks required on multi-bladed rotor systems fitted with elastomeric dampers and state the maintenance requirements of the various types of damper.	2

3.4.11	Describe the various methods used to dampen vibration.	2
3.4.12	Identify and explain electronic (strobe) and hand held rotor tracking equipment.	3
3.5	**Rotor System Maintenance and Inspection** *Study Ref. 1*	
3.5.1	Detail the following main rotor system maintenance activities: a. Blade cleaning and waxing b. Doubler delamination check c. Removing and refitting rotor heads including torquing procedures. d. Hoisting a rotor head e. Blade removal and replacement f. Tab bending g. Checking and lubricating bearings h. Stabiliser bar damper maintenance including damper timing	3
3.5.2	Specify the effects of stabiliser bar damper timing on rotorcraft control.	2
3.5.3	Describe the methods of main rotor droop compensation.	2
3.6	**Tail Rotor Systems** *Study Ref. 1*	
3.6.1	Detail a typical tail rotor assembly with regard to the following: a. Blade construction methods for metal and composite blades. b. Strike indication devices c. Pitch change mechanism d. Cross head e. Pitch change horn f. Yoke g. Balance weights h. Stops i. Pitch links j. Delta hinge k. Feathering action l. Blade attachment systems m. Tail rotor mounting n. Maintenance and inspection of tail rotor blades	3
3.6.2	Describe the construction and operating capabilities of ducted and Enstrom tail rotors systems.	2
3.6.3	Describe the construction and principles of operation of ducted fan rotor anti-torque systems.	2
3.6.4	Specify how anti-torque control is achieved by aerodynamic means.	2
3.6.5	Describe tail rotor balancing procedures and the placement of balance weights.	2
3.6.6	Describe the following factors: a. Tail rotor drift b. Tail rotor roll	2
3.6.7	Detail the identification and rectification of tail rotor system defect including the following: a. Vibrations b. Tail rotor strike c. Pedal binding d. Lack of tail rotor authority	3

3.6.8	Distinguish between low, medium and high frequency vibrations on a helicopter stating their likely source, frequency bands, detection methods and probable rectification.	3
3.6.9	State causes of variations in tail rotor pedal forces during rotorcraft operation.	2

4	**Flight Control Systems**	
	ATA 67	
4.1	**Mechanical Control System Components**	
	Study Ref. 1	
4.1.1	Detail the following components, their function, and where applicable, adjustment procedures: a. Push-pull tubes and their end fittings b. Bellcranks c. Levers d. Torque arms and torque tubes e. Primary and secondary control stops in both the cockpit and control surface f. Mixer boxes g. Force gradients h. Friction devices i. Magnetic brakes j. Trim units k. Bungee springs l. Universal joints m. Quadrants n. Components/switches on a typical collective and cyclic lever	3
4.2	**Cable Control System Components**	
	Study Ref. 1	
4.2.1	Detail the following components, their construction, function, identification, inspection and maintenance including wear limits: a. Automatic cable tensioning devices b. Cables c. Cable fittings d. Cable guards e. Fairleads and guides f. Pulleys	3
4.2.2	State acceptable cable deflection limits for fairleads.	2
4.2.3	Determine limitations on the fitment of new cables to used fibre type pulleys.	3
4.3	**Control Chains**	
4.3.1	Describe the applications, constructional features, and dimensional terms with respect to control chains, including silent chains.	2
4.3.2	State the physical features of chain installations that provide correct running in endless and terminating chains, protection against incorrect assembly, and jamming on sprocket teeth.	2
4.3.3	Detail the methods used to assess wear and distortion of chains and sprockets. Determine how elongation of chains is assessed. Explain the corrosion protection and storage requirements of chains.	3

4.4	**Swashplate Assemblies** *Study Ref. 1*	
4.4.1	Describe the construction and principles of operation for a typical swashplate assembly with particular regard to the following: a. Movement with corresponding control inputs b. Relationship of control inputs to control outputs c. Stationary and rotating members d. Swashplate support e. Collective sleeve f. Inner ring g. Outer ring h. Uniball i. Drive links j. Collective lever k. Bearings l. Control plate	2
4.4.2	Determine the control inputs for a swashplate assembly and explain how such inputs affect the tip path plane of the main rotor	3
4.5	**Rotorcraft Control System Layout** *Study Ref. 1*	
4.5.1	Detail the layout of a typical mechanical and hydraulic power assisted flight control system including collective, cyclic and tail rotor controls.	3
4.5.2	Determine the operation and functions of a cyclic control system.	3
4.5.3	Detail the layout and locations of components from the cyclic stick to the pitch change rod inclusive.	3
4.5.4	Determine the operation and functions of a collective control system.	3
4.5.5	Detail the layout and locations of components from the collective stick to the pitch change rod inclusive.	3
4.5.6	Determine methods of main rotor RPM compensation applicable to the collective control.	3
4.5.7	Determine the operation and functions of a tail rotor control system.	3
4.5.8	Detail the layout and locations of components of a tail rotor control system	3
4.6	**Main Rotor Control System Rigging** *Study Ref. 1*	
4.6.1	Detail procedures for rigging a typical main rotor control system for freedom of operation, correct range of movement, throttle-collective correlation, synchronised elevator operation, and friction adjustment.	3
4.6.2	Describe the effects of “play” in a main rotor control system and how play is commonly assessed and rectified.	2
4.7	**Tail Rotor Control System Rigging** *Study Ref. 1*	
4.7.1	Detail procedures for rigging a tail rotor control system including pedal travel and alignment, T/R range of movement, cable tension, control chain twist and sprocket engagement and rod or tube adjustment.	3

4.8	**General Maintenance Requirements** *Study Ref. 1*	
4.8.1	Identify defects in control cables and control rod assemblies including bearings.	2
4.8.2	Identify standards for control rod/cable clearances between fluid lines, electrical wiring and rotorcraft structure/hardware.	1
4.8.3	Identify limits for the use of fairleads, cable guides, cable drums, pulleys and bellcranks.	1
4.8.4	Describe the inspection and maintenance requirements, including corrosion and wear limits, for the following components: a. Cables b. Cable fittings c. Cable guards d. Fairleads e. Pulleys	2
4.8.5	State the number of threads permitted to be showing on a correctly assembled pushrod or control linkage.	2

5	**Hydraulics**	
	ATA 29	
5.1	**General Hydraulic System Layout**	
	Study Ref. 1, 3 & 4	
5.1.1	Detail the constructional features and explain the principle of operation of a typical rotorcraft hydraulic system including an open-centre type system.	3
5.1.2	Detail the layout of a dual hydraulic system; explain how it varies from a single system and how the hydraulic pumps on a multi engine helicopter would be connected into the system.	3
5.1.3	Identify flight controls that would typically be power assisted.	2
5.2	**Hydraulic System Components**	
	Study Ref. 1, 3 & 4	
5.2.1	Detail the relationship between the following components; explain their construction, determine their location and evaluate their function in a basic hydraulic power supply system: a. Accumulators b. Solenoid valve c. Selector valves d. Pressure regulator valve e. Filters, micronic filters and filter maintenance f. Filter clogging indicators g. Check valves including orifice check valves h. Pressure transmitter and switch i. Temperature bulb and switch j. Restrictor fittings k. Quick disconnect sockets l. Gear, gerotor and axial piston pumps m. Reservoirs and associated components n. Location of a reservoir in a system o. Irreversible valves p. Test couplings	3
5.3	**Servo Actuator Units**	
	Study Ref. 1, 3 & 4	
5.3.1	Describe the primary purpose of a hydraulic actuator in a flight control system.	2
5.3.2	Distinguish the differences between powered and power assisted flight controls.	3
5.3.3	Describe the construction, location of components and principles of operation of a typical Bell servo unit.	2
5.3.4	Specify how the feedback of rotor forces is prevented in a servo unit.	2
5.3.5	Identify the principles of operation of a dual type actuator unit.	1
5.3.6	Describe hydraulic lockage.	2
5.3.7	Describe bypass and distributor seizing systems.	2
5.3.8	Describe rotor load warning systems.	2

5.4	**Hydraulic Fluids and Seals** *Study Ref. 1, 3 & 4*	
5.4.1	Detail the generic requirements, composition, characteristics, colour code, precautions, seal compatibility and MIL specification for hydraulic fluid normally used in rotorcraft.	3
5.4.2	Describe the colour code of O-rings used with the common types of hydraulic fluid used in rotorcraft.	2
5.4.3	State the purpose of backup O-rings in a hydraulic system.	2
5.4.4	Specify how a leaking hydraulic pump shaft seal would be identified and rectified.	1
5.5	**Hydraulic Lines and Fittings** *Study Ref. 1, 3 & 4*	
5.5.1	Identify flexible hoses to determine pressure range, material of construction, and fluid compatibility. Explain what information is printed on hoses.	3
5.5.2	Identify by name and state the uses of tube and hose end fittings and their component parts.	2
5.5.3	Detail the procedures, equipment used and precautions to be observed when fabricating rigid and flexible fluid lines for use in rotorcraft including the tightening of flareless fittings.	3
5.5.4	Identify hydraulic system fittings and attaching parts by name, and state their uses in the system.	2
5.5.5	Detail installation and serviceability checks on rigid and flexible fluid lines.	3
5.5.6	Describe flexible hose maximum life requirements.	2
5.5.7	Specify how flexible hose length is measured and how twist is identified and prevented during installation.	2
5.5.8	Describe general system maintenance practices including flushing after contamination and checking a rigid pipe for internal obstruction or loss of concentricity.	1
5.5.9	Detail how hydraulic systems are commonly bled using auxiliary power or during ground running.	3
5.5.10	Evaluate the effects on helicopter controllability of a hydraulic system failure.	3
5.5.11	Describe the differences and requirements of sealed and vented hydraulic systems.	2

6	**Power Train Components**	
	ATA 63	
6.1	**Main Transmission and Drives**	
	Study Ref. 1	
6.1.1	Describe the construction, functions, component location, principle of operation inspection and maintenance of a typical main rotor transmission system with particular regard to the following: a. Reduction gear design including planetary gear systems b. Speed ratios c. Speed reduction and torque increase d. Drive quills for components and accessories e. Typical bearing types and arrangements in drive quills f. Backlash, gear mesh and wear patterns on drive quills g. Gear box castings h. Bearing types and arrangements i. Safety devices j. Lubrication and loads including common types of oil used k. Transmission oil cooler location in the lubrication system l. Filters and clogging warning devices m. Chip detectors and magnetic plugs n. Oil seals o. Identification of wear debris found in filters and on magnetic plugs p. Transmission mounts and, friction dampers q. Various mounting methods including the nodal beam mounting system r. Isolation mounts s. Main rotor system vertical alignment and adjustment t. Adaptor plates u. Engine mounts v. Clutches including centrifugal type w. The transmission drive effects of a free turbine engine x. Belts and belt drive mechanisms y. Engine to transmission input shafts z. Shaft lubrication aa. Shaft alignment bb. Shaft cooling cc. Shaft temperature sensing devices dd. Free wheel units including the sprag clutch ee. Rotor brakes ff. Main rotor masts or drive shafts and associated spline arrangements gg. Main rotor retention devices hh. Torque meters ii. Drive train servicing requirements jj. Drive train troubleshooting and rectification kk. General inspection requirements for a main rotor mast ll. Engine to transmission alignment. mm. Purpose of drive train offset to main rotor gearbox centre line input.	2

6.2	**Tail Rotor Drive Systems** *Study Ref. 1*	
6.2.1	Describe the construction, mounting, principles of operation and maintenance of the following tail rotor drive system assemblies: a. Drive shaft segments including balancing and alignment b. Shaft support assemblies including bearings c. Installation and alignment of a Hooke's joint d. Intermediate gearboxes including lubrication, filler and breather arrangements e. Universal joints and flexible couplings f. Extension shafts g. 90 degree gearbox including lubrication, filler and breather arrangements h. Magnetic plugs and chip detectors i. Drive shaft balancing j. Drive shaft alignment k. Tail rotor drive power source	2

7	**Fuel Systems**	
	ATA 28	
7.1	**Aviation Fuels**	
	Study Ref. 1	
7.1.1	Describe the following: a. Types and applications of aviation fuels b. Fuel colour coding c. Fuel storage d. Common causes of fuel contamination e. Quality control of fuel including water testing procedures, proprietary test products and test equipment f. Storage life and fuel deterioration g. Fuel dispensers including hydrants, bowsers and hand pumps h. Refuelling procedures including electrostatic bonding i. Reuse of drained or decanted fuel j. Disposal of fuel k. Drum refuelling precautions l. Fuel compatibility with seals m. Common sources of fuel system contamination n. Preventing/ rectifying fuel system contamination o. Fuel dispenser filtration devices including chamois filters	2
7.2	**Fuel System Components**	
	Study Ref. 1	
7.2.1	Describe the construction, operation, function, inspection and maintenance of the following rotorcraft fuel system components: a. Filters b. Primers c. Pumps (auxiliary/booster/ejector/jet) d. Centrifugal type booster bumps and when fuel booster pumps are normally used in flight e. Strainers f. Tanks (rigid, flexible, bladder, integral) fuel and associated hardware g. Crashworthy systems h. Valves and cocks i. Baffles j. Fuel pipes and hose assemblies k. Drains, sumps, vents and stack pipes l. Airspace interconnection on multiple tanks m. Flow meters n. Contents indicating systems including mechanical, electric and capacitance types o. Cross feed and transfer devices p. Refuelling and defuelling systems	2
7.2.2	Specify how the effects of altitude are compensated for in a vane type fuel pump.	1
7.2.3	Describe the operation of a jet pump in a rotorcraft's fuel tank system.	2
7.2.4	Describe the reasons a jet pump is used in lieu of an electrical or mechanical driven pump.	1
7.2.5	State how fuel pressure is regulated on common types of fuel booster pump.	1
7.2.6	State the units of fuel contents measurement generally associated with the different types of indicating system.	2

7.2.7	Specify why kilograms, instead of litres, are preferred for certain types of rotorcraft.	1
7.2.8	Describe the general principles associated with positioning fuel tanks on rotorcraft.	1
7.3	**Fuel System Layout** *Study Ref. 1*	
7.3.1	From given information, derive the location and determine the relationship of basic fuel system components for a typical fuel system supplying piston and gas turbine engined rotorcraft, including the electrical and instrument interface.	3
7.4	**Fuel System Maintenance** *Study Ref. 1*	
7.4.1	Describe the following maintenance activities: a. Fuel flow checks b. Fuel transfer checks c. Fuel system and dip stick calibration d. Fuel system decontamination e. Fuel tank/system leak testing and sealing f. Prevention of vapour locks g. Physical separation and securing of fuel lines and electrical cables	2
7.4.2	From given information, specify the effect of faults in fuel supply system components on engine operation.	2

8	Rotorcraft Weight and Balance	
	ATA 8	
8.1	**Theory of Weight and Balance Control**	
	Study Ref. 5	
8.1.1	Describe the meaning and application of the following weight and balance terms: a. Centre of gravity (CG) b. Rotorcraft weight c. Theory of weight and balance d. Weight limitations e. Maximum gross weight check f. CG design limits g. Rotorcraft loading aspects h. Rotorcraft operating weight i. Empty weight CG range j. Useful load k. Arm l. Datum/reference datum m. Moments and total moment n. Rotorcraft weighing configuration o. Weighing points p. Minimum fuel q. Zero fuel weight r. Unusable fuel and oil s. Ballast placement. t. Shifting weight u. Adverse-loaded CG v. Forward/rearward adverse-loading check w. Ramp weight x. Tare weight y. Fluid levels z. Installed equipment	2
8.2	**Weighing Procedures**	
	Study Ref. 5 & AC 43-2	
8.2.1	Specify the Rules requirements for rotorcraft weight and balance control.	2
8.2.2	Detail the following weight and balance principles, practices and procedures: a. Need for reweighing b. Rotorcraft weighing procedure c. Computation of fore and aft and lateral C of G limits d. Compilation of weight and balance records e. Ballast calculations using formula f. Maintenance of weighing scales and associated equipment including load cells g. Calculation of empty weight changes	3
8.2.3	Detail how to correctly complete, and state the information contained on, rotorcraft weight and balance control forms CAA 2102 and CAA 2173.	3

9	Environmental Systems, Equipment and Furnishings	
	ATA 21, 25, 30	
9.1	**Emergency and Role Equipment** *Study Ref. 1, AC43-6 & AC43-11*	
9.1.1	Specify the principles of operation, precautions, installation and maintenance/servicing requirements of the following equipment and furnishings: a. Life jackets b. Life rafts c. First aid kits and crash axes d. Emergency floatation equipment e. Portable fire extinguishers f. Emergency Locator transmitters g. Cargo handling and retention devices h. Seats, seatbelts, harnesses i. Fire extinguisher systems j. Fire and smoke detection warning systems k. Explosive devices and pyrotechnics l. Floats, panniers and stretchers m. Search lights n. Rescue hoists o. Cargo hooks p. Fire lighters q. Agricultural dispensing equipment r. Cameras	2
9.1.2	Describe typical ice and rain protection systems found on helicopters with regard to the following: a. Ice formation, classification and detection b. Anti-icing and de-icing systems; electrical, hot air and chemical c. Rain repellent and removal d. Probe and drain heating	2
9.2	**Air-conditioning and Heating** *Study Ref 1*	
9.2.1	Describe a typical air-conditioning system fitted to a rotorcraft with particular regard to the following: a. Distribution systems b. Sources of air supply c. Flow and temperature control d. Protection and warning devices e. Combustion heaters f. Bleed air heaters	2

10	Rotorcraft Servicing, Testing and Ground Handling	
	ATA 5, 7, 8	
10.1	**Ground Operations**	
	Study Ref. 1	
10.1.1	Describe the maintenance and operation of the following ground equipment: a. Maintenance and operation of lifting equipment b. Servicing stands and access equipment c. Auxiliary batteries d. Hydraulic test rigs e. Testing of specialist tools and gauges f. Ground handling wheels, towing arms and bridles	1
10.1.2	Specify the general safety precautions and requirements associated with engine starting, ground running, ground manoeuvring, towing, chocking and “tying down” a rotorcraft.	2
10.1.3	Describe rotor tie down methods.	2
10.1.4	State the requirements in respect of parking and protecting a rotorcraft for short and extended periods.	2
10.1.5	Identify the danger zones of a rotorcraft when rotors are turning.	2
10.1.6	Describe the constructional requirements and operational considerations when preparing a landing pad for a helicopter.	2
10.1.7	Describe special precautions applicable to personnel when engaging in under-slung load operations.	2
10.1.8	Illustrate internationally recognised helicopter marshalling signals.	2
10.1.9	Identify the danger zones around a helicopter during ground operations on level and sloping ground and specify ground access techniques when rotors are turning.	2
10.1.10	Specify the accepted cleaning methods for bubble canopies and other transparent plastic components.	2
10.2	**Rotorcraft Inspection**	
	Study Ref. 1	
10.2.1	Describe the various servicings performed on rotorcraft and define associated terms.	2
10.2.2	State the scope of pilot maintenance.	1
10.2.3	Describe lifing of components and mandatory replacement requirements.	2
10.2.4	Identify the need for scheduled and non-scheduled servicing including where component lives would normally be located.	2

10.2.5	Describe typical inspection requirements for rotorcraft that have suffered the following: a. Heavy landing b. Rotor over-speeds c. Over torque d. Sudden main rotor stoppage e. Tail rotor strikes f. Severe turbulence g. Severe flight manoeuvre h. Gearbox magnetic plug or chip light illumination i. Lightning strikes j. Water immersion	2
10.3	**Identification and control of Parts** *Study Ref. AC 20-2A*	
10.3.1	Specify how the authenticity of rotorcraft components may be properly controlled with particular regard to the following: a. General identification of bogus parts b. Acceptable parts c. Release documentation d. Records e. Identification of parts which have a history in New Zealand of bogus supply/manufacture f. Physical marking of parts including common manufacturer's identification marks g. Foreign sources h. Parts purchasing i. Life limited components j. Disposal of parts including life limited components k. Salvaged parts l. Unsalvageable parts m. Surplus parts n. Ex military parts o. Interchangeability of parts p. Parts pooling arrangements q. Determining eligibility of parts r. Authenticity inspection methods and techniques s. Dealing with overseas parts suppliers	2
10.3.2	Determine the responsibilities of certifying engineers regarding the removal, installation and handling of critical rotorcraft parts.	3
10.4	**Jacking and Levelling** *Study Ref. 1*	
10.4.1	Explain the following criteria for jacking and levelling a rotorcraft: a. Jacking points b. Jacking procedures c. Maintenance of jacks d. Use of levelling equipment e. Identification of levelling points f. Levelling to the flying position	2

10.5	**Ground and Flight Testing** *Study Ref. 1*	
10.5.1	Explain the requirements for flight and ground testing of rotorcraft including the following: a. When ground tests are mandatory after maintenance b. When flight tests are mandatory after maintenance c. Vibration analysis of rotating components (engine, transmission and rotors) d. The relationship of engine RPM, rotor RPM and torque settings e. Topping/full power checks f. Health Indicator Tests g. Autorotational RPM checks and the effects of A/C weight and density altitude h. Rundown times i. Functional hydraulic system checks	2