CIVIL AVIATION AUTHORITY OF NEW ZEALAND

Advisory Circular AC 61-10

Revision 3

09 May 2007

Pilot Licences and Ratings – Type Ratings

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 (AMC)** with the associated rule.

An AMC 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.

This Advisory Circular also includes **guidance material (GM)** to facilitate compliance with the rule requirements. Guidance material must not be regarded as an acceptable means of compliance.

Purpose

The Advisory Circular provides information on the flight tile experience and ground training requirements that are acceptable to the Director for meeting the Civil Aviation Rule requirements for the issue of an Aircraft Type Rating.

Related Rules

This Advisory Circular relates specifically to Civil Aviation Rule Part 61 Subpart B – Aircraft Type Ratings.

Change Notice

Revision 3 re-numbers this advisory circular from AC 61-1.10 to AC 61-10 as part of a project to standardise the numbering of all ACs.

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Table of Contents

Rule 61.53 Eligibility requirements 3
Flight time 3
Turbine powered aircraft 3
Aircraft type technical knowledge 3
Type competency demonstration 3
Heavy aircraft and multi-engine helicopters 4
Single engine helicopter 4

Rule 61.55 Issue 4
Logbook endorsement 4
Director endorsed type rating in specified circumstances 5
Endorsement on licence 6
Similar aircraft types 6

Appendix I Aircraft Type Rating Minimum Flight Experience 7

Appendix II Subject No 64 Basic Turbine Knowledge 8

Appendix III Technical examination syllabus — Aeroplane 18

Appendix IV Technical examination syllabus — Helicopter 21

Appendix V Demonstration of competency for aeroplanes exceeding 5700 kg MCTOW 23

Appendix VI Demonstration of competency for aeroplanes not exceeding 5700 kg MCTOW 25

Appendix VII Demonstration of competency for Helicopters 29

Rule 61.53 Eligibility requirements

Flight time

Rule 61.53(2) The minimum conversion flight instruction times acceptable to the Director are detailed in Appendix I to this Advisory Circular.

A type rating obtained under the Civil Aviation Regulations 1953 (in the group system) may be relied upon to obtain an individual aircraft type rating for a licence issued under Part 61, on production of logbook evidence of pilot in command or co-pilot flight time in that aircraft type.

Turbine powered aircraft

Rule 61.53(3) requires an applicant for a type rating on a turbine powered aircraft to have passed an approved Basic Turbine Knowledge examination. This requirement is a prerequisite to an applicant commencing conversion training for their first turbine type rating only. The written examination is based on the Subject 64 Basic Turbine Knowledge syllabus items detailed in Appendix II of this Advisory Circular.

The instructor conducting type conversion training is required to address the knowledge deficiencies identified in the trainee's knowledge deficiency report (KDR). The flight instructor must ensure that remedial action has occurred and that they have tested the applicant's knowledge on the deficient areas with content acknowledged against the relevant rule reference(s), before signing off the KDR(s).

Aircraft engineers who hold a credit in NZ AMEL Subject 8: Turbine Engines, meet this examination credit requirement.

Flight engineers rated on a turbine engine aircraft type meet this examination requirement.

Military pilots who can provide evidence that they have qualified as first or second pilot in gas turbine powered aircraft types meet this examination requirement.

Military engineers who can produce appropriate evidence of basic and specific type training on turbine power plants meet this examination requirement.

An examination credit in the subject of basic turbine knowledge which has been obtained in an ICAO Contracting State may be recognised in New Zealand if the applicant has obtained a type rating on a turbine powered aircraft in that country.

Aircraft type technical knowledge

Rule 61.53(4) requires an applicant for an aircraft type rating to demonstrate to an appropriately qualified flight instructor a satisfactory technical knowledge of the aircraft. This demonstration is based on items detailed in Appendix III for aeroplanes, and Appendix IV for helicopters, of this Advisory Circular.

Type competency demonstration

Rule 61.53(5) requires a type competency demonstration (for any type rating) in the ability to perform competently every normal, abnormal and emergency manoeuvre appropriate to the aircraft type for which the type rating is required.

> **For aircraft in excess of 5700 kg MCTOW** this demonstration generally consists of items detailed in Appendix V of this Advisory Circular. A flight simulator, approved by the Director for conversion to type training, may be used for all or part of this demonstration.

For single pilot certificated aeroplanes not exceeding 5700 kg MCTOW this is expanded on in the Demonstration of Competency - Type Rating - Aeroplane guide available from the CAA website http://www.caa.govt.nz/pilots/Instructors/Type_Rating.pdf. This demonstration generally consists of items detailed in Appendix VI of this Advisory Circular.

For helicopters this demonstration generally consists of items detailed in Appendix VII of this Advisory Circular.

Heavy aircraft and multi-engine helicopters

Rule 61.53(6) requires, for aircraft exceeding 5700 kg MCTOW or multi-engine helicopters, an "approved" course of technical training and an "approved" written examination. The course content and written examination are based on the items detailed in Appendix III and IV of this Advisory Circular.

This requirement may be met by completion of a Civil Aviation Authority of New Zealand (CAA NZ) approved course of technical training by an organisation certificated under Civil Aviation Rule Part 141 or 119 where the certificate authorises the holder to conduct such training. The organisation must certify that a satisfactory standard of technical knowledge has been achieved in the required type rating technical examinations.

Before commencing training at an organisation outside New Zealand, applicants should ensure that the course is "approved" by CAA NZ.

Single engine helicopter

Rule 61.53(7) The approved written examination for this rule is detailed in Appendix IV of this Advisory Circular.

This requirement would be met by certification that a satisfactory standard of technical knowledge has been achieved in the required type rating technical examinations by an organisation certificated under Civil Aviation Rule Part 141 or an air operator certificated under Part 135 where the certificate authorises the holder to conduct such training.

In the case of a helicopter not exceeding 1500 kg MCTOW the required examination, based on the items in Appendix IV, may be conducted orally by an appropriately qualified flight instructor.

Rule 61.55 Issue

Logbook endorsement

Rule 61.55(a)(1) To meet the requirement of this rule the flight instructor must make an entry in form CA 1373 - Pilot's Logbook.

Rule 61.55(a)(2) For purposes of this rule the flight instructor may submit a copy of the type rating training record to the Director in the following manner:

For single pilot certificated aeroplanes, CAA form 24061/13 is the acceptable type rating training record.

For the first turbine type, the training record must contain a copy of the trainee's Basic Turbine Knowledge examination credit and the knowledge deficiencies as addressed by the qualified instructor.

For a multi-crew aircraft type rating or a helicopter, the acceptable type rating training record is as specified in the Part 119 or 141 organisations exposition.

Although the type rating is issued when it is entered in the pilot's logbook by an appropriately qualified flight instructor and the CAA data base is updated on receipt of the training record, the type will not appear until the licence is reissued for any reason, or if separate application is made under rule 61.55(c).

A pilot who produces evidence that they have qualified as pilot-in-command on a aeroplane or a helicopter in the NZ Armed Forces may have that type endorsed on their civil licence provided the type is on the New Zealand Civil Aircraft Register.

Director endorsed type rating in specified circumstances

Foreign type ratings

Rule 61.55(b)(1) The manner acceptable to the Director for purposes of this rule is:

For single pilot certificated aircraft, on the New Zealand Civil Aircraft Register, for which a type rating has been issued by a foreign contracting State to the Convention, may be endorsed on a New Zealand licence provided the applicant produces evidence of having completed at least 5 hours as pilot in command on type, or the type is endorsed in the logbook by the holder of an appropriately qualified New Zealand flight instructor rating.

For Multi-crew aircraft, evidence the applicant has completed 500 hours pilot in command or 1000 hours as first officer on the type is acceptable to the Director.

Boeing 737 type ratings issued by CASA

CASA issues pilots who qualify in any variant (except 1/200 series) with command type endorsements on the Boeing 737 300 to 900 series aircraft. In the NZ licensing system, the Boeing 737 3/4/500 series and the 6/7/8/900 Next Generation (NG) series are treated as two separate type ratings. In order to be eligible for the issue of a NZ type rating in Boeing 737 3/4/500 and/or a 6/7/8/900 series aircraft, applicants who hold a CASA command type endorsement on this aeroplane must have:

- Successfully completed a course of type conversion at a NZ approved training organisation (a list of approved organisations is available from our website under "Pilots"); or
- Operational experience on the specific variant in the Australian airline environment; or
- Successfully completed a CASA approved type conversion course in Australia on the specific variant.

Test pilots

Rule 61.55(b)(2) provides for a pilot who has been approved to act as a test pilot under rule 19.405(1) to have the aircraft type endorsed on the licence on completion of acceptable flight experience. The following flight experience is acceptable to the Director for this purpose:

For single engine land, waterborne and ski equipped aeroplanes or helicopters – 5 hours

For multi engine aeroplanes or helicopters – 10 hours

For any other aircraft as specified by the Director.

Category A flight instructors

Rule 61.55(b)(3) provides for the holder of a Category A flight instructor rating to have a specific aeroplane type, provided for under rule 61.5(o) as having similar characteristics, endorsed on the licence on completion of acceptable flight experience. The following pilot in command flight experience is acceptable to the Director for this purpose:

Single engine, fixed pitch, fixed tricycle undercarriage, land aeroplanes – 1 hour

Single engine, fixed pitch, retractable tricycle undercarriage, land aeroplanes – 1 hour

Single engine, constant speed, fixed tricycle undercarriage, land aeroplanes – 1 hour 30 minutes

Single engine, constant speed, retractable tricycle undercarriage, land aeroplanes – 1 hour 30 minutes

Single engine, fixed pitch, fixed undercarriage, tail wheel, land aeroplanes – 1 hour

Single engine, constant speed, fixed undercarriage, tail wheel land aeroplanes – 2 hours

First of type

Rule 61.55(b)(4) provides for a flight instructor who holds a first of type authorisation under rule 61.57, to have the aircraft type endorsed on the licence on completion of flight experience acceptable to the Director. The flight experience acceptable to the Director is that specified in the first of type authorisation.

Endorsement on licence

Rule 61.55(c) requires that, for the type to appear on the licence, the pilot must make an application to amend the licence and pay the appropriate fee to CAA. The application must be made on form CAA 24061/04.

Similar aircraft types

Rule 61.55(d) allows for an aircraft type rating to include any other aircraft, **if** in the opinion of the qualified flight instructor, the type is so similar as to require no further conversion instruction or type competency demonstration. The flight instructor must endorse the logbook with the type and submit to the Director a certified copy of the logbook entry.

The decision on similar type is entirely the responsibility of the qualified flight instructor who is current on type and conversant with the experience and ability of the candidate.

Appendix I Aircraft Type Rating Minimum Flight Experience

For all aircraft

Demonstrate to a qualified instructor all normal and abnormal operations at or near to MCTOW.

For a single engine aeroplane land only

Initial issue is combined with the issue of an aeroplane pilot licence; subsequent types - 30 minutes.

For a single engine ski-plane

Using snow as the sole take-off and landing medium - 3 hours to include a minimum of 4 full stop landings on snow. Subsequent types - a minimum of 4 full stop landings on snow

For a single engine seaplane

Using water as the sole take-off and landing medium: initial issue - 5 hours; subsequent types - 2 hours.

For a multi-engine centreline-thrust aeroplane not exceeding 5700 kg MCTOW

Initial issue - 2 hours.

For a multi-engine (non centreline-thrust) aeroplane not exceeding 5700 kg MCTOW

Initial issue - 5 hours; subsequent types - 1 hour.

For a single engine helicopter not exceeding 5700 kg MCTOW

Initial issue will be combined with the issue of a helicopter pilot licence; subsequent types - 1 hour.

For a multi-engine helicopter not exceeding 5700 kg MCTOW

Initial issue - 5 hours; subsequent types - 3 hours.

For a helicopter exceeding 5700 kg MCTOW

Initial issue - 10 hours; subsequent types - 5 hours.

For any other aircraft

As specified by the Director.

Notes

The minimum conversion flight time will be dual instruction unless otherwise specified and will be confined to exercises relative to conversion to the particular aircraft type.

For simple single engine aeroplanes operating on land only, the minimum conversion flight time may (at instructor discretion) include the type competency demonstration in one flight.

For more complex single pilot certificated aeroplanes the type competency demonstration may form part of the minimum flight experience requirement.

For single engine aeroplanes operating on land only, the flight instructor who conducts the type competency demonstration may (at their discretion) include any variant or similar aircraft type they consider so similar as to not require further or specific instruction on that variant by adding that variant's designation to the competency demonstration record and pilot's logbook.

In the case of a single seat type, the instructor issuing the rating is to be satisfied that the pilot has successfully completed ground training to an appropriate level. In addition, before making the appropriate log book entry, the instructor is to personally observe from the ground the pilot's flying of the aircraft and be satisfied that an acceptable level of competence was displayed.

Appendix II Subject No 64 Basic Turbine Knowledge

Each subject has been given a subject number and each topic within that subject a topic number. These reference numbers will be used on ‘knowledge deficiency reports’ and will provide valuable feed back to the examination candidate.

Sub Topic	Syllabus Item
64.2	**Basic Turbine Engine Theory**
64.2.2	Describe Newton’s third law of motion and its practical application as it relates to the operation of a turbine engine.
64.2.4	Describe how gas undergoes changes in pressure, volume and temperature in accordance with Boyle’s and Charles’ Laws.
64.2.6	Describe each of the following and their application to turbine engine operation: (a) Bernoulli’s Theorem; (b) Brayton constant pressure cycle; (c) the pressure-temperature cycle; (d) open and closed cycles; (e) kinetic energy; (f) potential energy; and (g) thermodynamic laws.
64.2.8	Describe the relationship between velocity, pressure and temperature of air at subsonic, transonic and supersonic speeds.
64.2.10	Describe the changes to pressure, temperature and velocity of the gas flow as it passes through each section of a turbine engine.
64.2.12	Describe the changes in the airflow characteristics of velocity, temperature and pressure through a divergent and convergent duct.
64.4	**Turbine Engine Types**
64.4.2	Compare the working cycle of a turbine engine and a piston engine.
64.4.4	Describe the comparative advantages of turbine engines versus piston engines for aircraft propulsion.
64.4.6	Describe the basic constructional arrangements of the following engine types: (a) turbofan; (b) ducted fan (high bypass ratio); (c) prop fan; (d) turbojet; (e) turboprop; and

Sub Topic	Syllabus Item
	(f) turbo-shaft.
64.4.8	Describe the operating parameters, propulsive efficiency characteristics and uses of each of the above engines.
64.4.10	Identify engines that fall into either the thrust-producing or torque-producing category.
64.4.12	Describe the following mechanical arrangements of a turbine engine:
	(a) single-entry two stage centrifugal turboprop;
	(b) twin-spool axial flow turboprop;
	(c) single axial flow compressor, free turbine drive turboprop;
	(d) single-spool axial flow turbojet;
	(e) twin-spool by-pass turbojet (low by-pass ratio);
	(f) aft fan turbojet; and
	(g) triple-spool front fan turbojet (high by-pass ratio).
64.6	**Turbine Engine Inlet Systems**
64.6.2	Describe the purpose, construction and principles of operation of the engine inlet duct.
64.6.4	Describe a sub-sonic divergent inlet duct.
64.8	**Turbine Engine Compressors**
64.8.2	Describe the purpose of a compressor in a turbine engine.
64.8.4	Describe the basic principles of operation of centrifugal and axial flow compressors.
64.8.6	Describe the comparative advantages of centrifugal and axial flow compressors.
64.8.8	Describe the merits of combined centrifugal and axial flow compressor combinations in small turbine engines.
64.8.10	State typical compressor pressure ratios for the various types and configuration of turbine engines.
64.8.12	Describe the relationship between compressor ratio and specific fuel consumption.
64.8.14	Describe the compressor arrangements found on the various types of modern turbine engine.
64.8.16	Describe the purpose and function of:
	(a) diffusers;
	(b) impellers;
	(c) inlet guide vanes;

Sub Topic	Syllabus Item
	(d) rotor blades;
	(e) stator blades;
	(f) variable inlet guide vanes;
	(g) variable stator blades;
	(h) rotating stator blades; and
	(i) bleed valves.
64.8.18	Describe the pressure and velocity changes through a centrifugal compressor.
64.8.20	State the reasons and advantages for multiple spool compressors.
64.8.22	Describe speed relationships between compressor sections and how these speeds may vary with changing atmospheric conditions.
64.8.24	For various types of compressor arrangements identify; Ng, N1, N2, and N3 and state whether each is HP or LP.
64.8.26	State the reasons why axial flow compressors have a higher number of stages.
64.8.28	Describe the relationship between pressure, temperature and velocity in an axial flow compressor.
64.8.30	State the reason for the decrease in size and increase in the number of compressor blades towards the rear of an axial flow compressor.
64.8.32	State the reason for the small pressure change per stage in an axial flow compressor.
64.8.34	Describe the purpose of compressor taper.
64.8.36	Describe cycle pressure ratio.
64.8.38	Describe the operation and pressure ratios associated with low, medium and high bypass fans.
64.8.40	Describe typical compression ratios achieved in modern axial flow compressors and the factors that affect compression ratio.
64.8.42	State the conditions that are commonly known to produce compressor stall with particular regard to:
	(a) compressor maintenance;
	(b) blade damage;
	(c) intake damage/restriction;
	(d) engine handling/operation; and
	(e) fuel scheduling.

Sub Topic	Syllabus Item
64.8.44	Describe how the various stall control systems reduce the possibility of compressor stall.
64.8.46	Describe the purpose and operation of the following stall control devices and what engines they may typically be found on variable angle compressor vane systems; (a) variable angle compressor vane systems; (b) variable angle inlet guide vane system; (c) bleed valves; and (d) bleed band.
64.8.48	Describe the effects of a dirty, worn or damaged compressor on SFC and power output.
64.10	**Turbine Engine Combustion Section**
64.10.2	Describe the operation of the combustion chamber.
64.10.4	Describe the constructional features, materials and principles of operation of the following types of combustion chamber: (a) annular; (b) turbo-annular; (c) multiple can; (d) can-annular type; and (e) reverse-flow annular.
64.10.6	State the comparative advantages of each type of combustion chamber.
64.10.8	Describe the purpose, construction and operation of swirl chambers, air shrouds, liners, interconnectors and discharge orifices.
64.10.10	Describe the uses of primary, secondary and tertiary air flow through or around a combustion chamber.
64.10.12	State the percentages of airflow used for cooling and combustion.
64.10.14	Describe how flameout is caused and prevented.
64.12	**Turbine Engine Turbine Section**
64.12.2	State the function of the turbine section.
64.12.4	Describe meaning, the principles of operation and characteristics of the following turbine blade design: (a) impulse; (b) impulse-reaction; and (c) reaction.

Sub Topic	Syllabus Item
64.12.6	Describe multi-stage turbines.
64.12.8	Explain the purpose and function of nozzle guide vanes and how the driving force for impulse and impulse reaction turbines is obtained from the gas flow.
64.12.10	Describe the most common type of turbine blade design and give reasons why this type of blade is preferred.
64.12.12	Describe how a turbine blade extracts energy from the gas stream and drives the wheel/disc.
64.12.14	Identify factors that limit the power available from the turbine stage.
64.12.16	Explain the gas flow pattern through nozzle and blade assembly with particular emphasis on static pressure, temperature and velocity.
64.12.18	State the reasons for compressor-turbine matching and how it is achieved.
64.12.20	State why turbine assemblies increase in diameter towards the rear of the engine.
64.12.22	Describe the function of the following turbine assembly components: (a) case; (b) nozzle; (c) shroud ring; (d) tip shrouds; (e) wheel/disc; and (f) air seal.
64.12.24	Describe how turbine blades, discs and nozzles are cooled using bleed air and modern cooling techniques such as film cooling.
64.12.26	Explain how turbine cases are cooled.
64.12.28	Define turbine blade creep and state the causal factors for this condition.
64.14	**Turbine Engine Exhaust Section**
64.14.2	Describe the exhaust gas flow through convergent and divergent passages.
64.14.4	State the purpose, and principles of operation of the following exhaust nozzle types: (a) convergent; and (b) convergent-divergent.
64.14.6	Describe the noise levels of different types of exhaust system and their means of noise suppression.
64.16	**Thrust Reversers**
64.16.2	Describe thrust reversal.

Sub Topic	Syllabus Item
64.16.4	Explain the purpose of thrust reversal.
64.16.6	Describe the various types of thrust reverser.
64.18	**Turbine Engine Fuel Systems**
64.18.2	Describe the function of the following turbine engine fuel system components: (a) fuel control unit (hydro pneumatic, hydro mechanical and electro-hydro mechanical); (b) fuel filters (HP and LP); (c) fuel heater; (d) governors and limiting devices; and (e) main fuel pumps.
64.18.4	State the ideal fuel/air ratio for a turbine engine.
64.18.6	State the effect of a change in specific gravity with respect to weight of fuel.
64.18.8	State the purpose of water-methanol injection.
64.18.10	Describe the following properties in relation to turbine fuels: (a) specific gravity; (b) fire hazard; and (c) fuel icing.
64.18.12	State the differences between the various types of jet fuel and identify their common usage names.
64.18.14	Describe the purposes of additives in jet fuels and identify which are the most common for modern engine operations.
64.18.16	State the ground handling requirements and the safety precautions to be observed with the use of turbine engine fuels.
64.18.18	Describe the fuel system markings for jet fuels.
64.18.20	Describe the susceptibility of turbine fuels to water contamination over other types of aviation fuels.
64.18.22	Describe methods of fuel system contamination detection and control.
64.20	**Turbine Engine Lubrication Systems**
64.20.2	Describe the basic requirements, arrangements and principles of operation of typical turbine engine lubrication systems.
64.20.4	Compare the different properties/characteristics of oils used in turboprop, turbojet and turbofan engines.

Sub Topic	**Syllabus Item**
64.20.6	Describe the relationship, function and principles of operation of the following turbine engine lubrication system components:
	(a) oil cooler;
	(b) oil-fuel and oil-air heat exchangers;
	(c) oil filters/screens (pressure and scavenge);
	(d) oil pumps;
	(e) oil system chip detectors and magnetic plugs;
	(f) oil tanks;
	(g) breather (including centrifugal type) and pressurisation systems;
	(h) valves (by-pass/check/relief); and
	(i) oil fed engine anti-ice systems.
64.20.8	State the reason most turbine engines use fuel to cool the oil in preference to air.
64.22	**Turbine Engine Starting; Ignition; Relight; and Shutdown**
64.22.2	Describe why turbine engines require high-energy ignition systems.
64.22.4	Describe the general precautions and checks prior to ground running a turbine engine.
64.22.6	Describe general procedures for starting, ground run-up and shutting down a turbine engine.
64.22.8	Describe what is meant by self-sustaining rpm and how this is achieved.
64.22.10	Describe why it is necessary to accelerate an engine up to sustaining rpm as quickly and uniformly as possible.
64.22.12	Describe the positive cockpit indications of light-up during start.
64.22.14	Describe the indications, effects and remedial actions for the following defects:
	(a) hung start;
	(b) too rapid temp rise;
	(c) hot start;
	(d) wet start;
	(e) poor acceleration up to sustainable rpm;
	(f) over temp;
	(g) compressor stall during start;
	(h) compressor surge;

Sub Topic	Syllabus Item
	(i) lack of ignition;
	(j) tail pipe fire;
	(k) flameout;
	(l) overspeed;
	(m) over torque; and
	(n) bleed band or bleed valve stuck in the open or closed position.
64.22.16	Describe the conditions under which a low energy ignition system should be turned on.
64.22.18	Describe the requirement and procedures for an engine re-light in the air.
64.24	**Turbine Engine Air Cooling and Sealing**
64.24.2	Describe the requirement for cooling and sealing of engine components.
64.24.4	Describe the uses of low and high pressure air for cooling and sealing.
64.24.6	Describe the types of air and oil seals.
64.26	**Turbine Engine Indicating and Instrumentation**
64.26.2	Describe the basic requirements, methods of operation, and function of the following typical engine instrument systems:
	(a) flow measuring instruments (pressure/volume, fuel and mass air flow sensing types);
	(b) mechanical measuring instruments (engine RPM, torque and vibration);
	(c) pressure measuring instruments (oil and fuel);
	(d) power measurement (EPR, engine turbine discharge pressure or jet pipe pressure);
	(e) horsepower or thrust measurement (torque gauges)
	(f) temperature measuring instruments; and
	(g) turboprop ice warning systems.
64.26.4	Describe the following terms:
	(a) TIT;
	(b) ITT; and
	(c) EGT.
64.26.6	Describe how power loss is indicated on a turbine engine.

Sub Topic	Syllabus Item
64.28	**Thrust Augmentation**
64.28.2	Describe the requirements for thrust augmentation.
64.28.4	Describe the methods used for thrust augmentation.
64.28.6	Describe how injected fluid increases power output of an engine.
64.30	**Turbine Engine Performance**
64.30.2	Define the following terms and describe the relationship between them, and their application to engine operation: (a) equivalent shaft horsepower; (b) gross thrust; (c) net thrust; (d) resultant thrust; (e) specific fuel consumption (SFC); (f) thrust specific fuel consumption (TSFC); (g) flat rated SHP; (h) full rated SHP; (i) thrust distribution; and (j) thrust horsepower.
64.30.4	Describe the effect of the following factors on turbine engine performance, specifically thrust and fuel flow: (a) airspeed; (b) ram effect; (c) altitude; (d) pressure; (e) temperature; (f) humidity; (g) bleed air; and (h) air intake icing.
64.30.6	List the main factors that limit the power output of turbine engines.
64.30.8	Describe the propulsive efficiency of the following types of turbine engine: (a) turboprop;

Sub Topic	Syllabus Item
	(b) high by-pass ratio turbofan;
	(c) low by-pass ratio turbofan; and
	(d) turbojet.
64.30.10	Calculate SFC from given operating conditions.
64.30.12	Describe how specific thrust and SFC will be affected by increasing the compression ratio of an engine.
64.30.14	State the causes of the reduction in SFC with increasing airspeed in turboprop engines.
64.30.16	Identify components in a turbine engine that produce either forward propulsive or rearward propulsive forces.
64.30.18	Describe how the rated thrust of an engine is derived from the calculation of forward and rearward forces.
64.30.20	Describe the approximate power requirements needed to drive the compressor on the various types of engine.
64.30.22	Define giving practical examples:
	(a) by-pass ratio; and
	(b) engine pressure ratio and how/where it is measured.
64.30.24	Describe the effects of bleed air operation on engine performance.
64.32	**Turbine Engine Fire Protection Systems**
64.32.2	Describe the principles, features and parameters of typical fire protection systems.
64.32.4	Describe the operation of unit-type and continuous loop fire detectors.
64.32.6	List the common extinguishing agents and state any precautions when using.
64.32.8	Describe common fire extinguishing systems and the limitations with their use.
64.34	**Turbine Engine Anti-icing Systems**
64.34.2	Describe the principles, features and parameters of typical ice protection systems.
64.34.4	Describe effects of anti-ice system operation on engine performance for the various types of turbine engine and how this would be shown in the cockpit.
64.34.6	Describe the common source of bleed air.

Appendix III Technical examination syllabus — Aeroplane

An applicant for any aircraft type rating is required to demonstrate to an appropriately qualified flight instructor satisfactory technical knowledge for the aircraft type concerned. The following syllabus, appropriately modified to suit the aircraft type would meet this requirement for all aeroplanes.

In addition, for aircraft exceeding 5700Kg MCTOW, an approved course of technical training and an approved written examination are required. The course content and written examination are to be based on the following syllabus, appropriately modified to suit the aircraft type.

Primary flight controls and trims: Layout of various components and management, safety devices, precautions to be observed in operation and fault finding.

Carburettor heat and/or alternate air: Layout of various components and management, precautions to be observed in operation and fault finding.

Cowl flaps: Operating procedures and precautions to be observed in operation.

Mixture: Principle of operation, location and purpose of various components, operating procedure, precautions to be observed in operation and fault finding.

Propeller: Principle of operation, location and purpose of various components, operating procedure, feathering and un-feathering procedure, safety devices and fault finding.

Fuel system: Grade and specification of fuel, system layout and management, dumping facilities, fuel tank location, capacities, unusable fuel, consumption rates and safety devices, location and purpose of various components, emergency operation, precautions to be observed in operation and fault finding.

Oil system: Grade and specification of engine oil, system layout and management, tank capacities and location, safety devices, operating pressures, functional checks, emergency operation, location and purpose of various components, precautions to be observed in operation and fault finding.

Hydraulic system: Grade and specification of fluid, system layout and management, reservoir capacity and location, safety devices, operating pressures, functional checks, emergency operation, location and purpose of various components, precautions to be observed in operation, fault finding and remedial action to be taken in flight.

Pneumatic system: Layout and management, purpose and location of various components, operating pressures, emergency operation, functional checks, safety devices, precautions to be observed in operation and fault finding.

Electrical system and associated instruments: Layout and management, location and purpose of various components and circuits, functional checks, operating voltages, capacity and number of generators, alternators, inverters and batteries, safety devices, precautions to be observed in operation, emergency operation, fault finding and remedial action to be taken in flight.

Flaps: Layout and management, location and purpose of various components, functional checks, safety devices, precautions to be observed in operation, fault finding and remedial action to be taken in flight.

Speedbrakes: Layout and management, location and purpose of various components, functional checks, safety devices, precautions to be observed in operation, fault finding and remedial action to be taken in flight.

Landing gear: Layout and management, location and purpose of various components, functional checks, safety devices, precautions to be observed in operation, fault finding and remedial action to be taken in flight.

Brakes: Layout and management, location and purpose of various components, functional checks, safety devices, precautions to be observed in operation and remedial action to be taken in flight.

Avionics: To include where applicable, cockpit voice recorder system (CVR), flight data recording systems (FDR), health and usage monitoring systems (HUMS), flight management systems (FMS), attitude and heading reference systems (AHRS), air data computer (ADC), air data inertial reference units (ADIRU/SAARU), radar altimeters, altitude selectors, electronic flight information systems (EFIS), primary flight displays (PFD), head up displays (HUD), enhanced vision systems (EVS), navigation displays (ND) and/or multifunction displays (MFD), fully automatic digital engine control (FADEC), engine indicating and crew alerting systems (EICAS/ECAM), terrain awareness warning systems (TAWS), airborne collision avoidance systems (ACAS) and electronic checklists (ECL), layout and management, operating limitations, purpose and location of various components, precautions to be observed in operation, functional checks, safety devices, emergency operation, fault finding and remedial action to be taken in flight.

Auto-pilot: To include where applicable, flight directors, autothrottle, autoland, yaw dampers, rudder limiters, operating limitations, location and purpose of main components, operating procedure, safety devices, precautions to be observed in operation, fault finding and remedial action to be taken in flight.

Pitot-static system: Layout and management, location and purpose of various components, safety devices, functional checks, emergency operations, fault finding and remedial action to be taken in flight.

Vacuum/pressure system and associated flight instruments: Layout and management, purpose and location of various components, precautions to be observed in operation, functional checks, safety devices, emergency operation, fault finding and remedial action to be taken in flight.

Heating and environmental systems: Layout and management, location and purpose of various components, functional checks, precautions to be observed in operation, safety devices and fault finding.

De-icing and anti-icing systems: Layout and management, purpose and location of various components, precautions to be observed in operation, safety devices and functional checks.

Fire extinguisher systems: Layout and management, location and purpose of various components, fire warning devices, functional checks, action in event of fire and precautions to be taken in operation.

Pressurisation: Layout and management, location and purpose of various components, functional checks, emergency operation, precautions to be observed in operation, safety devices, fault finding and remedial action to be taken in flight.

Oxygen systems: Layout and management, location and purpose of various components, operating pressures, functional checks, emergency operation, safety devices, supply duration under various conditions, precautions to be observed in operation, fault finding and remedial action to be taken in flight.

Engines: Operating limitations, location and purpose of various components, operating procedure for starting, ground running, take-off, climb, cruising, landing and shutting down, functional checks, controls, safety devices, accessories, power control and interpretation of power charts, fuel and oil consumption, prevention of icing and fault finding.

Airframe: Type of structure, layout of various components and for waterborne aircraft the layout of the bilge system.

Weight and balance: Loading and centre of gravity calculations including, centre of gravity limits, use of load adjusters and loading charts, effect of fuel consumption on centre of gravity, effect of movement of crew, passenger or cargo on centre of gravity, effect of landing gear retraction on centre of gravity, precautions to be observed in loading and securing of load.

Aeroplane operations: Take-off and landing performance characteristics, aeroplane operating limitations, procedures to be followed in take-off, climb, landing and cruising in both symmetric and asymmetric flight, stalling speeds, safety speeds, interpretation of aeroplane flight manual data, use of radio and navigation equipment, including where applicable, aircraft communications addressing and reporting system (ACARS), controller-pilot datalink communications (CPDLC) and satellite communications (SATCOM), action in the event of forced landing on land or water and use of survival equipment including any aircraft parachute system (if applicable).

Appendix IV Technical examination syllabus — Helicopter

An applicant for any aircraft type rating is required to demonstrate to an appropriately qualified flight instructor satisfactory technical knowledge for the aircraft type concerned. The following syllabus, appropriately modified to suit the aircraft type would meet this requirement for all helicopters.

In addition, for aircraft exceeding 5700Kg MCTOW and for multi-engine helicopters an approved course of technical training and an approved written examination are required. The course content and written examination are to be based on the following syllabus, appropriately modified to suit the aircraft type.

An applicant for a type rating in a single engine helicopter not exceeding 5700 Kg MCTOW is required to pass an approved written examination in the normal, abnormal and emergency procedures of the helicopter's systems, performance and weight and balance calculations. This written examination is to be based on the following syllabus, appropriately modified to suit the aircraft type.

In the case of a helicopter not exceeding 1500 Kg MCTOW the required examination may be conducted orally by an appropriately qualified flight instructor. This oral examination is based on the following syllabus.

Primary flight controls and trims: Layout of various components and management, safety devices, precautions to be observed in operation and fault finding.

Carburettor heat and/or alternate air: Layout of various components and management, precautions to be observed in operation and fault finding.

Mixture: Principle of operation, location and purpose of various components, operating procedure, precautions to be observed in operation and fault finding.

Fuel: Grade and specification of fuel, system layout and management, dumping facilities, fuel tank location, capacities, unusable fuel, consumption rates and safety devices, location and purpose of various components, emergency operation, precautions to be observed in operation and fault finding.

Oil: Grade and specification of engine oil, system layout and management, tank capacities and location, safety devices, operating pressures, functional checks, emergency operation, location and purpose of various components, precautions to be observed in operation and fault finding.

Hydraulic system: Grade and specification of fluid, system layout and management, reservoir capacity and location, safety devices, operating pressures, functional checks, emergency operation, location and purpose of various components, precautions to be observed in operation, fault finding and remedial action to be taken in flight.

Electrical system and associated instruments: Layout and management, location and purpose of various components and circuits, functional checks, operating voltages, capacity and number of generators, alternators, inverters and batteries, safety devices, precautions to be observed in operation, emergency operation, fault finding and remedial action to be taken in flight.

Landing gear: Layout and management, location and purpose of various components, functional checks, safety devices, precautions to be observed in operation, fault finding and remedial action to be taken in flight.

Avionics: To include where applicable, cockpit voice recorder system (CVR), flight data recording systems (FDR), health and usage monitoring systems (HUMS), flight management systems (FMS), attitude and heading reference systems (AHRS), air data computer (ADC), air data inertial reference units (ADIRU/SAARU), radar altimeters, electronic flight information systems (EFIS), primary flight displays (PFD), head up displays (HUD), navigation displays (ND) and/or multifunction displays (MFD), fully automatic digital engine control (FADEC), engine indicating and crew alerting systems (EICAS/ECAM), terrain awareness warning systems (TAWS), airborne collision avoidance systems (ACAS) and electronic checklists (ECL), layout and management, operating limitations, purpose and location of various components, precautions to be observed in operation, functional checks, safety devices, emergency operation, fault finding and remedial action to be taken in flight.

Auto-pilot: Operating limitations, location and purpose of main components, operating procedure, safety devices, precautions to be observed in operation, fault finding and remedial action to be taken in flight.

Pitot-static system: Layout and management, location and purpose of various components, safety devices, functional checks, emergency operations, fault finding and remedial action to be taken in flight.

Vacuum/pressure system and associated flight instruments: Layout and management, purpose and location of various components, precautions to be observed in operation, functional checks, safety devices, emergency operation, fault finding and remedial action to be taken in flight.

Heating and environmental systems: Layout and management, location and purpose of various components, functional checks, precautions to be observed in operation, safety devices and fault finding.

De-icing and anti-icing systems: Layout and management, purpose and location of various components, precautions to be observed in operation, safety devices and functional checks.

Fire extinguisher systems: Layout and management, location and purpose of various components, fire warning devices, functional checks, action in event of fire and precautions to be taken in operation.

Engines: Operating limitations, location and purpose of various components, operating procedure for starting, ground running, take-off, climb, cruising, landing and shutting down, functional checks, controls, safety devices, accessories, power control and interpretation of power charts, fuel and oil consumption, prevention of icing and fault finding.

Rotor systems: Principle of main and tail rotor operation, location and purpose of various components, operating procedure, safety devices and fault finding.

Airframe: Layout of various components.

Weight and balance: Loading and centre of gravity calculations including, centre of gravity limits, use of load adjusters and loading charts, effect of fuel consumption on centre of gravity, effect of movement of crew, passenger or cargo on centre of gravity, effect of landing gear retraction on centre of gravity, precautions to be observed in loading and securing of load.

Helicopter operation: Take-off and landing performance characteristics, helicopter operating limitations, procedures to be followed in take-off, climb, cruising and landing, height/velocity diagram, interpretation of helicopter flight manual data, use of radio and navigation equipment, including where applicable, aircraft communications addressing and reporting system (ACARS) and satellite communications (SATCOM), action in the event of forced landing on land or water and use of survival equipment.

Appendix V Demonstration of competency for aeroplanes exceeding 5700 kg MCTOW

For any type rating a demonstration of competency in the ability to perform every normal, abnormal and emergency manoeuvre appropriate to the aircraft type is required.

For aircraft in excess of 5700 Kg MCTOW this demonstration is based on the following syllabus.

A simulator, specifically approved by the Director for conversion to type training, may be used for all or part of this demonstration.

Pre-flight requirements

Aircraft flight manual, release to service, engine charts, AIPNZ, route guide.

Aircraft and engine limitations, emergency equipment and procedures.

Aircraft loading, trim sheets and flight planning, fuel requirements and fuel management.

External and internal inspection, location of critical items and the purpose of inspection.

Engine start and after start procedures and cockpit checks, selection of navigation and communication frequencies, taxiing and steering, instrument checks and ATS clearances.

Take-off checks, engines, instruments, systems, crew briefing and radiotelephone procedures.

Flight manoeuvres

Normal take-off and landing.

Crosswind take-off and landing.

Rejected take-off.

Take-off with engine failure immediately after decision speed (V_1).

All normal climb and descent manoeuvres.

Circling approach at minimum authorised circling altitude.

Missed approach from not more than 100 feet agl.

Stall onset in clean, take-off and landing configurations, at least one stall to be demonstrated with the aircraft in a turning configuration.

Steep turns through 360 degrees in both directions, recommended bank angle 45 degrees.

Approach to V_{MCA} with asymmetric power.

Where applicable, recovery from unusual attitudes applicable to aircraft type.

Instrument flight

Asymmetric climb and descent procedures.

Interception and tracking of predetermined bearings, airways procedures, including entering, maintaining and departing from holding patterns.

Descent to minimum altitude through intermediate and approach procedures using ILS, VOR or a non-precision radio navigation facility.

Missed approach from minimum altitude with asymmetric thrust.

Emergency procedures

Engine fire and normal un-feathering or relight.

Emergency descent — pressurised aircraft.

Any other emergency procedures contained in the aircraft flight manual.

Normal and abnormal procedures

Each applicant is to demonstrate the proper use of the following systems, including the correct abnormal or emergency drills, or both, to be carried out in the event of failure or malfunction of the systems, appropriate to the aircraft type:

Auto-pilot:

Anti-ice and de-icing systems:

Electrical system — including failures where this may result in loss of flight instruments:

Hydraulics and pneumatics:

Air conditioning and pressurisation systems:

Oxygen system:

Weather radar.

The candidate is to have received training in every emergency, normal and abnormal operation with the aeroplane or approved flight simulator loaded as far as is practicable to a weight which will give a positive indication of its flight and handling characteristics under adverse conditions. It is recommended that; for normal operations, a short cross country flight with a landing at an aerodrome other than the aerodrome of departure be completed so that the candidate can experience operating the aircraft at MCTOW. For abnormal operations (in aircraft), appropriate secure ballast should be used to achieve MCTOW.

Appendix VI Demonstration of competency for aeroplanes not exceeding 5700 kg MCTOW

For any type rating a demonstration of competency in the ability to perform every normal, abnormal and emergency manoeuvre appropriate to the aircraft type is required.

The demonstration of competency requirements for single pilot certificated aeroplanes are expanded on, and assessed in accordance with the "Four Point Scale" published in the "Demonstration of Competency, Type Rating, Single Pilot Certificated Aeroplane" standards guide, available from the CAA website.

Form CAA 24061/13 is used to record conversion to type training flight time and the result of the type competency demonstration.

Instructor's submitting the competency demonstration record (CAA 24061/13) are requested to do so as soon as practicable after the completion of the type rating issue.

Operation of aircraft systems

The candidate will demonstrate practical knowledge of the operation of at least four of the systems installed on the aeroplane.

Performance and limitations

The candidate will be required to demonstrate practical use of charts, tables and appropriate data to determine performance, including (as applicable) take-off, climb, one engine inoperative, cruise, endurance and landing.

Essential performance speeds are to be quoted from memory. Other aeroplane performance data may be determined from the Pilot's Operating Handbook (POH) or the aircraft's Flight Manual (AFM).

Weight and balance, loading

The candidate will be required to complete accurate computations for a practical load that addresses all or most of the passenger and baggage stations. The computations are to use actual weights, and weight and balance data applicable to the aeroplane, including take-off weight, landing weight and the zero fuel weight. If a loading graph or computer is available with the aeroplane, it may be utilized.

The candidate is to have received training in every normal and abnormal operation with the aeroplane loaded as far as is practicable to a weight which will give a positive indication of its flight and handling characteristics under adverse conditions. It is recommended that for normal operations, a short cross country flight with a landing at an aerodrome other than the aerodrome of departure be completed so that the candidate can experience operating the aircraft at MCTOW. For abnormal operations, appropriate secure ballast should be used to achieve MCTOW.

Documents and airworthiness

The candidate is to determine the validity of all documents required to be carried on board the aeroplane and determine that required maintenance certifications have been completed.

Pre-flight inspection

The candidate is to determine that the aeroplane is ready for the intended flight. All required equipment and documents are to be located and, so far as can be determined by pre-flight inspection, the aeroplane is to be confirmed to be airworthy. Visual checks for fuel quantity, proper grade of fuel, fuel contamination and oil level are to be carried out in accordance with the

POH/AFM. If the aircraft design precludes a visual check, fuel chits, fuel logs or other credible procedures may be used to confirm the amount of fuel actually on board.

The candidate is to conduct an oral passenger safety briefing.

Engine starting and run-up

The candidate is to use the checklists provided by the aircraft manufacturer or owner/operator and use the recommended procedures for engine starting, warm-up, run-up and aeroplane systems checks to determine that the aeroplane is airworthy and ready for flight.

The candidate will demonstrate a practical knowledge of the elements related to recommended engine starting procedures, including the use of external power source, starting under various atmospheric conditions and the effects of using incorrect starting procedures.

The candidate is to take appropriate action with respect to unsatisfactory conditions (e.g. flooding) encountered or specified by the instructor.

Taxiing

Provided that traffic permits, the candidate is to taxi along taxiway centrelines where they exist. The candidate is to position the flight controls appropriately for wind conditions. During calm wind conditions the instructor will specify a wind speed and direction in order to test this ability.

While taxiing, the candidate will be expected to confirm the proper functioning of the flight instruments.

Take-off

The candidate is to demonstrate at least two (2) of the following take-off procedures:

- Normal
- Short field
- Rough water and/or
- Crosswind
- Soft surface
- Glassy water

Note: The candidate must be able to explain the operational necessity for any variation from recommended speeds, e.g. gusty or crosswind conditions.

Intentional engine shutdown and air-start (multi-engine only)

At an operationally safe height or the manufacturer's recommended minimum height, whichever is higher, the candidate will respond to a scenario presented by the instructor that requires an intentional engine shutdown. The candidate will then shut down and feather the appropriate engine (unless the POH/AFM advises against it) and complete the appropriate checklist(s).

The candidate will be asked to turn toward and away from the inoperative engine.

The instructor will require the candidate to restart the secured engine.

Engine failure (cruise flight)

At an operationally safe height or the manufacturer's recommended minimum height, whichever is higher, the instructor will simulate an engine failure during straight and level flight and/or during a medium turn. The candidate will be expected to control the aeroplane, carry out a forced landing, and in the case of a multi-engine aeroplane, identify the failed engine, perform the cause checks, and simulate feathering the propeller and shutting down the failed engine in accordance with the checklist.

Recovery from an approach to VMCA (mutli-engine only)

At an operationally safe height or the manufacturer's recommended minimum height, whichever is higher, the candidate will demonstrate an approach to Vmc with one engine windmilling and recover by reducing power on the operating engine and reducing pitch attitude.

Engine failure during take-off

At an operationally safe speed the instructor will simulate an engine failure during the take-off and/or an emergency that dictates an aborted take-off as the most desirable option.

Engine failure after take-off

At an operationally safe height or the manufacturer's recommended minimum height, whichever is higher, the instructor will simulate an engine failure. The instructor will establish zero-thrust on the simulated inoperative engine (if applicable) after the candidate has simulated feathering the propeller.

Cruising flight

The candidate will establish the aeroplane in cruise flight at the flight planned true airspeed in accordance with the performance charts in the POH/AFM, placards displayed in the aeroplane, or any other means authorized by the manufacturer.

Steep turn

At an operationally safe height, the candidate will be asked to execute a steep turn through at least 180° at 45° angle of bank.

Stalling

At an operationally safe height or the manufacturer's recommended minimum height, whichever is higher, stalls will be approached from various phases of flight and in various configurations appropriate to the aeroplane type and in accordance with the flight manual.

The instructor will ask for two stalls, one in the clean configuration and one in the landing configuration with recovery at the stall or onset as appropriate to the aeroplane type, with minimum height loss.

Circuit

The candidate is to demonstrate correct circuit procedures, including departure and joining procedures for the aerodrome(s) being used.

The candidate is to demonstrate the overshoot procedure on command by the instructor or as required by ATS (one engine inoperative for multi-engine aircraft).

The ability to comply with ATS clearances or instructions while maintaining separation from other aircraft must also be demonstrated.

Approach and landing

The candidate will be required to demonstrate at least three of the following landing procedures;

- One engine inoperative (compulsory for multi-engine)
- Cross-wind
- Short field
- Soft surface
- Glide
- Snow (4 required to be demonstrated)
- Normal
- Wheel
- 3 point
- Flapless
- Glassy water
- Rough water

Note: The candidate must be able to explain the operational necessity for any variation from recommended speeds, e.g. gusty or crosswind conditions.

Emergency procedures

The instructor will assess the candidate's knowledge of emergency procedures or abnormal conditions. Assessment may be carried out during any portion of the demonstration.

Assessment will be based on the candidate's ability to analyze simulated or real situations, take appropriate action and follow the appropriate emergency checklists or procedures for any three (3) of the following simulated emergencies/malfunctions:

- Propeller over speed
- Cabin fire
- Landing gear malfunctions
- Flap failure
- Emergency descent
- Electrical fire
- Heater overheat
- Loss of oil pressure
- Cross-feed
- Vacuum system failure
- Electrical malfunctions
- Brake failure
- Door opening in flight
- Engine fire
- Primary Flight Display (PFD)
- Multi Function Display (MFD)
- Loss of fuel pressure
- Any other unique emergency

In addition for:

Seaplanes

Taxiing upwind, downwind and crosswind with and without the use of drogues, step work, mooring and slipping, ramp and beach techniques, use of standard buoy, anchoring and weighing anchor, varying water conditions and tidal effects.

Appendix VII Demonstration of competency for Helicopters

For any type rating a demonstration of competency in the ability to perform every normal, abnormal and emergency manoeuvre appropriate to the aircraft type is required.

For helicopters this demonstration is based on the following syllabus.

Pre-flight inspection

The candidate is to determine that the helicopter is ready for the intended flight. All required equipment and documents are to be located and, so far as can be determined by pre-flight inspection, the helicopter is to be confirmed to be airworthy. Visual checks for fuel quantity, proper grade of fuel, fuel contamination and oil level are to be carried out in accordance with the POH/AFM. If the helicopter design precludes a visual check, fuel chits, fuel logs or other credible procedures may be used to confirm the amount of fuel actually on board.

The candidate is to conduct an oral passenger safety briefing.

Engine starting and run-up

The candidate is to use the checklists provided by the aircraft manufacturer or owner/operator and use the recommended procedures for engine starting, warm-up, run-up and helicopter systems checks to determine that the helicopter is airworthy and ready for flight.

The candidate will demonstrate a practical knowledge of the elements related to recommended engine starting procedures, including the use of external power source, starting under various atmospheric conditions and the effects of using incorrect starting procedures.

The candidate is to take appropriate action with respect to unsatisfactory conditions encountered or specified by the instructor.

The candidate is to have received training in every normal and abnormal operation with the helicopter loaded as far as is practicable to a weight which will give a positive indication of its flight and handling characteristics under adverse conditions. It is recommended that for normal operations, a short cross country flight with a landing at an aerodrome other than the aerodrome of departure be completed so that the candidate can experience operating the aircraft at MCTOW. For abnormal operations, appropriate secure ballast should be used to achieve MCTOW.

Taxiing

Surface or air or both.

To include hovering — upwind, downwind and crosswind.

Hover patterns and hover turns on the spot to left and right.

While taxiing, the candidate will be expected to confirm the proper functioning of the flight instruments.

Take-off and landing

The candidate is to demonstrate normal and crosswind, including vertical take-off to hover and vertical landing from hover.

Minimum power take-off and roll-on (running) landing.

Maximum performance take-off and steep approach.

Confined areas operations and sloping ground landings.

Quick stops.

Emergencies

Autorotative approach with power recovery to the hover and engine failure in the hover.

Recovery from low RPM condition at altitude.

Settling with power (vortex ring state) and incipient stage recovery at altitude.

Incipient ground resonance.

Single engine operation for multi engine helicopters.

Primary Flight Display (PFD), Multi Function Display (MFD), Altitude Heading Reference System (AHRS) and Air Data Computer (ADC) failures (as applicable).