For information only:

- Please note that this Appendix will be part of the next revision of AC61-10, *Pilot Licences and Ratings – Type Ratings.*
- CAA expects to publish the new revision of AC61-10 on the 1st of November 2024.
- Until then, this Appendix is provided to enable flight training providers to amend their training material before the update occurs in November. Please continue to use the current version of AC61-10 for the syllabus for Basic Turbine Knowledge rating (BTK) examinations.
- Please also note, there may be some minor changes and updates once the next revision of AC61-10 is published in November 2024, but we will endeavour to highlight any further changes at that time.

Table of Contents

Appendix II - Subject No 65 Basic Turbine Knowledge - Helicopter

Note: This syllabus is based on a "basic" level of knowledge applicable to the operation of a turbine engine, such as would be required by a pilot about to undergo training toward a type rating on their first turbine engine helicopter.

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

65.2 Basic Turbine Engine Theory

65.2.2	Describe Newton's third law of motion and its practical application as it relates to the operation of a turbine engine.
65.2.4	Describe how gas undergoes changes in pressure, volume and temperature in accordance with Boyle's and Charles' Laws.
65.2.6	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
65.2.8	Describe the changes to pressure, temperature and velocity of the gas flow as it passes through each section of a turbine engine.

65.4 Turbine Engine Types

65.4.2	Compare the working cycle of a turbine engine and a piston engine.
65.4.4	Describe the comparative advantages of turbine engines versus piston engines for helicopters.
65.4.6	Describe the mechanical arrangements of a free power turbine in a turboshaft engine.

65.6 Turbine Engine Inlet Systems

65.6.2	Describe the purpose of the engine inlet duct.
65.6.4	Describe and explain the principles of operation of a Bellmouth inlet duct on a helicopter turboshaft engine.

65.8 Turbine Engine Compressors

65.8.2	Describe the purpose of a compressor in a turbine engine.
65.8.4	Describe the basic principles of operation of centrifugal and axial flow compressors.
65.8.6	Describe the comparative advantages of centrifugal and axial flow compressors.

65.8.8 Describe the merits of combined centrifugal and axial flow compressor combinations in turbine engines.

65.8.10 Describe the purpose and function of—

(a) impellers

(b) inlet guide vanes (fixed and variable)

(c) rotor blades

(d) stator blades

(e) variable stator blades

(f) diffusers

(g) bleed valves / bands

65.8.12 State the reasons why axial flow compressors have a higher number of stages than centrifugal compressors.

65.8.14 State the reason for the small pressure change per stage in an axial flow compressor.

65.8.16 State the reason for the decrease in size and increase in the number of compressor blades towards the outlet end of an axial flow compressor.

65.8.18 Explain what is meant by compressor stall/compressor surge.

65.8.20 State the conditions that are commonly known to produce compressor stall/surge with particular regard to—

(a) compressor maintenance

(b) blade damage

(c) intake damage/restriction

(d) engine handling/operation

(e) fuel scheduling

65.8.22 Describe the indications of a compressor stall/surge.

65.8.24 Describe the operation of the following stall/surge control devices—

(a) variable angle inlet guide vanes

(b) bleed valves

(c) bleed bands

65.10 Turbine Engine Combustion Section

65.10.2 Describe the purpose and operation of the combustion chamber(s).

65.10.4 Describe the constructional features and principles of operation of the following types of combustion chamber—

(a) multiple can

(b) annular

(c) can annular

(d) reverse flow

65.10.6 State the comparative advantages of each type of combustion chamber.

65.10.8 Describe the purpose of—

(a) swirl chambers

(b) air shrouds

(c) liners

(d) interconnectors

65.10.10 Describe the uses of primary, secondary and tertiary air flow through and/or around a combustion chamber.

65.10.12 State the percentages of airflow typically used for cooling and for combustion.

65.10.14 Describe how flameout is caused and managed.

65.12 Turbine Engine Turbine Section

65.12.2 State the purpose and operation of the turbine section.

65.12.4 Describe the function of the following turbine assembly components—

(a) casing and associated structures

(b) wheel/disc

(c) shafts

(d) nozzle guide vanes

(e) blades

65.12.6 Describe the principles of operation and characteristics of the following turbine blade design types—

(a) impulse

(b) impulse-reaction

(c) reaction

65.12.8 State which type of turbine blade design is most common and explain why this type of blade is preferred.

65.12.10 Identify factors which limit the power available from the turbine section.

65.12.12 Describe power and gas producer turbines.

65.12.14 Define turbine blade creep and state the causal factors for this condition.

65.14 Turbine Engine Exhaust Section

65.14.2 State the function of the exhaust section on a helicopter.

65.16 Reserved

65.18 Turbine Engine Fuel Systems

65.18.2 Describe the distinguishing features of aviation turbine fuel (AVTUR/Jet A1).

65.18.4 Compare and differentiate between AVGAS and turbine engine fuel (including Biojet) and describe methods of reducing the likelihood of fuelling with the wrong type.

65.18.6 State the differences between the various types of turbine engine fuel (including Biojet) and identify their common usage names.

65.18.8 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 heater

(c) governors and limiting devices

(d) engine driven fuel pumps

65.18.10 State the ideal fuel/air ratio for a turbine engine.

65.18.12 Describe the following properties in relation to turbine engine fuels—

(a) specific gravity

(b) fire hazard

(c) fuel icing

65.18.14 State the effect of a change in specific gravity with respect to weight of fuel.

65.18.16 Describe the purposes of anti-icing and anti-microbiocidal additives in turbine engine fuels.

65.18.18 Describe the susceptibility of turbine fuels to water contamination over other types of aviation fuels.

65.18.20 Describe methods of fuel system contamination detection.

65.18.22 Explain the precautions which can be taken to avoid fuel contamination with water and other impurities.

65.20 Turbine Engine Lubrication Systems

65.20.2 Describe the basic principles of operation of typical turbine engine lubrication systems.

65.20.4 Describe the function and principles of operation of the following turbine engine lubrication system components—

(a) oil cooler

(b) oil-fuel heat exchangers

(c) oil filters/screens (pressure and scavenge)

(d) oil system chip detectors and magnetic plugs

(e) valves (bypass/check/relief)

65.20.6 Differentiate between a wet sump and a dry sump oil system.

65.22 Turbine Engine Starting; Ignition; Relight; and Shutdown

65.20.2 Describe the basic principles of operation of typical turbine engine lubrication systems.

65.22.2 Describe general procedures for starting and shutting down a turbine engine.

65.22.4 Describe the cockpit indications of a positive light-up during start.

65.22.6 Describe what is meant by self-sustaining rpm and how this is achieved.

65.22.8 Describe what is meant by a “blow out” or “motoring” cycle of the engine and state when this would be carried out.

65.22.10 Describe the causes, indications, effects and remedial actions for the following start defects—

(a) hung start

(b) hot start

(c) wet start

(d) tail pipe fire

65.24 Turbine Engine Air Cooling and Sealing

65.24.2 Describe the requirement for cooling and sealing of turbine engine components.

65.24.4 Describe the uses of compressor bleed air for cooling and sealing.

65.24.6 Describe how turbine blades, discs and nozzles are cooled using compressor bleed air.

65.26 Turbine Engine Indicating and Instrumentation

65.26.2 Describe the following types of turbine engine indicators and instrumentation including their function and basic principles of operation—

(a) engine rpm

(b) engine torque

(c) fuel flow

(d) pressure indicators

(e) temperature indicators

(f) vibration indicators

65.26.4 State the meaning of the following terms—

(a) NG

(b) NP

(c) NR

(d) TOT

(e) EGT

65.28 Turbine Engine Performance

65.28.2 Define the following terms and describe the relationship between them, and their application to engine operation—

(a) power

(b) thrust

(c) torque

(d) shaft horsepower (SHP)

65.28.4 Describe the effect of the following factors on turbine engine performance—

(a) altitude

(b) pressure

(c) temperature

(d) humidity

(e) bleed air

65.28.6 On a graph, draw a power available curve for a typical light turbine engine helicopter.

65.28.8 With respect to turbine engine helicopters, explain the requirement for range flying.

65.28.10 Derive performance planning information from graphs published in turbine engine helicopter Flight Manuals, with emphasis on—

(a) hover ceiling

(b) hover IGE and/or OGE, at various all-up weights

(c) gross weight for hovering

(d) climb performance

(e) range and endurance