

APPENDIX 1. FLIGHT CREW LICENCES AND AIRCRAFT CATEGORY RATINGS

SECTION 1.1 BASIC AERONAUTICAL KNOWLEDGE (BAK)

Unit 1.1.1 BAKC: Basic aeronautical knowledge – all aircraft categories

1. Reserved

2. Terminology

2.1 Direction of flight

2.1.1 Describe direction using the following methods:

- (a) as a 3 figure group;
- (b) as a 2 figure group;
- (c) in the clock code.

2.1.2 Define the meaning of aircraft heading (HDG).

2.1.3 Describe the differences between the following terms when used to describe direction:

- (a) true (T);
- (b) magnetic (M);
- (c) compass (C).

2.2 Distance, speed and velocity

2.2.1 State the units used for lateral distance in respect of the following:

- (a) navigation;
- (b) visibility.

2.2.2 Define the meaning of knot (kt) when used to express aircraft speed.

2.2.3 Define wind velocity (W/V).

2.2.4 Differentiate between the following acronyms:

- (a) IAS;
- (b) CAS;
- (c) TAS;
- (d) GS.

2.3 Time

2.3.1 Express time as a 4 figure group (24 hour time).

2.3.2 Convert local standard time to UTC.

2.3.3 Convert UTC to local standard time.

2.4 Units of measurement

2.4.1 State the units used to describe vertical measurement and the differences between the following:

- (a) height;
- (b) altitude;
- (c) elevation.

2.4.2 State the unit of measurement used to express:

- (a) runway dimensions;
- (b) temperature;
- (c) atmospheric pressure;
- (d) weight;

- (e) volume (liquids);
- (f) visibility.

2.5 Basic physics

- 2.5.1 Describe the meaning of kinetic and potential energy and the relationship to basic aircraft operations.
- 2.5.2 Describe the meaning of 'aircraft energy state' with respect to kinetic and potential energy.
- 2.5.3 Describe the effects on 'aircraft energy state' of acceleration, deceleration, climb and descent.

3. Power plants and systems – basics

3.1 Piston engine aircraft

- 3.1.1 Describe the basic principle of operation of a 4 stroke cycle internal combustion engine and state the purpose and function of the following components:
 - (a) cylinders;
 - (b) pistons;
 - (c) piston rings;
 - (d) inlet/exhaust valves;
 - (e) crank shaft;
 - (f) cam shaft;
 - (g) spark plugs.
- 3.1.2 Describe the effect of increasing altitude and temperature on engine performance and how the following affect the power output of an engine:
 - (a) throttle lever position;
 - (b) RPM.
- 3.1.3 State the function of the following engine components and/or features:
 - (a) carburettor;
 - (b) throttle;
 - (c) magneto, dual ignition;
 - (d) alternator;
 - (e) battery, battery compartment vent;
 - (f) propeller;
 - (g) circuit breaker, fuse, bus bar;
 - (h) impulse start;
 - (i) oil cooler;
 - (j) fuel tank vents.
- 3.1.4 In relation to power plants and systems, state the purpose and importance of monitoring the following gauges:
 - (a) RPM (tachometer);
 - (b) CHT and EGT;
 - (c) voltmeter, ammeter, loadmeter;
 - (d) fuel pressure;
 - (e) oil temperature and pressure.
- 3.1.5 Describe the purpose and function of an engine lubrication system in relation to engine cooling.
- 3.1.6 State the purpose of mixture control and describe the effect of excessively rich and lean mixture strengths on engine operation.

- 3.1.7 Describe the advantages and disadvantages of a simple carburettor and a direct injection system.
- 3.1.8 List typical services provided by the following systems in a light aircraft and the actions a pilot would take to rectify or detect a malfunction:
- (a) hydraulic system;
 - (b) electrical system;
 - (c) ignition system;
 - (d) vacuum system.

3.2 Fuels and oils

- 3.2.1 Describe the following in relation to fuels:
- (a) the sources of fuel contamination;
 - (b) the advantages and disadvantages of fuelling prior to overnight parking;
 - (c) how to identify different grades of aviation fuel;
 - (d) the hazards/problems with:
 - (i) mixing different hydraulic fluids;
 - (ii) using incorrect grades of fuel.

3.3 Engine handling

- 3.3.1 State the causes and effects of detonation, limited to improper use of mixture control, MP/RPM, and use of incorrect fuel octane.
- 3.3.2 Describe the effect on an engine of the following:
- (a) prolonged idling;
 - (b) using incorrect mixture settings in flight.
- 3.3.3 State reasons for the following limitations/actions:
- (a) minimum oil pressure;
 - (b) minimum/maximum oil temperature;
 - (c) minimum/maximum CHT;
 - (d) maximum RPM;
 - (e) ignition checks: pre-take-off and shutdown;
 - (f) prolonged use of starter motor;
 - (g) use of pitot heat on the ground;
 - (h) engine warm up on prolonged descents.
- 3.3.4 Explain the significance of blue or black exhaust smoke produced by an aircraft piston engine.

3.4 Malfunctions

- 3.4.1 For paragraphs (a), (b) and (c), the components are listed in paragraph (d):
- (a) describe the cockpit indications which may suggest a malfunction or failure of a component;
 - (b) state the actions (if any) a pilot should take to rectify a malfunction or failure of a component;
 - (c) describe the consequences if a malfunction or failure of a component listed above cannot be rectified;
 - (d) the following is a list of components that applies to paragraphs (a), (b) and (c):
 - (i) alternator;
 - (i) magneto;
 - (ii) battery;
 - (iii) ignition switch;
 - (iv) fuel vent (blockage), fuel/booster pump;

- (v) oil cooler, cowl flaps;
 - (vi) vacuum pump;
 - (vii) hydraulic brakes.
- 3.4.2 For paragraphs (a) and (b), the piston-engine gauges are listed in paragraph (c):
- (a) with reference to engine gauge indications, identify reasons for an abnormality and state pilot actions (if any) to rectify a problem;
 - (b) state the consequences if the problem cannot be rectified by the pilot;
 - (c) the following is a list of piston-engine gauges that applies to paragraphs (a) and (b):
 - (i) oil temperature and pressure;
 - (i) CHT;
 - (ii) fuel pressure;
 - (iii) tachometer;
 - (iv) ammeter/load meter;
 - (v) voltmeter;
 - (vi) engine icing.
- 3.4.3 Describe the method for checking the operation of carburettor heat prior to take-off.
- 3.4.4 State the atmospheric conditions of outside air temperature and relative humidity, engine control settings and power conditions which are conducive to the formation in a carburettor, including the severity of the icing, of the following:
- (a) throttle ice;
 - (b) fuel evaporation ice;
 - (c) impact ice.
- 3.4.5 State the danger of progressive throttle increments if engine icing is not diagnosed.
- 3.4.6 Describe the use of carburettor heat for:
- (a) anti-icing;
 - (b) de-icing;
 - (c) ground operation.
- 3.4.7 Describe the difference between the use of 'alternate air' and 'carburettor heat' controls.
- 3.4.8 State the effect of the application of carburettor heat on engine performance and engine instrument indications.
- 3.4.9 Describe the symptoms of fuel vaporisation and the method of rectification.

3.5 Flight instruments

- 3.5.1 Explain the colour code markings on an airspeed indicator (ASI).
- 3.5.2 Describe the basic operation of the primary flight instruments and associated systems.
- 3.5.3 State:
- (a) the effect of a blockage of the pitot or static source on the indications displayed by each pressure instrument; and
 - (b) the effect of using an alternate static source located inside the cockpit, on the reliability of pressure instrument indications; and
 - (c) the effect of low suction and loss of electrical power on the reliability of the gyroscopic flight instruments; and
 - (d) the causes of toppling of gyroscopic instruments and identify conditions under which they would re-erect; and
 - (e) how, when and why a directional indicating gyro should be synchronised with the magnetic compass.
- 3.5.4 Describe the methods to determine the serviceability of the primary flight instruments and magnetic compass.

4. Aerodynamics

4.1 Basic aerodynamics

4.1.1 Basic physics – aircraft energy state in terms of the following:

- (a) kinetic energy;
- (b) potential energy;
- (c) inertia.

4.1.2 Explain the meaning of the following terms:

- (a) aerofoil, angle of attack, relative airflow;
- (b) centre of pressure, centre of gravity;
- (c) lift, weight, thrust, drag.

4.1.3 Describe the meaning of the following terms in respect of an aerofoil:

- (a) chord;
- (b) span;
- (c) camber;
- (d) aerodynamic stall.

4.2 Lift and drag

4.2.1 State whether lift and drag of an aerofoil will increase or decrease with changes in the following:

- (a) airspeed;
- (b) angle of attack.

4.2.2 Explain the following types of drag which affect a subsonic aircraft in flight:

- (a) parasite (zero lift) – form, interference, skin friction;
- (b) induced (lift dependent).

4.2.3 State how total drag varies with airspeed.

4.3 Climbing

4.3.1 Describe the difference between rate of climb and angle of climb.

4.4 Wake turbulence

4.4.1 List the factors that affect the strength of vortex flow with respect to the following:

- (a) aircraft weight;
- (b) speed;
- (c) wing shape.

4.4.2 State the primary control hazard that may result from a vortex encounter.

4.4.3 Describe the following:

- (a) approximate flow direction around each vortex; and
- (b) approximate location of vortices (in still air) generated by a preceding aeroplane during:
 - (i) cruise flight; and
 - (ii) take-off and landing; and
- (c) approximate take-off/touchdown points and flight profiles which should be used to avoid wake turbulence.

4.4.4 State the effect of wind and atmospheric turbulence on the following:

- (a) strength of vortices;
- (b) longevity of vortices;
- (c) location and direction of movement of vortices.

4.5 Thrust stream turbulence (jet blast or rotor downwash)

- 4.5.1 Describe how the hazard from thrust stream turbulence varies with changes in engine power and distance from the source.

5. Navigation**5.1 Charts**

- 5.1.1 Identify the major features displayed on visual charts.
- 5.1.2 State the charts used to identify controlled airspace (CTA) and prohibited, restricted and danger (PRD) areas.

5.2 Documentation

- 5.2.1 Determine runway data from ERSA for a given airport.
- 5.2.2 Determine data pertaining to Prohibited, Restricted and Danger areas.
- 5.2.3 Use ERSA to determine the time a restricted area is active.

6. Operations, performance and planning**6.1 Airworthiness and aircraft equipment**

- 6.1.1 State the documents required to determine the serviceability of an aircraft.
- 6.1.2 Describe how to certify the aircraft for flight.
- 6.1.3 Describe the process to record an aircraft defect on a release to service document (maintenance release).

6.2 Take-off and landing performance

- 6.2.1 Differentiate between pressure height and density height.
- 6.2.2 Describe how to use an altimeter to obtain:
- local QNH at an aerodrome;
 - pressure height of an aerodrome;
 - elevation of an aerodrome.
- 6.2.3 Calculate the following:
- density altitude given pressure altitude (or elevation and QNH) and temperature;
 - pressure altitude given airfield elevation and QNH.
- 6.2.4 State the effect (increase/decrease) of the following factors on take-off, landing, and take-off climb performance:
- strength of headwind/tailwind component;
 - air temperature;
 - QNH;
 - airfield elevation;
 - ground effect and windshear;
 - frost on an aircraft.
- 6.2.5 Explain the following terms:
- maximum structural take-off and landing weight;
 - climb weight limit.

6.3 Speed limitations

- 6.3.1 Explain the following terms/abbreviations:
- normal operating speed (V_{NO});
 - never exceed speed (V_{NE});
 - maximum manoeuvre speed (V_A);

- (d) turbulence penetration speed (V_B);
 - (e) limit and design load factors.
- 6.3.2 Describe situations which may result in an aircraft exceeding speed limits and load factor limits.

6.4 Weight and balance

- 6.4.1 Explain the meaning of the following terms used in the computation of weight and balance data:
- (a) datum;
 - (b) arm;
 - (c) moment;
 - (d) station;
 - (e) centre of gravity and limits;
 - (f) empty weight;
 - (g) operating weight;
 - (h) MTOW;
 - (i) zero fuel weight (MZFW);
 - (j) MLW.
- 6.4.2 Calculate the following weight and balance information:
- (a) MTOW;
 - (b) capacity and arm of the baggage lockers;
 - (c) capacity, arm, grade and specific gravity of the fuel;
 - (d) location and arms of the seating.
- 6.4.3 Determine if an aircraft is loaded within the prescribed CG for the aircraft.
- 6.4.4 State the likely results of exceeding aircraft weight limits.

Unit 1.1.2 RBKA: Basic aeronautical knowledge – aeroplane**1. Reserved****2. Power plants and systems****2.1 Piston engine**

- 2.1.1 Describe the method of using a manual mixture control for an aircraft piston engine fitted with a fixed pitch propeller.
- 2.1.2 State what indications would signify the presence of engine icing in an aircraft fitted with a fixed pitch propeller.

3. Aerodynamics**3.1 Lift and drag**

- 3.1.1 State whether lift and drag of an aerofoil will increase or decrease with changes in flap settings.
- 3.1.2 For the following, recall the typical angles of attack at which a basic low-speed aerofoil:
 - (a) generates maximum lift (16°);
 - (b) is most efficient (best L/D: 4°).
- 3.1.3 Describe how the angles of attack relate to the following:
 - (a) stall speed;
 - (b) best glide speed.
- 3.1.4 State the relationship between attitude, angle of attack and airspeed in level flight.

3.2 Flight controls

- 3.2.1 Describe the primary and further effects of the elevator, rudder and aileron on an aeroplane's movement about its longitudinal, lateral and normal (vertical) axes.
- 3.2.2 Describe the effect of changes in power and airspeed on pitch trim and on the effectiveness of the elevator, rudder and ailerons.
- 3.2.3 Describe the purpose of trim controls.
- 3.2.4 State the effect of lowering or raising flap on lift, drag and attitude.

3.3 Climbing

- 3.3.1 State the effect (increase/decrease) on climb rate and angle resulting from changes in the following:
 - (a) weight;
 - (b) power;
 - (c) airspeed (changed from recommended);
 - (d) flap deflection;
 - (e) headwind/tailwind component, windshear;
 - (f) bank angle;
 - (g) altitude and density altitude.

3.4 Descents

- 3.4.1 State the effect on rate, angle of descent and attitude resulting from changes in the following:
 - (a) power – constant IAS;
 - (b) flap – constant IAS.
- 3.4.2 State the effect of headwind/tailwind on the glide path and glide distance (relevant to the earth's surface).

- 3.4.3 Explain why gliding at any indicated airspeed other than the recommended glide speed will reduce the distance that can be achieved in still air.

3.5 Turning

- 3.5.1 Describe what is meant by a balanced turn.
- 3.5.2 Describe the terms 'g' wing loading load factor.
- 3.5.3 During a level turn, state the effect (increase/decrease) of bank angle on the following:
- (a) stall IAS, including the rate of increase of stall speed with increasing bank;
 - (b) the aircraft's structure (load factor) and possible airframe damage if limits are exceeded.
- 3.5.4 List reasons for avoiding steep turns:
- (a) shortly after take-off; and
 - (b) during a glide, particularly on approach to land.
- 3.5.5 Explain why an aeroplane executing balanced level turns at low level may appear to slip or skid when turning downwind or into wind.
- 3.5.6 Given level flight stall speed, determine the stall speed and load factor during turns at 45 and 60 degrees bank.

3.6 Stalling, spinning and spiral dives

- 3.6.1 Describe:
- (a) the symptoms when approaching the stall; and
 - (b) the characteristics of a stall.
- 3.6.2 Explain:
- (a) the effect of using ailerons when approaching and during the stall; and
 - (b) why an aeroplane may stall at different speeds.
- 3.6.3 State the effect (increase/decrease/nil) of the following variables on the level flight stall IAS:
- (a) power;
 - (b) flap;
 - (c) wind shear vertical gusts;
 - (d) manoeuvres;
 - (e) weight;
 - (f) frost and ice;
 - (g) altitude.
- 3.6.4 Describe the aerodynamic principles of stall recovery.
- 3.6.5 Describe manoeuvres during which an aeroplane may stall at an angle which appears to be different to the true stalling angle.
- 3.6.6 Differentiate between a spin and a spiral dive in a light aeroplane and describe the standard recovery technique from each.

3.7 Taxi, take-off, landing

- 3.7.1 Describe situations which may cause an aeroplane to 'wheel barrow' and state the recommended pilot action in the event of such an occurrence.
- 3.7.2 Describe the effect of a cross-wind on high- and low-wing aeroplanes during taxi, take-off and landing.
- 3.7.3 List the advantages of taking-off and landing into wind.
- 3.7.4 Compare a flapless approach to an approach with flap in terms of:
- (a) attitude during descent; and
 - (b) approach path angle; and
 - (c) threshold and touchdown speeds; and

(d) landing roll.

3.7.5 Describe the effect of wind shear (wind gradient) and ground effect on aerodynamic and flight characteristics and identify.

3.8 Structural damage

3.8.1 Describe the effect of structural damage, including bird strikes, with emphasis on:

- (a) stall characteristics; and
- (b) controllability.

4. Operations and performance

4.1 Take-off and landing performance

4.1.1 State the effect (increase/decrease) of the following factors on take-off, landing, and take-off climb performance:

- (a) runway slope;
- (b) wet runway surface;
- (c) slushy runway surface.

4.2 Aircraft limitations

4.2.1 Explain the following terms/abbreviations:

- (a) flap operating speed (V_{FO});
- (b) flap extended speed (V_{FE}).

Unit 1.1.3 RBKH: RPL Basic aeronautical knowledge – helicopter**1. Reserved****2. Power plants and systems****2.1 Piston engine**

- 2.1.1 Describe the method of setting the correct mixture in a helicopter fitted with a piston engine.
- 2.1.2 State what indications would signify the presence of carburettor or induction ice.

2.2 Helicopter engines and systems

- 2.2.1 Describe pilot actions that can be performed to rectify a malfunction related to the following:
 - (a) main and tail rotor systems:
 - (i) abnormal vibrations from main and tail rotor systems;
 - (ii) flight control systems;
 - (iii) trimming devices;
 - (iv) stabilisers;
 - (b) transmissions:
 - (i) clutches;
 - (ii) free-wheel units;
 - (iii) rotor brakes;
 - (c) oil systems:
 - (i) reservoirs;
 - (ii) pressure pumps and filters;
 - (iii) pressure gauges;
 - (iv) temperature gauges;
 - (v) scavenge pumps;
 - (vi) oil coolers;
 - (vii) pressure relief valves;
 - (viii) oil cooler by-pass valves;
 - (ix) dipsticks.

3. Aerodynamics – helicopter**3.1 Lift and drag**

- 3.1.1 State the aerodynamic properties of a rotor blade in respect of the following:
 - (a) aerofoil shape;
 - (b) blade twist;
 - (c) blade taper.
- 3.1.2 Match each of the following terms with an appropriate definition:
 - (a) rotor thrust;
 - (b) rotor drag;
 - (c) total reaction;
 - (d) relative airflow;
 - (e) rotational airflow;
 - (f) induced airflow;
 - (g) centrifugal reaction;
 - (h) rotor disc;

- (i) coning angle.

3.2 Hovering flight

3.2.1 Label a diagram showing the vectors acting on a rotor blade in hovering flight.

3.2.2 Define each of the following terms:

- (a) ground effect;
- (b) tail rotor drift;
- (c) rotor shaft tilt effect;
- (d) re-circulation.

3.2.3 Describe each of the following:

- (a) vortex ring state (settling with power);
- (b) loss of tail rotor effectiveness (LTE);
- (c) the conditions leading to LTE;
- (d) the appropriate recovery action.

3.3 Rotor blade freedom of movement

3.3.1 In regard to rotor blade freedom of movement describe each of the following terms:

- (a) feathering;
- (b) flapping;
- (c) flapping to equality;
- (d) dragging;
- (e) advance angle;
- (f) phase lag.

3.4 Forward flight

3.4.1 In regard to forward flight, define the following terms:

- (a) dissymmetry of lift;
- (b) flapback;
- (c) cyclic limits;
- (d) airflow reversal;
- (e) retreating blade stall;
- (f) compressibility;
- (g) inflow roll;
- (h) translational lift.

3.4.2 Describe the vectors acting on various sections of a rotor blade in forward flight.

3.5 Power requirements

3.5.1 Define each of the following terms:

- (a) rotor profile drag;
- (b) induced drag;
- (c) parasite drag.

3.5.2 Describe the power available and power required curves and their relationship to the following:

- (a) best speed for range;
- (b) best speed for endurance;
- (c) best rate of climb;
- (d) best angle of climb.

3.5.3 Select from a list, the statement which best describes:

- (a) overpitching;

- (b) the conditions leading thereto;
- (c) the appropriate recovery action.

3.6 **Autorotative flight**

- 3.6.1 Describe the following terms:
 - (a) autorotative force;
 - (b) autorotative section.
- 3.6.2 Describe the effect on autorotative flight from variations in the following:
 - (a) all-up-weight;
 - (b) density altitude;
 - (c) airspeed;
 - (d) rotor RPM.
- 3.6.3 Label a diagram showing the vectors acting on a rotor blade section during forward autorotative flight.
- 3.6.4 Label a diagram showing the vectors acting on a rotor blade section during an autorotative flare.

3.7 **Other conditions**

- 3.7.1 Select from a list the statement which best describes:
 - (a) ground resonance;
 - (b) mast bumping;
 - (c) dynamic roll-over;
 - (d) the conditions leading to:
 - (i) ground resonance;
 - (ii) mast bumping;
 - (iii) dynamic roll-over;
 - (e) the appropriate recovery action for each condition in paragraph (d).

4. **Operations, performance and planning**

4.1 **Helicopter limitations**

- 4.1.1 State the reasons for the following limitations:
 - (a) maximum rotor RPM – power on;
 - (b) maximum rotor RPM – power off;
 - (c) minimum rotor RPM – power on;
 - (d) minimum rotor RPM – power off;
 - (e) never exceed speed – power on;
 - (f) never exceed speed – power off;
 - (g) maximum sideways speed;
 - (h) maximum rearward speed;
 - (i) maximum take-off weight;
 - (j) maximum all up weight;
 - (k) minimum operating weight;
 - (l) maximum positive and negative flight load factors.

4.2 **Helicopter landing sites**

- 4.2.1 Recall the requirements for basic and secondary HLS in respect of the following:
 - (a) physical specifications;
 - (b) operational requirements;
 - (c) general conditions of use.

4.3 Take-off and landing weight

- 4.3.1 Describe the effect of the following variables on the take-off and/or landing performance of a helicopter:
- (a) weight;
 - (b) power;
 - (c) ground effect.
- 4.3.2 Determine hover performance in and out of ground effect given the following:
- (a) gross weight;
 - (b) pressure altitude;
 - (c) temperature;
 - (d) flight manual performance charts.

4.4 Weight and balance

- 4.4.1 Recall the meaning of the term 'lateral centre of gravity range' when it is used in the computation of weight and balance data.

Unit 1.1.4 **RBKG:** **RPL Basic aeronautical knowledge – gyroplane – *Reserved***

Unit 1.1.5 **RBKS:** **RPL Basic aeronautical knowledge – airship – *Reserved***