SECTION 7 HANDLING

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7.1 BEFORE FLIGHT

7.1.1 Before Starting the Engine

Check that the aircraft documentation is in order and that no dated or airframe hours lifed items are due for attention. Calculate the centre of gravity to ensure that it will remain within limits for the entire flight (Section 8.1).

Carry out a pre-flight inspection as detailed in the FRCs, which meets the requirement of the CAA/LAMS schedule.

7.1.2 Starting the Engine

Start the engine using the checks and drills in the FRCs. Note the warnings on the significance of the Starter warning light.

The same priming and starting drill can be applied whether the engine is hot or cold. The most likely cause of failure to start is over-priming so the drill should be followed carefully. With the fuel on, the throttle a quarter open and the mixture at cutoff, switch the fuel pump on. Move the mixture control to full rich until a slight but steady fuel flow is noticed and return the mixture control to cutoff. Switch the fuel pump off. Select the left (impulse) magneto and engage the starter. Immediately the engine fires, release the starter, select magnetos to "both" and move the mixture control smoothly to fully rich. If the engine is hot it may be found easier to start the engine without any priming. Starting should always be carried out with the mixture control initially in the lean cutoff position as described above.

If the starter motor is operated for a total of 30 seconds in any 15 minute period, a wait of 15 minutes should be observed before any further attempt is made to start so that the starter motor can cool and the battery stabilize.

Should the engine fail to start after a maximum of 10 seconds starter use, it may be that the engine is over-primed. The following drill should then be followed to avoid running out of starter time. Leave the magneto on Left and the fuel at cutoff; open the throttle fully; operate the starter for 5 seconds; this will drain the fuel from the cylinders and the engine may actually start; if it starts, quickly return the throttle to a quarter open and put the mixture to fully rich. If it does not start, set the throttle at a quarter open, leave the mixture at cutoff and the magneto on Left, and attempt another start without re-priming. If the engine still will not start it should be left for 15 minutes to allow the starter to cool. A normal start should then be attempted. Experience has provided many permutations of the failed starting drill, many of which will vary from the above and may on occasions be more successful. Whatever drill is used the limitations on starter use must be observed.

It is important that the engine is not left at idling on the ground for longer than is necessary during taxying. At all other times the engine should be set to 1200 RPM to reduce the danger of sparking plug fouling.

7.1.3 Testing the Engine

The dead cut/live magneto check is carried out after starting. Set 1200 RPM and select magneto to 'R', ensuring that there is an RPM drop but that the engine does not stop; re-select 'both' and repeat the check with magneto 'L'. As the engine is normally stopped by cutting off the fuel, this check is the only one which can easily ascertain whether a magneto is permanently live.

The engine run should only be done after 4 minutes warm-up or with the engine oil temperature at least in the yellow/green. It is done at 1800 RPM by selecting 'R' and checking that the RPM does decrease but not by more than 175 whilst the engine continues to run smoothly. 'Both' is then re-selected and the RPM allowed to stabilize at 1800 for a few seconds. The same procedure is then repeated for the 'L' magneto and, additionally, it is checked that the RPM difference between 'L' and 'R' is not more than 50.

7.1.4 Testing the Constant Speed Unit

The test of the constant speed unit achieves two objectives. Firstly it checks that the propeller pitch responds to the demands of the propeller RPM control; secondly it circulates the cold oil in the propeller hub and replaces it with warmed oil, allowing the pitch change mechanism to move more smoothly and freely. It should be done on the first flight of each day and whenever the engine is cold.

To test the unit, use the throttle to set 1800 RPM leaving the propeller control at maximum RPM. Then move the propeller control to the minimum RPM position. Note that the RPM starts to fall. Move the propeller control back to maximum RPM before the RPM falls by more than 500. Repeat the whole procedure a second time to change the oil in the propeller hub.

7.1.5 Taxying

Do not attempt to move the rudder pedals when the aircraft is not moving. To taxy, close the throttle and release the parking brake. It may be necessary to use some power to start the aircraft moving but, as soon as it moves, close the throttle and re-apply the toe brakes momentarily to ensure that they are working.

To turn the aircraft on the ground the nosewheel steering must be used. The brakes should not be used alone for turning as this will lead to excessive side loads on the nose tyre and leg. If very tight turning is required the rudder should be moved fully in the required direction and light braking applied on the appropriate (inside) wheel. Uneven ground should be crossed slowly.

7.2 HANDLING IN FLIGHT

7.2.1 Takeoff

After testing the engine, which should be done on every flight and not just on the first flight of each day, carry out the takeoff checks from the FRCs. Takeoff performances are given in Section 5.

Line the aircraft up on the takeoff path, release the brakes and open the throttle fully in about 2 seconds. Check that the RPM is a minimum of 2550 and that the oil pressure, oil temperature and cylinder head temperature are not red. There is little tendency for the aircraft to swing for reasons of torque or slipstream effects as the aircraft has been designed to minimise these characteristics. The nosewheel should be lifted just clear of the ground at 45 kts and the aircraft flown off at 55 kts with takeoff flap or 59 kts flapless.

7.2.2 Crosswind Takeoff

If the wind is approaching the crosswind limit of 25 kts, the nosewheel should not be raised until the takeoff speed when the aircraft should be rotated cleanly to the climbing altitude. Any tendency for the upwind wing to lift during a crosswind takeoff should be corrected by the use of ailerons.

7.2.3 Climb

Initially climb at a shallow angle, allowing the speed to increase to 76 kts clean, 70 kts with takeoff flap. At 200 ft, apply the brakes momentarily to stop any vibration from the rotating mainwheels and raise the flaps in stages, increasing to the appropriate speeds, until the flaps are up. There is little sink or trim change whilst the flaps are raised unless the aircraft is significantly below the correct speed. Climb at 77 kts at full throttle, checking that the RPM is approximately 2650 - 2700 RPM. Reduce the climbing speed by 5 kts every 5000 ft. The aircraft will initially climb at approximately 1300 - 1400 ft/min, depending on weight, temperature and height.

The mixture should be left at fully rich at all power settings above 75% unless this results in rough running; in this case progressively weaken the mixture and observe the manifold pressure. As the mixture is weakened, the manifold pressure will stay steady but then start decreasing. Some uneven engine running may also be apparent at this point, richen the mixture again until smooth running is regained and the manifold pressure returns to the original figure; leave the mixture at this setting. It is unlikely that any mixture adjustments will be needed below 5000 ft amsl in the climb. It should be remembered that this mixture setting is appropriate for only one combination of manifold pressure, altitude and engine RPM, and a change in any of these factors will result in the need to reset the mixture.

The mixture should always be set to fully rich before descending as the weaker mixtures applicable to flight at altitude are too weak for correct engine operation at lower levels; thus the engine may not respond correctly to throttle opening at the bottom of the descent if weak mixture is still selected.

7.2.4 General Flying

Introduction The limitations and centre of gravity requirements should always be checked before any flight to ensure that the aircraft parameters will be complied with.

Flying Controls The flying controls are well-balanced and very little rudder is required with aileron application as the ailerons cause little asymmetric drag, even at full aileron deflection.

Trimmer The elevator trimmer is very powerful and care should be exercised in its use. The out-of-trim forces require firm but manageable pressure if the trimmer is operated to either extreme within the speed range. There are no rudder or aileron trimmers available to the pilot. The directional trim changes associated with power and speed alterations require the use of only small rudder pedal movements to maintain balanced flight.

Power Mixture Changes Alterations in power settings cause pitch/yaw movements, the movements being proportional to the power change. The propeller turns clockwise, the following pitch/yaw changes occurring with power alterations:

	Power Increase	Power Decrease
Pitch	Nose Up	Nose Down
Yaw	Nose Left	Nose Right

The mixture control should invariably be set to fully rich before any change in power setting is made as the change may result in too weak a mixture and consequent rough running or high cylinder head temperatures. Mixture adjustments in the cruise should be made using the same procedure as outlined for the climb. The engine performance figures for climb, cruise and endurance are given in Section 5.

> Flaps The maximum speed for operating the flaps is 120 kts IAS takeoff position and 98 kts IAS landing position. The flaps can be operated with < little effort in the air at the normal circuit speeds, but more effort is needed at the upper speed limit. Care must be taken to ensure that the flap lever is locked in the selected position after operation. Should the flaps be left unlocked they will tend to move to the down position at low speed; this may be significant, particularly during stalling or aerobatics when the changed flight characteristics and limitations may result in unexpected aircraft behaviour or overstressing.

There is little trim change unless the flaps are operated at the extreme of the speed limit. There is significant change in lift characteristics and little drag penalty with takeoff flap (18°); landing flap (40°) selection results in very little more lift but a large increase in drag. The trim changes are as follows, the aircraft staying in level flight during all flap selections:

	88 kts	50 kts
Flap from up to takeoff	Nose pitches down	Very slight nose down pitch
Flap from takeoff to landing	Nose pitches further down	Negligible pitch
Flap from landing to takeoff	Nose pitches up slightly	Negligible pitch
Flap from takeoff to up	Nose pitches up more strongly	Slight pitch nose down

Stability The aircraft is neutrally stable in roll and has nil aileron breakout force which gives good response and a good rate of roll. The ailerons have exceptional drag balance during aileron application; very little rudder is needed to maintain balanced flight during rolling manoeuvres, even with full aileron appalication. The aircraft is stable in pitch and is easily trimmed. There is no tendency for the aircraft to become unstable in pitch at extremes of speed or 'g'.

Sideslipping The aircraft can be side-slipped well and the rate of height loss can be increased markedly by this method. The following figures give a guide.

ENGINE - Idle INDICATED AIR SPEED - 60 Kts

	No sideslip	Full left rudder	Full right rudder
R of D	700 ft/min	1250 ft/min	1050 ft/min

Reduced Visibility Flying In poor visibility it may be felt prudent to fly at reduced airspeed. The safest speed to fly is 70 kts as this represents a good speed for aircraft controllability and is also the best climbing angle speed, allowing best climb performance, should near obstacles be sighted. The best climb angle performance requires half flap at 70 kts and this should be put down whilst flying at reduced airspeed as it also results in a lower nose position giving a better field of view.

Turbulence If turbulence becomes violent enough to cause concern, the aircraft should be flown at 75 kts with the flaps up. This gives a safe margin of speed over the stalling or overstressing conditions that can result from turbulence.

Icing Conditions The aircraft is not cleared for flight in icing conditions as there is no airframe or wing protection. These conditions must be avoided and every effort must be made to fly clear of them if they are encountered inadvertently. The engine icing protection can automatically allow for air filter blocking.

> Gliding The aircraft glides well at 80 kts, covering across the ground about ten and a half times the height lost in still air. The average gliding performance is as follows, varying with height, temperature and weight (Ref graph in Section 5).

	Speed	Rate of Descent	Glide Angle Still Air
AUW 2150 lbs Engine Off Propellor Windmilling	80kts	870 ft/min	1:09.1 or 1.5 Nm/1000ft <

During a prolonged glide there is a risk of over-cooling the engine which might result in the engine subsequently not responding properly to throttle opening. Two precautions should be taken to counter this risk. Firstly the engine should be warmed and the plugs cleared by opening the throttle smoothly to full power and back every 1000 ft in glide. The second precaution against over-cooling is to open up the throttle very steadily in about 4 seconds when overshooting at the bottom of the glide. It must be remembered that there is a significant difference in the rate of descent between engine idling and propellor windmilling and realistic practice should concentrate on the much more likely cause of a failed engine, ie propellor windmilling.

7.2.5 Stalling in Level Flight

The aircraft has little aerodynamic stall warning in level flight, the approaching stall being signalled by the warning buzzer. Mild wing drop may occur in any configuration but this can always be halted by the application of opposite rudder during recovery. Ailerons remain effective up to the stall but care should be taken in the use of ailerons to keep the wings level if the stall should be prolonged. The approximate stalling speeds (IAS) are as follows:

>	975 kg (2150 lb)
Flaps up power off	57 kts
(18°) Takeoff flap, power off	54 kts
(40°) Landing flap, power off	51 kts <
Regulation of stall warning horn	7 - 10 kts above stalling speed

With practice a full stall may be recovered within 50 ft but if the recovery is initiated at the sound of the stall warning there should be no height loss in any configuration.

Recovery is effected by applying enough rudder to stop any further wing drop and, at the same time, moving the control column forward to unstall the wings; very little control column movement is normally necessary. If the engine power is available it should be fully applied immediately.

7.2.6 Stalling in a Turn

In a level turn the bank will either increase or decrease at the stall, but this tendency can be immediately controlled by conventional recovery action.

7.2.7 'g' Stalling

If the aircraft is deliberately pulled to the stalling angle of attack above the stalling speed, there is aerodynamic stall warning in the form of elevator buffet felt through the control column. This buffet occurs just before the aircraft stalls. At the stall the rate of pitch decreases and, if further back pressure is applied the aircraft will tend to drop a wing. If this occurs during a turn the aircraft will either roll out of the turn or roll into the turn and this is not entirely predictable or consistent. If the control column is immediately moved forward to unstall the wings, the roll will stop and autorotation or spinning will not develop.

7.2.8 'Flick' Manoeuvres

If pro-spin control is applied above the stalling speed the aircraft will flick and enter a spin in the direction of the applied control. The rate of rotation is initially very rapid but the aircraft responds immediately to corrective control action. Dependent on the airspeed at entry, the aircraft will settle into a conventional spin after one to two turns after the flick. Unless correct pro-spin or anti spin control application is applied, the aircraft may enter a spiral dive with the speed increasing very rapidly and the risk that VNO (140 kts) will be exceeded during recovery. Disorientation may occur during the initial high rotation rate of the aircraft and it is recommended that flick manoeuvres are not attempted by inexperienced pilots before adequate demonstration and supervision has been received. As the 'g' forces during flick manoeuvres will exceed 2'g', they should never be attempted with the flaps extended. Deliberate flick manoeuvres should not be entered above 70 kts IAS.

7.2.9 Erect Spinning

(a) Entry Height The height loss is about 250 ft per turn and recovery takes about 500 ft. These height losses may vary, dependant on how many turns of the spin are done and how prompt and correct the recovery action is. They may be used as a basis for planning recovery which should be complete by 1500 ft above ground level. It is recommended that inexperienced pilots allow a further 1000 ft to the entry height. Thus the entry height for a 4 turn spin for an inexperienced pilot should be:

4 turns 4 x 250	1000 ft
Recovery	500 ft
Min Height	1500 ft
Safety Allowance	1000 ft
	4000 ft above ground level.

(b) Spin Entry At stall warning apply full rudder in the intended direction of spin and at the same time bring control column centrally fully back. Hold these control positions. If the correct control movements are not applied a spiral dive may develop as shown by an airspeed increasing above 80 kts.

7.2.10 Erect Spin Characteristics

At entry, the aircraft pitches nose up slightly whilst rolling rapidly in the direction of applied rudder. The aircraft rolls almost to the inverted during the first half turn of the spin and then the spin progressively stabilizes over about 3 turns, ending up with about 50° of bank and the nose about 40° below the horizon. The rate of rotation is about 150° per second or 2½ seconds per turn. The average load factor throughout is 1.2G. The IAS stabilizes at about 75 kts to the right and 80 kts to the left. If full pro-spin control is not maintained throughout the spin, the aircraft may enter either a spiral dive or a high rotational spin. A spiral dive is recognized by a rapid increase in airspeed with the rate of rotation probably slowing down as the spin changes to a spiral dive. The wings can be levelled by using aileron with rudders central and the dive then recovered using elevator (whilst observing the 'g' limits). A high rotational spin is recognizable by a steeper nose down attitude and a higher rate of rotation than in a normal spin; airspeed will be higher than a normal spin but will not increase rapidly; recovery is as given in Section 3, Para. 3.7.2 Incorrect Recovery.

7.2.11 Erect Spin Recovery

The following actions are a composite spin recovery procedure and allow for erect spins entered from any configuration.

1. Close the throttle
2. Raise the flaps
3. Check the direction of spin as indicated by the turn co-ordinator
4. Apply and hold full rudder to oppose the direction of spin
5. Holding the ailerons neutral, progressively and firmly move the control column forward until the spin stops. It may be necessary to move it all the way forward to the front stop. The rate of control column movement should be such that it would move from fully back to fully forward in about 3 seconds
6. Immediately the spin stops, centralise the rudder
7. Level the wings with ailerons and recover from the dive

The aircraft will normally stop spinning within 1 turn of the application of the recovery action (see Section 3.7 for high rotational spin recovery). Failure to apply the correct spin recovery actions may delay or prevent exit from the spin, the most common mistakes being the use of less than full opposite rudder and slow or insufficient forward movement of the control column. As the control column is moved forward during the recovery actions, the spin may appear to speed up momentarily before stopping; this is normal and should not be taken as an indication that the aircraft is not recovering.

7.2.12 Inverted Spinning

The aircraft is not cleared for inverted spinning.

7.2.13 Tailslides

The aircraft is likely to suffer control surface damage if allowed to tailslide and this manoeuvre should not be carried out deliberately. If control is lost near the vertical the controls should be centralised and firmly held there until the nose has dropped and flying speed regained. If the throttle was closed the engine will probably stop turning and an air start will be necessary. If a tailslide is thought to have occurred the aircraft should be flown gently and landed for an engineering inspection for damage.

7.2.14 Aerobatics

Aerobatics may be carried out provided the aircraft centre of gravity is within the prescribed limits (See Section 8.1). The recommended entry speeds for an inexperienced pilot are as follows:

Rolling into and out of inverted flight	90 kts
Stabilized inverted flight	80 kts
Slow roll	110 kts
Stall turn entry	110 kts
Stall turn rotate	50 kts
Loop	115 kts
Roll off the top	125 kts
Flick roll max	70 kts

The following precautions should be observed whenever aerobatic flight is undertaken.

1. Check that both wing fuel tanks are still functioning after aerobatic flight and each are capable of providing full fuel flow required for maximum continuous power.

2. Ensure that following aerobatics sufficient fuel will be available in either wing fuel tank to enable the aircraft to return to the nearest airfield.

3. Ensure that aerobatics are carried out at sufficient altitude to recover to normal flight and to switch fuel tanks if the engine should cut.

7.2.15 Inverted Flight

The engine is equipped with an inverted flight oil system and the wing fuel tanks incorporate a flop tube system. Limitations on the oil pressure indications during manoeuvres involving inverted flight are fully described in Section 2.4, and must be observed.

7.3 CIRCUIT AND LANDINGS

7.3.1 Approaching the Landing Pattern

Before joining the circuit or entering any landing procedure or approach pattern, the Rejoin Checks should be carried out as laid out in the FRCs.

7.3.2 Circuit Procedure

Join at 85 kts. Carry out the pre-landing checks in the downwind position. To commence descent reduce the throttle setting to achieve approximately 1500 RPM and lower takeoff flap. Allow the speed to reduce and enter a descent at 75 kts. (78 kts if a flapless circuit is being carried out). Maintain this speed round the final turn until the wings are level on finals. Lower landing flap as required and complete the final checks. The threshold speed of 70 kts with landing flap or 75 kts flapless is achieved by throttling back smoothly as the round-out is commenced. The power setting required will vary with the wind conditions.

7.3.3 Landings

Normal With the round-out complete and the throttle closed, adjust the attitude to keep the aircraft off the ground, allowing the main wheels to touch down at 45 - 50 kts dependent on the AUW. Keep the nosewheel off the ground until 40 kts. This is easily done as the elevator remains effective throughout the landing procedure. Commence braking as necessary. Do not push the control column forward or the propeller tips could touch the ground. Keep straight with nosewheel steering and move the stick progressively aft as speed decreases.

Glide After the end of the downwind leg the speeds to be flown are 70 kts flap up, 70 kts takeoff flap and 60 kts landing flap for threshold speed 55 kts. The final turn can be commenced in about the same position as for a normal circuit and the throttle closed. The two stages of flap are used as required to achieve the touchdown point. The considerable drag of full flap may be used to dive off excess height up to the limiting speed of 88 kts. As the glide approach angle is steeper than for a normal circuit it is necessary to commence round-out slightly higher but the landing is the same as for a normal approach. An actual forced landing would probably be made with the engine failed and windmilling which would result in a higher rate of descent than with the engine idling; thus all practises should be done with the aim of touching down 1/3 way down the landing strip so that there is a margin of safety to allow for the increased rate of descent in the real case. Also it is usually less hazardous to run off the end of a landing strip at 10 kts than to fall short of the beginning at 40 kts; thus it is erring on the safe side to be slightly high.

Short Landing Fly a normal approach until lowering full flap. Reduce the power slightly and allow the speed to fall to 55 kts when power will need to be increased to stop the speed falling further. The round-out and landing are the same as for a normal landing except that power should not be reduced until after the round-out has been commenced. Once the mainwheels are on the ground the nosewheel should be lowered immediately but gently. Braking may then commence with the stick being moved progressively aft as speed decreases. As the approach speeds are significantly lower than for a normal circuit, the pilot must be ready to counter any sink or windshear effect with immediate application of power.

Flapless Landing The aircraft has a very robust manually operated flap system and thus flap failure practice has little relevance. Flapless approach may be practised but, due to the aircraft's excellent gliding performance, the approaches will be very flat; care must be taken to avoid an overshoot. With more than 15 kts headwind a nearly normal glide path angle can be flown at about 1200 RPM but, with less headwind, progressively flatter approaches are required. The speed should be held at 78 kts throughout the final turn and, once wings are level, it should be allowed to reduce to 75 kts through the threshold. The round-out should be smooth and the aircraft should be landed on the mainwheels at 50 kts to reduce the chance of touching the tail bumper.

> Crosswind Landing Landings are permitted within the crosswind limit of 25 < kts. The aircraft should be flown down the extended runway with the wings level using the "crab" technique. The excellent lateral control available results in no difficulty being experienced in holding the wings level as the aircraft is yawed straight with rudder just prior to landing. The ailerons should be held deflected into wind after landing to reduce the possibility of the upwind wing lifting during the ground roll. In high crosswind conditions the nosewheel should be gently lowered as soon as the mainwheels are on the ground so that nosewheel steering is available to assist with directional control. A slight "snatch" may be felt on the rudder pedals when the nosewheel touches the ground as the nosewheel tries to align itself with the direction of travel of the aircraft.

Abandoned Landing A landing should be abandoned if misjudgement or conditions result in a heavy bounce during the attempt to land. The elevator should be held just aft of central and the wings kept level with aileron whilst the throttle is opened fully. Any attempt to apply corrective action is likely to make the situation worse resulting in more serious bounces and probable undercarriage and propeller damage.

Touch-and-go-Landing After landing raise the flaps from the landing (40°) setting to the takeoff (18°) setting. The aircraft should then be flown off the ground at the normal speed of 55 kts and climbed at a shallow angle to reach a climbing speed appropriate to the flap setting as follows: <

Takeoff flap	70 kts
Flap up	77 kts

At 200 ft the flap should be raised.

Going Round Again Open the throttle fully. Climb at the speed appropriate to flap setting and raise the flaps above 200 ft as for a touch-and-go landing.

7.3.4 After Landing

Complete the after landing and closing down checks in the FRCs. Note the flight times and details for entry in the appropriate aircraft documents.

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