PART II
HANDLING

NOTE.—The use of oxygen is advised at all times when the engine is running.

32. **Management of the fuel system**

(i) Without drop tanks.—The locking plate provided should be fitted so that it is not possible to select DROP TANKS ON as this would prevent fuel from being transferred from the wing tanks to the main tank.

(ii) With drop tanks.—Start the engine, warm up, taxy out and take off with the drop tanks selector lever at ON and with the main tank cock ON. Continue to fly until the no-transfer warning light comes on, indicating that the transfer of fuel from the drop tanks has ceased, then select drop tanks OFF and continue the flight on wing tanks.

NOTE.—The drop tanks should not be jettisoned unless operationally necessary. Their drag is small and the gain in range when they are jettisoned is very slight.

33. **Preliminaries**

(i) On entering the cockpit check :

Ignition switches	OFF
Undercarriage lever locking catch	LOCK
Hood spring-loaded locking bolt	Correctly positioned (*see* para. 23 (ii)).

Then switch on the electrical master switch and check :

Undercarriage indicator... ... all lights green.

NOTE.—The cowling gills will be open until the electrical master switch is turned on, when (on early aircraft) they will take up the position selected by the control switch, and (on later aircraft) will close completely unless the engine is hot.

(ii) Check that the footstep is retracted (*see* para. 26).

(iii) Check the operation of the hydraulic handpump by partially lowering, and then raising, the flaps.

(iv) Check that power failure warning light is on.

34. **Starting the engine and warming up**

NOTE.—Where a full run-up is intended, the tail of the aircraft must be securely lashed down.

(i) Set :

Gills (on early aircraft)	OPEN
Throttle	CLOSED
Fuel cut-off control	CUT-OFF
Flaps	UP (selector at VALVE SHUT)
Propeller speed control	OVERRIDE
Carburettor air intake filter control	FILTER (*see* para. 20)
Supercharger control	M (low gear)

(ii) Have the engine turned by hand through at least two revolutions of the propeller in order to avoid the possibility of hydraulic shock damage.

(iii) Turn on the main tank cock (checking the booster pump audibly), and open the throttle to the stop.

(iv) Load the cartridge starter.

(v) Prime the engine with the following number of strokes if cold :

Air Temperature °C.	+30	+20	+10	0
Number of strokes	1	1	2	3

(vi) Switch ON the ignition.

(vii) Press the starter and booster-coil pushbuttons, keeping the latter depressed until the engine is running smoothly. Move the fuel cut-off control to NORMAL as soon as the engine fires and continue to prime, if necessary, until the engine is running smoothly.

(viii) Should the engine fail to start, the fuel cut-off control must be returned immediately to CUT-OFF ; otherwise, fuel will be injected into the engine under pressure and there will be in consequence a serious risk of fire.

(ix) Should a cartridge fail to fire, a wait of one minute should be allowed before the Coffman starter breech is re-indexed.

(x) Screw down the priming pump.

(xi) Run the engine at its lowest steady speed for about one minute, then gradually open up to 1,000 r.p.m. and warm up at this speed.

35. **Testing the engine and services**

While warming up :

(i) Check all temperatures and pressures and test the operation of the hydraulic system by lowering and raising the flaps.

(ii) Test each magneto as a precautionary check before increasing power further.

After warming up to 120°C. (*cylinder*) *and* 15°C. (*oil*) :

(iii) Open up to 0 lb./sq. in. boost and check :

(*a*) That r.p.m. are within 50 of those normally obtained, thus verifying that all cylinders are operating.

NOTE.—Check that the generator is charging the accumulators by noting that the power failure warning light is out.

(*b*) The operation of the supercharger gear change by changing to high gear, noting the momentary drop in oil pressure and the flicker of the r.p.m. indicator.

(*c*) The correct engagement of the high gear clutches by noting that 0 lb./sq. in. boost is maintained and that r.p.m. are 80–100 below those obtained on the power check.

Then change back to low gear and

(*d*) Exercise and check the operation of the constant speed propeller by moving the speed control lever over its full range at least twice. Return it to OVERRIDE.

(*e*) Test each magneto in turn. If the single ignition drop exceeds 50 r.p.m. but there is no undue rough running the ignition should be checked at climbing power (*see* sub-para. (v) below).

NOTE. The following checks should be carried out after repair, inspection other than daily, or at any time at the discretion of the pilot. When these checks are performed the tail must be securely lashed down.

(iv) Open the throttle fully and check take-off boost and static r.p.m.

(v) Throttle back to the climbing gate and, if r.p.m. have fallen below 2,700, test each magneto in turn. If the single ignition drop exceeds 50 the aircraft must not be flown.

36. **Taxying**

(i) Before taxying check :

Brake pressure ... 100–110 lb./sq. in.

Pneumatic supply pressure ... ... 450 lb./sq. in. (if lower, ensure that it has built up during warming up and running up of the engine).

(ii) The brakes are very powerful and must be used with care.

37. **Check list before take-off**

T-Trimming tabs	At full normal load (11,800 lb.)	At overload (12,600 lb.) 2 × 45 gal. drop tanks	At overload (13,750 lb.) 2 × 1,000 lb. bombs
Elevator ...	1 div. nose down	2 divs. nose down	2 divs. nose down
Rudder ...	Fully left	Fully left	Fully left

P —Propeller speed control lever — OVERRIDE

F —Fuel ... ... — Check contents and cock settings. No-transfer warning light out (*see* para. 2 (v)).

F —Flaps ... — UP (Selector at VALVE SHUT)

Gills ... ... — ⅓ open (if manually operated) Check visually.

Supercharger — M (low gear).

Carburettor air intake filter control — FILTER

38. **Take-off**

(i) Always use full throttle for take-off.

(ii) The tendency to swing to the right can be controlled easily by the rudder.

(iii) Retract the undercarriage as early as possible after take-off. Should the undercarriage red lights fail to go out, throttle back and reduce speed to about 145–150 m.p.h. (125–130 knots) I.A.S. when the deceleration will allow the wheels to lock up.

(iv) Move the propeller speed control lever smoothly back to AUTO when comfortably airborne before reducing boost.

39. **Climbing**

(i) Unless operating in dusty or sandy conditions the carburettor air intake filter control should be set to COLD at a height of 2,000 ft.

(ii) The speed for maximum rate of climb is 190 m.p.h. (164 knots) I.A.S. from sea level to 20,000 ft., but there is little loss in rate of climb if speed is increased to 210 m.p.h. (180 knots) I.A.S.

40. **General flying**

(i) *Stability :*

The aircraft is stable laterally and directionally but is unstable longitudinally except on the glide. There is a slight tendency to tighten in turns at medium and high altitudes.

(ii) *Change of trim :*

Undercarriage up	Nose up.
Flaps up	Initially nose down, finally nose up.
Flaps down ...	Nose down (during the first 20° of flap movement the change of trim is marked).
Cockpit hood open	Nose down.

There is a marked change of directional trim with changes in speed and power, moreover, changes in directional trim induce changes in longitudinal trim, left yaw tending to make the nose drop and right yaw tending to make it rise.

These tendencies should be countered by accurate use of the rudder trimming tab. This control is powerful and sensitive and must be used with care.

Operation of the cowling gills produces a marked change of trim and in aircraft fitted with manually operated gills, no attempt should be made to open or close them when in a high speed dive.

(iii) *Flying at reduced airspeed in conditions of poor visibility.* Reduce speed to 200 m.p.h. (172 knots) I.A.S., open the cockpit hood and lower the flaps to 20°, set the propeller speed control lever to give 2,400 r.p.m. and fly at about 170 m.p.h. (146 knots) I.A.S. .

41. **Stalling**

(i) The stalling speeds, engine "off," gills closed, in m.p.h. (knots) I.A.S. are :

	At Overload (2×1,000 lb. bombs) 13,750 lb.	At Overload (2×45 gal. drop tanks) 12,600 lb.	At full Normal load (less drop tanks) 11,820 lb.	At light load (All ammunition expended and half fuel remaining). 10,570 lb.
Undercarriage and flaps UP	118 (102)	112 (96)	110 (94)	105 (90)
Undercarriage and flaps DOWN ...	106 (92)	103 (89)	100 (86)	95 (82)

NOTE.—With the gills open the above speeds are increased by approximately 5 m.p.h. or knots in all cases.

(ii) Warning of the approach of the stall is given by tail buffeting, which is more marked with the undercarriage and flaps up than with them down, and by aileron snatching which can be felt just before the stall itself. The right wing drops at the stall and the wing drop is more marked with the undercarriage and flaps up than with them down.

NOTE.—When carrying 2 × 1,000 lb. bombs the pre-stall buffeting is more pronounced.

(iii) Ample warning of the approach of a stall in a steep turn is given by tail bufleting. Further backward movement of the control column then induces aileron snatching and a tendency for the aircraft to flick out of the turn.

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42. **Spinning**

Intentional spinning is not permitted. Should an accidental spin occur, normal recovery action should be applied immediately and care must be taken in the recovery dive to prevent the aircraft pulling out too violently, causing a stall and probably another spin. This tendency is more noticeable if the aircraft is spun when flying at an aft C.G. loading. Spinning is accompanied by fore and aft pitching and considerable bufleting.

43. **Diving**

(i) The aircraft becomes increasingly nose heavy as speed is gained and should not, therefore, be trimmed into the dive.

(ii) Closing the throttle in the dive induces a further nose-down change of trim, and this should be borne in mind during combat.

(iii) Speed is gained very rapidly and care must be taken to avoid exceeding the limiting speeds.

(iv) The tendency to yaw to the left should be countered by accurate use of the rudder trimming tab. This control, like the elevator trimming tab control, becomes extremely sensitive at high speed.

NOTE.—On aircraft with the manual cowling gills control, the gills should be closed before the dive is commenced.

44. **Aerobatics**

(i) All normal aerobatics are easy to perform but a large amount of height may be gained or lost during some manoeuvres and an ample margin must be allowed.

(ii) The minimum speeds recommended, in m.p.h. (knots) I.A.S., are :

Loop	380 (324)
Roll	260 (223)
Half roll off the top of a loop	400 (344)
Climbing roll	400 (344)
Upward roll	450 (387)

45. **Check list before landing**

Reduce speed to 200 m.p.h. (172 knots) I.A.S. and check :

Brake pressure	
U—Undercarriage ...	DOWN (check by indicators and warning light)
P—Propeller speed control lever	Set for 2,400 r.p.m. (fully forward on the final approach)
F—Flaps	20° DOWN
Gills	SHUT (if manually operated)
Supercharger ...	M (low gear)
Carburettor air intake filter control	FILTER

Reduce speed to 150 m.p.h. (128 knots) I.A.S. and lower flaps fully. Then return the selector to VALVE SHUT.

46. **Approach and landing**

(i) The recommended final approach speeds in m.p.h. (knots) I.A.S. are :

	At full normal load (less drop tanks)	At light load (all ammunition expended and half fuel remaining)
Flaps fully down		
Engine assisted	115 (99)	110 (95)
Glide	130 (112)	125 (107)
Flaps up		
Engine assisted	130 (112)	125 (107)

(ii) The initial straight approach should be made at a speed some 10–15 m.p.h. or knots above these figures.

(iii) (*a*) Should it be necessary in emergency to land at overload weights the recommended final approach speeds in m.p.h. (knots) I.A.S. are as follows :

	At overload (12,600 lb.) 2 × 45 gal. drop tanks full	At overload (13,750 lb.) 2 × 1,000 lb. bombs
Flaps fully down		
Engine assisted	120 (102)	125 (107)

(*b*) Should it be necessary in emergency to land with one bomb only, speed on the circuit and final approach should not be allowed to fall below 130 m.p.h. (112knots) I.A.S. Below this speed full aileron is insufficient to hold the wings level. The recommended approach speed is 150 m.p.h. (130 knots) I.A.S., and only 40° flap should be used to maintain adequate lateral control. All turns should be made with the single bomb on the outside of the turn.

(iv) The pilot must be prepared for a tendency to swing to port after landing.

NOTE.—The brakes are very powerful and must be used carefully as it is easy to overcorrect a swing if they are applied coarsely.

47. **Mislanding**

(i) The aircraft will climb away easily with the flaps and undercarriage down with the throttle at the climbing gate.

(ii) Before the undercarriage is raised the flaps selector lever must be at VALVE SHUT, otherwise the undercarriage will not retract fully.

(iii) Raise the undercarriage and climb at 140–145 m.p.h. (120–125 knots) I.A.S.

(iv) Raise the flaps in stages above 300 ft. retrimming as required.

48. **Beam approach**

	Preliminary Approach	Inner Marker on Q.D.R.	Outer Marker on Q.D.M.	Inner Marker on Q.D.M.
Indicated height (feet) ...	Down to 1,500	1,000	700-800	150
Action ...	Lower the flaps 20°	Lower the undercarriage	Lower the flaps fully	Throttle back slowly
Resultant change of trim	Strongly nose down	Nose down	Nose down	Slightly nose down
I.A.S.	170 m.p.h. (146 knots)	160-170 m.p.h. (137-146 knots)	130 m.p.h. (112 knots)	115 m.p.h. (99 knots)
R.P.M. ...	2,400	2,400	2,400	2,700
Boost (level flight)	4	2	1½	-
Boost (500 ft. min.) ...	-6	-3	-2½	—
Boost (overshoot ...	—	-	-	+6

Remarks: (i) Set the carburettor air intake filter control to FILTER before commencing the preliminary approach.
(ii) Before lowering the flaps 20° reduce speed to 200 m.p.h. (172 knots) I.A.S.

Overshoot
Raise the undercarriage and retrim. Climb at 150 m.p.h. (128 knots) I.A.S. and raise the flaps in stages above 300 ft. retrimming as required.

Altimeter error at take-off ± 20 feet
Altimeter error at touch down ± 60 feet
Subtract 2 millibars from QFE to give zero reading at touchdown.

49. **After landing**

(i) Before taxying raise the flaps and open the gills (if manually operated).

On reaching dispersal:

(ii) Open up to not more than 0lb./sq. in. boost and exercise the two-speed supercharger by changing to high gear, running in that gear for 30 seconds, and then changing back to low gear.

(iii) Idle the engine at 800-1,000 r.p.m. for a short period, and then stop it by closing the throttle and setting the fuel cut-off control to CUT-OFF.

(iv) Turn off the fuel and switch off all the electrical services, including the electrical master switch.

NOTE.—Starter cartridges should be removed overnight to avoid deterioration.