PART III
HANDLING

52. Cockpit checks

Before entering the cockpit check the following:—

Item	Check
Ejection seat	Safety pin fitted in safety strap
Cockpit port ventilating louvre	Position Locking catch up
Internal control locks	Removed and stowed

Enter the cockpit and check:—

Cockpit hood	Security and operation External and internal jettison controls secure, locking wire in place
Undercarriage selector (28)	DOWN
Undercarriage emergency release (44)	Fully aft, locking wire in place
Armament switches and controls (6)	Set to SAFE or OFF
Flying controls	Full and correct movement
Control column	Emergency folding lever locked, locking wire in place
H.P. cock (4)	OFF

Then set Ground/Flight switch to FLIGHT and work from left to right:—

Training switch (1)	OFF Light off
Arrester hook	Lever UP
Tail wheel lock (18)	Unlocked
Hydraulic handpump	Fitted in position

Item	Check
Elevator trimmer control (17)	Full and correct movement
Throttle (7)	GROUND IDLE Gate
Flap lever (19)	UP
Undercarriage warning light (26)	Out
Propeller fine pitch stop switch (15)	NORMAL
Tank selector (10)	Select OUTER WING Check functioning of booster pumps aurally, then select FUSELAGE
Air brakes (11)	CLOSED
H.P. cock (4)	ON, and check booster pump, then OFF
Flap emergency lever (20)	UP, locking wire in place
Bomb carrier mechanical release	Levers forward, safety catch in place
A.P.I. unit (12)	Setting
Ignition switch (22)	OFF, light out
Power failure warning light (34)	On
Oxygen (49)	Contents
Engine and jet pipe fire warning lights (38) (39)	Out
Windscreen de-icing control (46)	OFF
Pressure head heater	OFF
External and internal lighting	As required
G.G.S. retraction switch (54)	Test
Emergency cockpit lights	Test
Signal pistol stowage (61)	Check
V.H.F. (57)	Off
Seat harness	Check operation Lock in fully aft position
First aid stowage (63)	Check contents

Item	Check
Wing folding master control (65)	Warning light and indicator
Wing spread control levers (65)	NEUTRAL. Check wing pin warning lights on both mainplanes
Generator field circuit breaker (60)	In

53. **Management of the fuel system**

(i) The fuel tanks should be used in the order:—

(a) Drop tanks (if fitted)

(b) Outer wing tanks

(c) Inner wing tanks

(d) Fuselage tanks

The fuel level warning light comes on when the level in the fuselage tanks is lower than about 245 gallons. It also serves as a reminder that the tanks at present selected are empty, and that fuel is accordingly being used from the fuselage tanks. The next tanks should then be selected for transfer, when the level in the fuselage tanks should rise again above 250 gallons, and the light go out.

NOTE.—Under conditions of high fuel consumption, the rate of transfer from the *inner* wing tanks and drop tanks may not be sufficient to materially increase the fuel level in the fuselage tanks. The rate of transfer from the outer wing tanks is, however, adequate.

(ii) The H.P. cock on the throttle quadrant must be selected fully open when starting and left open while the engine is running.

(iii) If there is a fault in the transfer system, either of the wing tanks on one side may remain full until all the fuel from the corresponding tanks on the other side has been transferred. The aircraft will become progressively one wing heavy, and a careful watch should be kept on the

amount of aileron trimmer required to maintain lateral trim. If this should exceed one-quarter of the total trimmer range at cruising speeds of about 225 knots, the transfer system is faulty. If the fault is due to an unserviceable booster pump in the outer wing tank, the the rate of transfer from the tank with the faulty pump will depend on air pressure alone and will be very slow, but should be sufficient for engine requirements up to about 100 lb./sq. in. torquemeter pressure. It will not transfer until the tank with the serviceable booster pump is empty.

(iv) The aircraft should be flown accurately in normal attitudes whenever the fuel level is below 50 gallons in the main tank, due to a chance of fuel starvation.

54. Checks before starting

(i) The propellers must be at their minimum fine pitch setting (8°) before starting. Any attempt to start the engine at a coarser angle will result in engine overloading and subsequent stalling and overheating. If the propellers are not in fine pitch, have a ground battery plugged in, and carry out the following:—

(a) Propeller fine pitch stop switch to NORMAL.

(b) H.P. cock open.

(c) Press the starting pitch button until the propellers reach their fine pitch setting. Hold the button in for about five seconds after they have stopped changing pitch since the fining off process may be halted at the *flight* fine pitch stop for a few seconds whilst this is being withdrawn. If it is not possible to see the propellers, a change in the sound made by the feathering pump may be taken as evidence that the propellers have ceased altering pitch.

(d) Close the H.P. cock and have the ground battery disconnected and the door to the rear compartment closed.

NOTE.—In emergency, the aircraft battery may be used to operate the feathering pump for up to 15 seconds in any period of two minutes. All other services must be switched off.

(e) Check that the propellers turn freely by hand when the propeller brake is released.

(f) The engine should be started with the aircraft into wind.

55. Starting the engine (compressed air)

(i) Have the compressed airline *securely* plugged in. Ensure that all ground crew keep clear of the air hose while air is being fed under pressure to the starter motor, and also clear of the jet pipes while the engine is running.

(ii) Check that:—

Ground/Flight switch	FLIGHT
Propeller fine pitch stop switch	NORMAL
Throttle lever	Shut at GROUND IDLE position
H.P. cock	Closed
Tank selector	FUSELAGE

(iii) Trip ON the ignition switch and check that the green ignition warning light comes on. Immediately before signalling for the compressed air to be turned on, open the H.P. cock fully. The starting cycle only commences when the propellers begin to turn. Light up usually occurs between 1,100 and 1,400 r.p.m. When the engine speed has reached 2,500 r.p.m., signal to the ground crew to turn off the compressed air. Any delay will result in damage due to overspeeding the starter.

(iv) The green light should go out automatically as the engine accelerates to about 2,700 r.p.m.; if it does not, the switch should be manually tripped to OFF. Extra fuel will then be made available to allow acceleration to 4,100 ± 100 r.p.m. No throttle movement must be made until this figure is reached.

(v) During the start a careful watch should be kept on J.P.T. If it shows signs of exceeding 600°C., the start should be abandoned immediately by closing the H.P. cock and tripping OFF the ignition switch.

(vi) If the engine fails to start, it should be motored over by the compressed air starter, with the H.P. cock closed and ignition OFF, taking care not to exceed 2,500 r.p.m. This will dry out the engine before attempting another start.

(vii) If fire occurs in the jet pipe, the H.P. cock should be closed and the engine kept turning by compressed air up to the maximum r.p.m. of 2,500.

56. **Starting the engine (cartridge starter)**

To be issued by amendment.

57. **Warming up**

Check that the oil pressure is above 30 lb./sq. in. The recommended warm up speed is 6,000 r.p.m.; the engine should not be allowed to exceed this speed until the oil temperature has reached 35°C.

58. **Checks after starting**

Aileron and rudder trim	Full and correct movement
Fire warning lights	Out
*Oxygen	ON
Flaps	Operate, check movement against gauge
Mk. 4B compass	Switch on inverters separately Syncronise compass Check stand-by compass
Oil temperature	80°C. max.
Engine speed at ground idle	4,100 ± 100 r.p.m.
J.P.T.	500°C. max.
Generator warning light	Out
Radio	Test

*Oxygen *must* be used at all times when the engine is running.

59. **Testing the engine and services**

(i) When the oil temperature has reached 35°C., the throttle may be slowly opened to the Flight Idle gate.

(ii) Below 7,800 r.p.m. all throttle movements *must* be made slowly. Engine acceleration up to this speed is poor, and the greatest care must be taken not to stall the engine particularly in the initial stages of acceleration, between the Ground Idle gate and the Flight Idle gate. Warning that the engine is stalling or is stalled is given by:—

(a) Vibration and excessive noise in the jet pipe.

(b) R.p.m. not following the throttle movements.

(c) Rapid rise in J.P.T.

(iii) If the jet pipe temperature shows signs of exceeding 600°C. the H.P. cock should be closed. Any delay will cause serious damage.

(iv) With the throttle at the Flight Idle gate position, check that the engine speed is 7,100 ± 50 r.p.m. The Flight Idle gate setting is critical and very small variations may affect elevator control characteristics on landing. The correct r.p.m. may not be achieved until the engine is thoroughly warm and there will be an increase of 50 r.p.m. for every five knots of head wind.

(v) Check the constant speeding r.p.m. of 7,800 $^{+0}_{-50}$. The tail wheel should be lashed to the ground if an engine power exceeding 100 lb./sq. in. torque is used on the run up.

60. **Checks before taxying**

Tail wheel	Unlocked
Artificial horizon	Serviceability
Wheel brakes pressure	300 lb./sq. in. minimum

61. **Taxying**

Check that there is equal braking on each wheel. Idling thrust is fairly high, and once the aircraft is moving it is generally possible to taxy with the throttle in the Ground Idle position. The rudder is ineffective and use of the brakes is necessary to control direction. Throttle movements should be made slowly, and during prolonged periods of taxying, especially in high winds, careful watch should be kept on engine temperatures. Full use should be made of the tail wheel lock when taxying straight in strong cross winds. On selecting UNLOCK, the tail wheel must be relieved of side loads before the lock will withdraw. When stationary for long periods, 6,000 r.p.m. should be selected to ensure even cooling of the engine.

62. **Checks before take-off**

Trimmers	All neutral
Propeller	Fine pitch stop switch NORMAL
Fuel	H.P. cock fully open Tank selector FUSELAGE
Flaps	TAKE-OFF
Air brakes	CLOSED
Wings	Spread and locked Master control lever fully forward All warning lights out and indicators flush with wings
Instruments	Set Inverters ON
Oxygen	ON
Hood	Locked, as required
Harness	Tight and locked in rear position

63. **Take-off**

(i) Taxy forward a few yards to straighten the tail wheel and engage the tail wheel lock.

(ii) Apply the brakes and slowly increase engine r.p.m. to 7,800 and at a torquemeter reading of 100 lb./sq. in. check all engine instruments.

(iii) Release the brakes and open up the throttle smoothly to take-off power. In aircraft not fitted with the modified P.C.U. (C.U.24) momentary overspeeding up to 8,200 r.p.m. may occur particularly if the throttle movements are not made smoothly. There is no tendency to swing, but if taking off in a strong crosswind, the tail wheel should be kept on the ground until full rudder control becomes available.

(iv) The aircraft should be flown off at 100 to 105 knots.

(v) Retract the undercarriage, and then the flaps, retrimming as necessary. The tail wheel light may show unlocked until the flaps are fully up.

(vi) When the undercarriage is up, check jet pipe and oil temperatures and throttle back to the climb gate, or as required.

64. **Climbing**

(i) The recommended climb speed is 165 knots from sea level to 10,000 feet, thereafter reducing speed by 2 knots per 1,000 feet.

(ii) If, on a prolonged climb, it appears that the jet pipe temperature limitations may be exceeded power should be reduced or speed increased.

65. **Engine handling**

(i) In the air the throttle must not be closed beyond the Flight Idle gate position, except when restarting the engine.

(ii) While the engine is constant speeding in the air (i.e. 7,800 r.p.m.), normal but smooth throttle movements may be made between the Flight Idle gate and Take-Off positions. There is a possibility of flame extinction, however, if the throttle is closed suddenly.

(iii) Constant speed conditions of 7,800 r.p.m. apply under all normal conditions of flight. The r.p.m. should not normally fall below this figure, but should they do so, the propeller will have fined-off sufficiently to be resting against the Flight Fine Pitch Stop. Should this happen, the stop should be disengaged; otherwise the propeller will behave as though it were of fixed pitch, i.e. any further reduction of power or airspeed will lead to a reduction in r.p.m., and any rapid opening of the throttle may result in the engine stalling.

(iv) Normal r.p.m. can be ensured by maintaining:—

(a) airspeeds above 160 knots, or

(b) power settings above 100 lb./sq. in. torque, or

(c) a suitable combination of (a) and (b), e.g. a minimum of 50 lb. per sq. in torque and a minimum of 130 knots.

(v) When it is not practicable to meet the conditions in (iv) above, such as in stalling practice, the Fine Pitch Stop should first be manually withdrawn or the undercarriage lowered. Before withdrawing the stop by either of the above methods, see that one at least of the conditions of (iv) above is maintained; otherwise the propeller will fine-off rapidly with considerable r.p.m. surge, and the consequent variations in propeller drag may cause changes in longitudinal trim. The oil pressure will drop momentarily when the stop is withdrawn.

(vi) Aircraft fitted with the unmodified P.C.U. (C.U.15) have poor throttle response at the lower speeds, and smooth throttle movements must be made.

(vii) The torquemeter needle may fluctuate, especially at high power settings.

66. **General flying**

(i) The aircraft is easy and pleasant to fly and stability about all axes is excellent. The flying controls are well harmonized, but at high speeds, the rudder becomes heavy. Fairly large stick forces are required to manoeuvre above about 300 knots.

(ii) At speeds below 120 knots, the ailerons tend to upfloat and their movement is restricted; lateral control however is adequate.

(iii) Trimming controls are very effective within the speed range. The electrically-operated aileron and rudder tabs are powerful, and their effect increases with speed. Should they lock fully over, due to a fault in the actuating gear, speed should be reduced to a safe minimum.

(iv) *Changes of trim*

(*a*) *Longitudinal trim*

Undercarriage DOWN ...	Slight nose down
Lowering flaps	
to MANOEUVRE	Negligible
to TAKE-OFF	Slight nose down
to LAND	Slight nose down

(b) *Lateral trim.* Small changes of lateral trim occur in flight due to the uneven transfer of fuel from the wing tanks. The amount of trim required for a given condition varies considerably with airspeed.

(c) *Directional trim.* A small amount of starboard rudder trim is required to prevent yaw as maximum speeds are approached. There is no directional change of trim with alteration of power.

(v) *Use of air brakes*

(a) Extending the air brakes produces a moderate, but immediate, nose-down trim change, which can be easily held up to the limiting speed (300 knots). There is moderate buffet, particularly at the lower airspeeds and, due to uneven opening, there may be small lateral trim changes during operation.

(b) Use of the air brakes below 3,000 ft. is not recommended until experience is gained.

67. **Manoeuvrability**

Manoeuvrability is good, but wing loading is high, and the radius of the turning circle is therefore large, particularly at altitudes above 10,000 ft. For maximum rate of turn the airspeed should be kept as high as possible above 250 knots. If flaps are used, there is a decrease in the radius of the turning circle, but no increase in the maximum rate of turn.

68. **Flying at reduced airspeed**

Reduce speed to 170 knots and lower the flaps to the take-off position. Speed may then be reduced to 150 knots.

69. **Flying in conditions of severe turbulence**

The recommended speed is 250 knots.

70. **Flight planning charts**

(i) Full flight planning data is not yet available but will be issued by amendment. The following table gives an

approximate indication of the performance to be expected.

Height (ft.)	Best range speed (knots)	Approximate ANMPG	Speeds between which the reduction in ANMPG will not exceed 5%
0	235	0.95	195-290
5,000	225	1.05	185-280
10,000	215	1.17	180-260
15,000	205	1.3	170-250
20,000	190	1.47	165-230

(ii) The speed for maximum endurance is 170 knots at all heights.

71. **Pressure error corrections**

The pressure error corrections, undercarriage and flaps up, are large, and reference should always be made to the table when flight planning.

A.S.I.	150	200	250	300	knots
P.E.C.	+5	+6	+8	+10	knots

72. **Stalling**

(i) The approximate stalling speeds are as follows:—

	19,400 lb. approx. (i.e. 95% internal fuel. No external stores)	*21,200 lb. approx.*
Power off		
Flaps and u/c UP ...	110 knots	115 knots
Flaps and u/c DOWN	95 knots	105 knots
Power on		
Under typical approach conditions	95 knots	100 knots

(ii) There is little stall warning, but slight airframe buffeting may commence some 5 knots above and continue to the stall. Approximately 2 to 3 knots above the stall the starboard wing tends to drop but lateral level may

be maintained with aileron. At the stall, either wing may drop with mild aileron snatch and the nose falling gently away. The amount of wing-drop is usually small, but depends how long it has been delayed by the use of aileron. Normal recovery action is immediately effective. The stick should not be pulled right back when carrying out stalling practice as this may lead to a spin.

(iii) Warning of the stall when "g" is applied is given by mild airframe buffeting and a tendency for either wing, usually the starboard, to heavy-up, with slight aileron snatch. At the stall, either wing may drop, but usually the starboard. Releasing the stick effects immediate recovery.

73. **Spinning**

Intentional spinning is prohibited. Should an accidental spin occur, normal recovery action should be applied immediately, and a speed of 200 knots attained before easing out of the resultant dive. Elevator control may be insufficient to unstall the aircraft after auto-rotation has ceased, but careful use of the engine is known to be effective in restoring control in such circumstances.

74. **Diving**

(i) In calm air the aircraft is very steady in the dive to the limiting speed. The elevator control forces should be trimmed out during the dive; otherwise excessive "g" may result on the pull-out. Starboard rudder-trim may be required to prevent yaw as the higher speeds are reached.

(ii) Acceleration in the dive is very rapid, and care must be taken not to exceed the limiting speed or mach number.

75. **Checks before landing**

Brakes	OFF Sufficient pressure
Air brakes	CLOSED
Undercarriage	DOWN and locked Green lights ON Tail wheel LOCKED (airfield landings only)
Propeller	Fine pitch stop switch NORMAL
Flaps	TAKE-OFF FULLY DOWN on final approach
Fuel	Contents
Harness	Tight
Hood	Locked, as required

NOTE.—It is difficult to open the hood above a speed of 160 knots.

76. **Approach and landing**

(i) The circuit should be made at 140-150 knots. The turn on to the final approach should be made at 120-130 knots, and the airfield boundary crossed at 105-110 knots. Care should be taken that the apparent nose-down attitude does not encourage approach speeds below those recommended.

(ii) With the unmodified P.C.U. (C.U.15), engine response is poor on the approach, and early corrective action must be taken if undershooting. The pilot has little or no immediate impression of increase of power, and reference should be made to the torquemeter.

(iii) To ensure maximum response to throttle-opening if undershooting, or if having to go round again, it is advisable to maintain a torquemeter reading of above 40 lb./sq. in.

(iv) Closing the throttle to the Flight Idle gate position for landing produces a very marked nose-down change of trim which varies according to the throttle position just

before the cut and the speed with which the throttle is moved. The greater the movement of the throttle and the greater the speed with which it is moved, the greater will be the resultant nose-down change of trim. At forward C.G. (i.e. less than 200 gallons of fuel remaining) the nose-down change of trim cannot always be held by full elevator movement, and it may be difficult to land the aircraft on three points if the throttle is closed to the Flight Idle gate too soon. It is recommended that the throttle is not closed to this position until the aircraft is over the runway and about to touch down.

(v) The throttle must not be closed beyond the Flight Idle gate until the aircraft has actually touched down and is firmly on three points.

(vi) If after touchdown the throttle is left at the Flight Idle gate, deceleration of the aircraft is poor owing to the high residual thrust. Unless landing on long runways, there should be no undue delay in closing the throttle to the Ground Idle position.

(vii) Rapid closing of the throttle to the Ground Idle position will cause an equally rapid fining-off of the propeller, with consequent high drag. Whilst this is useful for the rapid deceleration of the aircraft in the initial stages of the landing run, it has the effect of blanketing the rudder and elevator, rendering them ineffective. Thus any drift at touchdown will be greatly accentuated, and a swing may easily develop requiring early and careful use of the brakes. The throttle should therefore be closed slowly and smoothly to the Ground Idle gate. Power must not be used to check a swing.

(viii) During the landing run, once the throttle has been closed to the Ground Idle position, the reverse torque light may blink on and off. This ceases as the aircraft slows down.

(ix) *Landing in crosswinds*

A touchdown on three points should always be made and the tail wheel kept firmly on the runway if an initial swing into wind is to be avoided. The aircraft should not be "wheeled" on.

77. **Landing with asymmetric load**

Lateral control is quite adequate, and normal approach speeds should be used when up to 4 rocket hang-ups occur on one side. If a landing is necessary under the worst condition of one-wing heaviness, a straight final approach should be made at an airspeed of not below 125 knots. (See para. 53 (iii)).

78. **Simulated forced landing practice**

A guide to the gliding characteristics which might be experienced were the propeller to be feathered, may be obtained by setting the throttle to the Flight Idle gate; and at a steady airspeed of 160 knots, adjust the throttle so that the torquemeter needle just begins to move from its minimum position. As speed and altitude are reduced, it may be necessary to make very slight adjustments to the throttle to keep the torquemeter needle in this position. The Flight Fine Pitch Stop must be WITHDRAWN.

79. **Instrument approach**

The following speeds, flap settings and approximate power settings are recommended for use during instrument approaches with the undercarriage lowered.

	Torquemeter pressure	Flaps	Airspeed (knots)
Pattern Final Glide path			

80. **Going round again**

(i) Should the decision to go round again be made on the ground once the throttle has been moved to the Ground Idle position, the throttle must be opened *slowly* until 7,800 r.p.m. are attained, to avoid stalling the engine. Acceleration on opening the throttle is initially very poor, and an early decision to go round again should be taken, normally before cutting to the Ground Idle position.

(ii) On going round again from the approach, the throttle should be opened smoothly to the Take-Off position.

(iii) The climb-away should be at 120 knots and the flaps should be raised to the Take-Off position and undercarriage retracted.

(iv) There is a moderate nose-up change of trim on raising the flaps, and re-trimming is necessary.

(v) At about 140 knots raise the remainder of the flaps.

81. **Checks after landing**

Brake pressure	Sufficient for taxying
Flaps	UP
J.P.T.	Normal. (If high, ensure Flight Fine Pitch Stop WITHDRAWN)

82. **Stopping the engine**

(i) Run the engine at 6,000 r.p.m. for about 30 seconds to ensure even cooling of the engine.

(ii) Close the throttle to the Ground Idle position and stop the engine by turning off the H.P. cock.

(iii) If required, press the starting pitch button until the propellers are fully feathered. The propeller brake will then be automatically applied.

(iv) When the propellers have ceased turning, check:—

Electrical services	OFF
Chocks	In position
Wheel brakes	OFF
Ejection seat	Secure safety strap with safety pin
Engine intake guards	In position