# PART III
# *HANDLING*

## 43. External checks

The outside of the aircraft should be systematically checked for obvious signs of damage, security of panels, filler caps, doors, wheel fairings, and tip tanks. The engine intakes and tank vents should be free of debris, the jet pipe should be checked for wrinkling and the turbine and compressor blades for damage. The pressure head cover, undercarriage ground-locks and aileron clamping blocks must be removed.

Check that the hood external locking handle is flush.

## 44. C.G. data

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NOTE.—When the aircraft is flown with two crew, ammunition need not be carried. When flown solo, ballast (which may be in the form of ammunition and which must not then be used during flight) must be carried in lieu of the navigator.

(i) *C.G. limits*

| | |
|---|---|
| Forward limit (all configurations) | 0.9 ins. a.o.d. |
| Aft limits | |
| Clean aircraft | 5.7 ins. a.o.d. |
| With empty tip tanks | 6.2 ins. a.o.d. |
| With full tip tanks | 8.9 ins. a.o.d. |

(ii) *Effect of consumable and expendable stores*

(a) Consumption of tip tank fuel causes the C.G. to move rapidly forward.

(b) The furthest aft C.G. position for a clean aircraft occurs when carrying two crew, no ammunition and with about 290 gallons (2,240 lb. AVTAG) fuel remaining.

(c) Consumption of internal fuel causes the C.G. to move forward, the most forward C.G. position being reached in flight with two crew, full ammunition and with about 70 gallons (540 lb. AVTAG) fuel remaining.

(d) The C.G. moves aft when ammunition is expended.

## 45. Cockpit checks

Remove and stow control locks, close and lock the canopy, checking locking catch is engaged. Switch on the battery isolating switch, and then commence checks on the cockpit port wall and work from left to right.

| Item | Check |
|---|---|
| Cockpit pressure control wheel (3) | Off |
| Tip and pylon tank jettison levers | Off |
| I/C switch | NORMAL |
| I.F.F. switches (5) | Off |
| Aileron trim cut - out switch | On |
| Aileron trim switch (4) | Operation<br>Check trim light for correct operation<br>Set neutral (light out) |
| V.H.F. set selector switch (8) | As required |
| Tip and pylon tank jettison switches (9) | Off |
| H.P. cock (10) | Off |
| Flaps (11) | Check operation with hand-pump |
| Elevator trim (15) | Check operation, set to neutral |
| Throttle friction (13) | Adjusted |
| Throttle | Closed |
| Airbrakes (16) | IN |
| L.P. cock (2) | ON |

| Item | Check |
|---|---|
| Aileron spring strut adjuster (1) | Correctly set<br>If in doubt wind fully to one side and reset $2\frac{1}{2}$ turns back |
| Hydraulic audio warning switch (17) | On |
| Undercarriage emergency retraction switch (17) | OFF |
| Brakes pressure gauge (17) | Check pressure<br>Brakes on |
| Aileron power warning light (17) | On |
| Undercarriage position indicator (23) | Check 3 green lights (test changeover) |
| A.Y.F. (22) | OFF |
| Direct-vision panel | Secure |
| Generator warning lights (29) | On |
| Turn-and-slip indicator | Functioning |
| Fuel transfer indicators (39) | White |
| Fuel gauge (38) | Contents |
| Fire warning light (37) | Out. Pull to test |
| Starter master and flight instrument switch (34) | Off |
| Emergency lamp switch (40) | Off |
| Fuel pump and flight instrument switches (41) | Off |
| Fuel pressure indicator (42) | White |
| De-icing pump (19) | Locked in |
| Pilot's oxygen regulator (46) | Wired on. Air - dilution switch NORMAL<br>Indicator and blinker responding to breathing |

| Item | | Check |
|---|---|---|
| | | Test mask fit by pushing the emergency switch fully in, in the central position |
| | | Check contents |
| Hood jettison lever (69) | | Down |
| Anti-G valve (21) | | OFF |
| Aileron power control (68) | | Check operation<br>Select up and locked—POWER |
| Radar supplies | | Off |
| A.P.S.57 radar control panel (51) | | Off |
| Generator warning lights (52) | | On |
| Main inverter failure indicator (55) | | Black |
| Fuel pump (54) | Circuit breaker. | Set in |
| External lights (54) | | |
| Instrument (54) | | |
| Aileron trim (57) | | |
| Pressure head heater switch (49) | | Off |
| All other switches | | As required |
| Navigator's oxygen regulator (63) | | As for pilot's check |
| Gun door tool (61) | | Secure |
| Crowbar (58) | | Secure |
| Fire-extinguisher | | Secure |

## 46. Management of the Fuel System

The internal tanks, wing tip and pylon drop tanks, all feed automatically when the L.P. and H.P. cocks are on. Two fuel transfer indicators show black when fuel is transferring from the external tanks. The indicators will show white if the fuel transfer flow ceases, or if the

external tanks are empty. Before starting the engine, the fuel booster pump must be switched on to prime the spill flow fuel system. Failure of the pump, indicated by the fuel pressure magnetic indicator turning white, below approximately 20,000 ft. should not cause fuel starvation. If the pump fails above 20,000 ft. it may not be possible to obtain maximum r.p.m.

## 47. Starting the engine

(i) *Checks before starting*

NOTE.—The high energy ignition should be checked before starting by pressing the relight button and listening for the clicking noise of the igniter plugs sparking.

| | |
|---|---|
| Fuel pump and flight instrument switch | On<br>Check fuel pressure indicator black<br>Main inverter failure indicator white<br>Check instruments |
| Starter master and flight instruments switch | On<br>Main inverter failure indicator black |
| Throttle | Closed |

(ii) *Starting the engine*

(a) Turn on the H.P. cock, and then press the starter pushbutton.

(b) The r.p.m. will rise rapidly to approximately 1,500 r.p.m. and then drop to approximately 1,100-1,200 r.p.m., when light-up will occur. The r.p.m will then rise again until idling speed is reached.

(iii) If the engine does not start correctly it will be in one of the following sets of circumstances. The pilot should carry out whichever instructions are applicable:—

(a) *Cartridge fails to fire*

If a cartridge does not fire, close the H.P. cock and wait at least 15 seconds before re-opening it. Should

the first cartridge fail to fire, the starter pushbutton will be held electrically in the depressed position and will return to the starting position only at the end of the automatic starting sequence. The remaining cartridge may then be fired after re-opening the H.P. cock.

(b) *Engine fails to rotate*

If the engine does not rotate or does so at low r.p.m. and there is a heavy discharge of yellow smoke from the starter exhaust for a period of approximately 10 seconds, the safety disc has probably blown. The H.P. cock should be closed and the cause of failure rectified before attempting a further start.

(c) *Failure to light up*

If the engine rotates but the r.p.m. show progressive drop below 1,100-1,200 indicating that the engine has not lit up, the H.P. cock must be closed before the r.p.m. have fallen to 800.

(iv) Two successive failures to start indicate a fault which should be investigated before a further start is attempted.

(v) After failure to light up, surplus fuel must be allowed to drain from the jet pipe.

(vi) The cartridge breeches should not be reloaded until they have cooled down; expended cartridges can be removed however, and the breeches left open to assist in cooling.

(vii) To avoid difficulty in removal, expended cartridges should not be left in the breech for more than eight hours.

## 48. Checks after starting

| | |
|---|---|
| Engine idling r.p.m. | 3,000 ± 200 |
| Jet pipe temperature | Max. 450°C. |
| Fire warning light | Out |
| Generator warning lights | Out |
| Aileron power warning light | Out |

## 49. Checks before taxying

| | |
|---|---|
| Hydraulics | Test flaps and airbrakes |
| V.H.F. | As required |
| Brakes | Pressure 2,400 lb./sq. in. |
| Mk. 4F compass | Set, check heading with E.2 compass |
| Altimeter | Set |
| Pressure head heater | As required |

## 50. Taxying

The rudders are ineffective at normal taxying speeds and it is necessary to use brake to turn the aircraft.

## 51. Checks before take-off

| | |
|---|---|
| Trim | Elevator neutral |
| Throttle friction | Adjusted |
| Airbrakes | IN |
| Fuel | L.P. cock ON |
| | H.P. cock ON (catch engaged) |
| | Contents |
| | Booster pump ON (fuel pressure indicator black) |
| Flaps | 30° down |

| | |
|---|---|
| Instruments | Check and set<br>Main inverter failure indicator—black<br>Pressure head heater—ON |
| Oxygen | ON and reaching mask<br>Blinkers operating |
| Pressurisation | OFF, HOT or REDUCE |
| Hood | Closed and locked |
| Harness | Tight and locked |
| Flying controls | Ailerons in POWER, warning light out<br>Full, free and correct movement |

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## 52. **Take-off**

NOTE.—1. **30° flap must be used for take-off, otherwise the take-off run will be unduly prolonged and may result in damage to the nosewheel oleo.**

2. **The aircraft should not be flown if the static r.p.m at full throttle are less than 10,150 or if, during the take-off run, they fall below 10,050.**

(i) Align the aircraft on the runway with the nosewheel straight release the brakes and open the throttle smoothly to full power. A slightly shorter take-off run will be obtained if the throttle is fully opened before releasing the brakes.

(ii) To keep straight initially it may be necessary to use brake: the rudders become effective at about 70 knots.

(iii) The nosewheel should be eased off at about 100 knots and the aircraft flown off at about 120 knots.

(iv) When comfortably airborne, apply the brakes momentarily and raise the undercarriage.

(v) Raise the flaps.

(vi) If applicable, check that fuel is transferring from the drop tanks.

## 53. Climbing

(i) The recommended climbing speeds, with or without wing-tip tanks fitted, using 10,250 r.p.m. reducing to 10,100 r.p.m. above 25,000 ft. are:—

| Altitude | Knots | Mach No. |
|---|---|---|
| Sea level | 330 | .50 |
| 5,000 ft. | 315 | .52 |
| 10,000 ft. | 295 | .53 |
| 15,000 ft. | 275 | .55 |
| 20,000 ft. | 255 | .56 |
| 25,000 ft. | 235 | .57 |
| 30,000 ft. | 215 | .58 |
| 35,000 ft. | 200 | .61 |
| 40,000 ft. | 180 | .62 |
| 45,000 ft. | 165 | .62 |

(ii) After take-off the aircraft may be allowed to accelerate to the recommended speed while climbing, provided that this speed is reached below 5,000 ft.

(iii) While climbing, the r.p.m. may increase slowly and must be checked periodically to ensure that the maximum permissible figure is not exceeded. If the jet pipe temperature or r.p.m. reaches the maximum, power must be reduced.

(iv) Above 40,000 ft. it is important that the correct speeds be maintained; should the speed fall below that recommended, the rate of climb will suffer and it may be found necessary to resort to level flight to regain climbing speed.

(v) All throttle corrections in the air must be made slowly and smoothly, particularly at high altitudes or when increasing power from low power settings.

## 54. General flying

(i) *Flying controls*

(a) *Ailerons in POWER.* The powered ailerons make the aircraft light and pleasant to control laterally. As artificial feel is provided by a spring strut in the

aileron circuit, the force required varies with aileron deflection and not with speed. At indicated speeds above 375 knots, the power control stalls progressively so that although the initial response is immediate, the rate of roll is limited by the power control stall, restricting the amount of aileron applied.

(b) *Elevator.* At low speeds the elevator forces are moderate but increase progressively with increase in airspeeds.
Elevator effectiveness is good throughout the speed range.

(c) *Rudder.* The rudder centralising forces are very strong, being assisted by a powerful spring. The rudder lacks feel and effectiveness at low speeds but becomes more effective at high speeds. Directional control in all normal conditions of flight is, however, adequate.

(ii) *Trimmers*

(a) *Aileron.* There is practically no lateral trim change with speed; any adjustment which is required should be made with the spring strut adjuster.

NOTE.—The electrically-operated trim tab, for use in manual control, must be in the neutral position whenever the ailerons are in POWER.

(b) *Elevator.* The elevator trimmer increases in sensitivity as speed increases and must be used with caution at high airspeeds. At high mach numbers it becomes less effective.

(c) *Airbrakes.* The airbrakes are relatively ineffective at slow speeds, but become progressively more effective at increased speeds. A mild general airframe buffet is produced when they are extended.
Throttling back and extending the airbrakes at high airspeeds produces a rapid deceleration. At high altitudes, deceleration is poor.

(iii) *Changes of trim*

| | |
|---|---|
| (a) Undercarriage down | Slight nose-down |
| (b) Flaps down—0°- 30° | Slight nose-down |
| Flaps down—beyond 30° | Strong nose-up |
| (c) Airbrakes on extension | Nose-up trim change followed by a nose-down trim change, then a return to trimmed condition |
| Airbrakes on retraction | Slight sink followed by characteristic behaviour described above |

(iv) *General engine handling*

In flight, particularly at altitude, there may be a lag in engine response to throttle movement and/or an inability to obtain maximum r.p.m. Normal engine control can only be regained by reducing altitude.

55. **Flying at reduced speed**

(i) Reduce speed to 150 knots. At this speed the aircraft is comfortable to handle. 30° of flap may be lowered which will increase the forward visibility but considerably more power will be required to maintain 150 knots and general airframe buffet will be present.

(ii) The D.V. panel can be removed in flight. Because of the noise it is recommended that a speed of 170 knots is not exceeded.

(iii) Visibility in rain is poor and unless a windscreen wiper is fitted it may be necessary to remove the D.V. panel before a landing is attempted.

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

The recommended speed for flying in conditions of severe turbulence is 330 knots up to 20,000 feet, thereafter reducing progressively to 220 knots at 40,000 feet and above.

57. **Stalling**

A.L.1 (i) Stalling ~~speeds~~ speeds are found to vary considerably dependent upon the way the stall is approached (small amounts of

G increase the stalling speed considerably), and the condition of the aircraft. The precise stalling speed at certain weights and in certain configurations is difficult to determine due to fluctuation of the A.S.I. needle at low airspeeds.

(ii) The following are the approximate stalling speeds in knots with the throttle closed:—

| | U/C and Flaps up | U/C and Full Flap down |
|---|---|---|
| *Typical service load*<br>Full tip tanks, full internal fuel and ammunition, 2 crew | 120 | 105 |
| *Typical landing weight*<br>Empty tip tanks, 140 gallons internal fuel, no ammunition, 2 crew | 115 | 100 |

(iii) At all weights and configurations there is little or no warning of the stall. It usually occurs with mild buffet and a tendency for either wing to drop gently. The wings can be held level by use of aileron but this will create a yaw and a heavy rudder force is required to counter it.

(iv) Use of flaps causes buffet and this masks any pre-stall warning that may be present.

(v) Use of airbrakes does not affect the stall.

(vi) Recovery is straightforward and is effective immediately the pressure on the control column is relaxed, but unless full power is used there will be a considerable loss of height.

(vii) *G-stalling.* When G is applied, warning of the stall is given by buffeting and continued rearward movement of the control column will cause either wing to drop. Recovery is immediate upon relaxing the pressure.

58. **High speed flight**

NOTE.—The limitations are laid down for structural reasons and must not be exceeded.

(i) The characteristics described below may be experienced at slightly higher or lower indicated mach numbers than those stated due to variation of mach meter pressure error.

(ii) The high mach number characteristics may vary slightly from aircraft to aircraft, they also depend, particularly at high altitudes, on the angle of dive (rate of increase of speed), on G, and on the condition of the aircraft.

(iii) Tip tanks
The carriage of wing tip tanks does not affect the high mach number characteristics.

(iv) (a) *Below 6,000 ft.*

*The limiting speed is 500 knots*

The behaviour of the aircraft at high airspeeds is good. The elevator control is crisp and the trimmer is very sensitive so care must be taken not to exceed the limit of $+5\frac{1}{2}$ G (accelerometer reading). Above 375 knots the aileron power control stalls progressively with increase in speed, so that full aileron deflection will not be possible. Rate of roll will therefore be reduced.

(b) *Between 6,000 ft. and 25,000 ft.*

*The aircraft is limited to 0.83M.*

At about 0.82M a moderate nose-down change of trim will occur which should trim out as the limit of 0.83M is reached. Slight general buffet is present above 0.81M.

(c) *Above 25,000 ft.*

*The aircraft is limited to the mach number at which the marked nose-up trim change starts.*

This will occur at approximately 0.86M. The typical behaviour before and beyond this point is described below:—

| | |
|---|---|
| 0.815M - 0.82M | Moderate nose-down trim change starts. |
| 0.845M - 0.85M | Nose-up trim change starts. |
| 0.86M | Nose-up trim change marked. |
| 0.87M | Nose-up trim change strong. |
| 0.885M | Left wing drops. Nose-up trim change disappears, and may be succeeded by a nose-down change, concurrently with, or slightly after, the wing drop. Full aileron is required to hold the wing drop. |

Slight general buffet is present above 0.81M.

## 59. Aerobatics

(i) Until experience is gained the following minimum speeds in knots are recommended:—

| | |
|---|---|
| Roll ... ... ... ... ... ... | 270 |
| Loop ... ... ... ... ... | 350 |
| Roll off the top ... ... ... ... | 370 |

(ii) Aerobatics are permitted with tip tanks full or empty.

(iii) The negative G traps in the fuselage tank ensure a supply of fuel for 10 seconds of inverted flight.

## 60. Spinning

Intentional spinning is prohibited, but if an unintentional spin occurs normal recovery action is effective. The aircraft is reluctant to enter a spin to port unless pro-spin controls are applied; it will however spin readily to starboard. The rate of rotation in a spin to starboard is faster than in a spin to port. The elevator is extremely effective in unstalling the wings and must be used with care. The control column should be moved slowly and progressively forward *only until rotation ceases.* The ailerons should be kept neutral throughout the recovery and the rudder centralized the moment rotation ceases. If the undercarriage and flaps are down they should be raised.

On recovery the aircraft assumes a steep attitude, and should be eased gently out of the dive, otherwise if a harsh recovery is made a high speed stall may result. If the recovery is effected in an inverted attitude it may be advantageous to half roll and ease the aircraft out of the ensuing dive. If a spin occurs at high altitudes, once recovery has been effected, the airbrakes should be used to prevent a high mach number from being reached.

## 61. Circuit and landing

NOTE.—The aircraft is at the normal maximum landing weight with a full crew, empty tip tanks, no ammunition and full internal fuel.

(i) *Circuit procedure*

A setting of approximately 7,000 r.p.m. will give a circuit speed of 200 knots with undercarriage and flaps up.

(ii) *Checks downwind*

| | |
|---|---|
| Brakes | Pressure—operation—off |
| Airbrakes | IN |
| Undercarriage | Down (below 220 knots)<br>Three green lights |
| Fuel | Contents |
| Flaps | As required. (Below 190 knots for 0-30°) |
| Harness | Tight and locked |

A setting of approximately 8,000 r.p.m. will be required to maintain 150 knots with undercarriage and 30° flap down.

(iii) *Final approach*

(a) The turn onto the final approach should be made at 140 knots and full flap lowered when required.

(b) To ensure a rapid response to throttle opening, power should not be reduced below 5,000 r.p.m. until the final decision to land has been made.

(c) The runway threshold should be crossed at the following speeds:—

| | | |
|---|---|---|
| At normal landing weight ... | ... | 110 knots |
| At maximum landing weight | ... | 115 knots |

(d) If the speed is allowed to fall below 110 knots the drag characteristics are such that a large increase in power will be necessary to counteract any excessive sink.

(iv) *Landing*

(a) It is difficult to hold the nosewheel off the runway after touchdown.

(b) The brakes can be used continuously as the maxaret units will prevent wheel locking; however, to prolong the efficiency and life of the brakes, braking should be judicious according to the length of landing run available.

(c) The aircraft must be firmly on the ground before applying brakes. If the aircraft is allowed to touch down with the brakes on, the maxaret units will not operate and the wheels will lock. However if, once having started turning, the wheels should stop because of a skid or a bounce, they will not lock unless the skid or bounce continues for more than 4 seconds.

## 62. Instrument approach

The following speeds and approximate power and flap settings are recommended for use during instrument approaches with the undercarriage down. These figures apply with wing-tip tanks fitted, but empty.

| | R.p.m. | Flaps | Airspeed (knots) |
|---|---|---|---|
| Downwind | 7,500 | $\frac{1}{4}$ | 150-155 |
| Final | 7,500 | $\frac{1}{2}$ | 140-145 |
| Glide path | 7,500 | $\frac{3}{4}$* | 125-130 |

* When the runway comes into view the flaps may be lowered fully.

## 63. Going round again

(i) Open the throttle smoothly to the power required. Normally the use of full power is unnecessary and 9,000 r.p.m. will generally be sufficient. When full power is used, the control column will be near its forward limit.

(ii) The following procedure is recommended:—

(a) Increase power as required.

(b) Raise the undercarriage.

(c) Raise the flaps. It is recommended that the flaps are raised in stages, especially at night, as slight sink occurs and the control column displacement as the flaps retract is considerable.

## 64. Checks after landing

| | |
|---|---|
| Flaps | UP |
| Brakes | Pressure sufficient for taxying |
| Pressure head heater switch | Off |
| Cockpit pressure control | Off |

## 65. Stopping the engine

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Close the throttle fully and allow the engine to run at idling r.p.m. for at least half a minute before closing down. Then:

| | |
|---|---|
| H.P. cock | Off |
| V.H.F. | Off |
| Fuel pump and flight instrument switch | Off |
| Master starting and flight instrument switch | Off |
| All other switches | Off |
| Chocks | In position |
| Brakes | Off |

NOTE.—1. Put the L.P. cock off if the aircraft is to remain on the ground for long periods between flights. This will help to avoid hot starts and thus prolong the life of the engine.

2. The battery master switch should not be moved to BATTERY ISOLATED until the generator power failure light has come on, otherwise the electrical system may be damaged.