PART III

HANDLING

LIST OF CHAPTERS

PART III—HANDLING

Chapter 1—STARTING, TAXYING AND TAKE-OFF

Contents

NOTE: When reference is made to the flap configuration selected it is made in the order:—Wing flap/Aileron droop/Tailplane flap. Therefore the abbreviation "15 - 10 - 10" indicates that 15° Wing flap, 10° Aileron droop, and 10° Tailplane flap have been selected.

1 Preliminary checks

Carry out the External, Internal and Pre-start checks. Strict adherence to these checks will ensure that no item is missed and that the minimum amount of checking remains after starting.

NOTE: All checks referred to in this Part are detailed in the Flight Reference Cards.

2 Starting the engines

Start the engines using the drills in the Flight Reference Cards.

3 Functional checks

(*a*) Carry out the functional checks listed in the Flight Reference Cards.

(*b*) *Aileron droop and tailplane flap*
Use of the standby selectors should be restricted to the minimum required for a brief functional check of their operation, so avoiding unnecessary drain on the emergency battery.

◀ (c) *Autopilot checks*

(i) Select Mach hold or barometric height hold, check autopilot MI shows RDY.

(ii) Engage the autopilot, check autopilot MI shows ENG.

(iii) Check that the control column locks in the pitch plane but retains freedom of movement in the rolling plane. (As the autopilot engages, a small snatch may be felt on the control column.)

(iv) Null the heading indicator on the IFIS, and engage the heading hold. Check there is no freedom of movement in the rolling plane.

(v) Note the tailplane angle.

(vi) Trim nose-up, allowing the stick to move. The tailplane limit switches will trip and the autopilot disengage. Check AP warning on SWP and the autopilot MI shows RDY. Press the ICO reset button and cancel the SWP warning. Check that the stick returns to the centre and note the new tailplane angle which should be approximately 1½° more nose-up. Check autopilot MI shows ENG.

NOTE: The heading switch returns to OFF automatically during this check.

(vii) Repeat by trimming nose-down, noting a new tailplane angle of ¾° more nose-down. Re-engage the heading hold and rotate the heading pointer until the limit switch trips and disengages the autopilot. Check that the stick moves in the same direction as the heading pointer. Repeat for the opposite direction. ▶

(d) *Boundary layer control*

(i) On the ground, asymmetric opening of the throttles with airbleed in use can cause an engine to surge and sustain a high JPT. This may result in serious damage to turbine and nozzle assemblies. With BLC on, throttle openings should be synchronised (using RPM gauges) and the JPT's carefully monitored. If de-synchronisation occurs, or an abnormal rise in JPT is observed, the engines must be throttled back to ground idle immediately. When the RPM and JPT's have stabilised the throttles may be re-opened. It is particularly important to observe these precautions in crosswind conditions or when in the jet efflux of other aircraft.

(ii) The blowing pressure obtained at any given RPM will be affected by changes in ambient temperature.

(iii) If the tailplane blow magnetic indicator does not change to black, increase RPM by 1 to 2%.

4 Taxying

(*a*) Confirm that the brake pressure gauge indicates 4,000 PSI total pressure. Depress foot pedals fully, select the parking brake off and release foot pedals noting that the parking pressure is released. Press foot pedals and check that 1,700 PSI is applied to each wheel. Taxy forward and test the brakes.

(*b*) A moderate application of power is required to get the aircraft under way. When the aircraft is moving, idling RPM are sufficient to maintain a normal taxying speed. The anti-skid units do not operate below 15 knots therefore harsh braking during taxying will cause unnecessary tyre wear, and possible locking of the wheels. Taxying on icy/wet/greasy surfaces should be carried out with extreme care.

(*c*) The nosewheel steering is engaged by aligning the rudder bar approximately with the nosewheel and pressing the nosewheel steering button.

(*d*) Nosewheel steering should normally be used for all manoeuvring. The maximum nosewheel deflection is 50°. Differential braking may be used for steering if required, and will be necessary for turns of small radii. After initiating the turn with the nosewheel steering release the button and apply brake as required in the direction of the turn. On completion of the turn re-align the rudder bar and nosewheel before re-engaging the nosewheel steering.

(*e*) With nosewheel steering engaged, the nosewheel response to the rudder bar movement is immediate and, at fast taxying speeds, over-controlling can be induced.

(*f*) During taxying, check the functioning of the compasses and the slip indicator.

◀(*g*) At engine speeds between 54% and 77% RPM the 4th stage compressor discs are subjected to high fatigue stresses. Therefore, if possible, power settings within this range should be avoided. ▶

5 Checks before take-off

Carry out the take-off checks listed in the Flight Reference Cards.

6 Engine checks before take-off

(*a*) Align aircraft with runway centre-line and with nosewheel straight; carry out the engine checks listed in the Flight Reference Cards.

(*b*) Slam accelerations may be made. The acceleration times may vary considerably due to a number of variable factors, but will normally be in the region of 12 seconds (blown) and 15 seconds (unblown) from ground idling RPM. The inlet guide vane operating range is between about 80% and 90% RPM varying with ambient temperature by approx. 1½% per 10° change in temperature, i.e. increase in temperature delays the opening of the inlet guide vanes. During the checks it should be confirmed from the IGV indicators that they are functioning correctly. Care should be taken to ensure that the aircraft is stationed into wind otherwise intake banging will probably occur during the slam accelerations.

7 Take-off

(*a*) (i) The maximum recommended crosswind component is 25 knots. If there is a significant crosswind (5 knot component) or if marked turbulence is expected after take-off the yaw and roll autostabilisers should be set to APPROACH. Invariably after becoming airborne the "into wind" wing will lift, the amount varying with the crosswind component. This should be anticipated and gentle but firm corrective action taken. Corrective action will induce some adverse yaw which can be eliminated by use of rudder. For every 10 knots crosswind component, increase unstick speed by 5 knots. For every 1,000 lb. asymmetric wing load, increase unstick speed by 2 knots.

(ii) After successful completion of the relevant engine checks release the brakes and engage the nosewheel steering. Initial acceleration is slow. Directional control may be maintained by use of the nosewheel steering until the rudder becomes effective at approximately 70 knots. Once released, the nosewheel steering should not be re-engaged. If wheelbrakes are used to keep straight, the length of take-off run will be increased.

(*b*) *Unblown take-off*

(i) *Unstick speeds* (*unblown*)

The aircraft will unstick at the following speeds (ISA, S.L.):

AUW (lb)	*Unstick speed*
39,000	156
42,500	164
46,000	170

(ii) Raise the nosewheel clear of the ground 5 knots below the unstick speed, avoiding an excessive attitude, and fly off at the unstick speed. The aircraft must be clear of the ground before 170 knots is reached, to avoid exceeding the tyre limitations.

(iii) When safely airborne, retract the undercarriage and allow the airspeed to increase to 175 knots. Then, at approximately 100 ft. above the ground, retract the flaps, aileron droop and tailplane flap together. The undercarriage retracts quickly and some slight vibration may be felt from the rotating nosewheel. Neither undercarriage nor flap configuration retraction causes any significant change of trim.

(iv) After the aircraft has been cleaned up, carry out the after take-off checks and establish the initial climb.

NOTE: If, following an UP selection of the undercarriage, the correct indications are not obtained, the undercarriage position should, if possible, be checked visually before any further selection is made. Damage may be caused if an undercarriage that has not retracted into its housing is cycled.

(c) *Unblown safety speeds*

(i) At an AUW of 39,000 lb. from an unstick speed of 156 knots, in the flap configuration 15-10-10 the aircraft will climb on one engine provided the undercarriage is retracted.

(ii) For variations in AUW adjust the safety speed by 2 knots/1,000 lb.

(iii) For increases in temperature above ISA, increase safety speed by 3 knots/5°C increase in temperature.

(d) *Blown take-off*

(i) *Unstick speeds (blown)*

The aircraft will unstick at the following speeds (ISA, S.L.):

AUW (lb)	*Unstick speed*
39,000	132
42,500	137
46,000	142

(ii) At ISA, no stores and 39,000 lb. AUW, raise the nosewheel clear of the ground 5 knots below the unstick speed (127 knots), avoiding an excessive attitude, and fly off at the unstick speed (132 knots).

(iii) When safely airborne retract the undercarriage. Allow the aircraft to accelerate to 150 knots, and increase height to 200 ft. AGL. At a minimum airspeed of 150 knots at 200 ft. select the flap configuration to 15-10-10, and at 170 knots clean-up fully. The trim changes throughout are negligible.

(*e*) *Blown take-off* (ISA, AUW 43,500 *lb.*)

(i) Raise the nosewheel clear of the ground at approximately 135 knots, avoiding an excessive attitude, and allow the aircraft to fly off at about 140 knots.

(ii) When safely airborne, retract the undercarriage. There is negligible change of trim. Allow the aircraft to accelerate to 160 knots and increase height to 200 ft. AGL. At a minimum airspeed of 160 knots at 200 ft. select the flap configuration to 15-10-10, and at 180 knots clean-up fully.

(f) *Blown safety speeds* (ISA, *undercarriage up*)

(i) At an AUW of 39,000 lb. with no stores, a minimum airspeed of 150 knots, a minimum height of 200 ft. and in a maximum flapped configuration of 30-20-20, the aircraft can be safely cleaned-up and will then climb away following an engine failure.

(ii) At an AUW of 43,500 lb., a minimum airspeed of 165 knots, a minimum height of 200 ft. and in a maximum flapped configuration of 15-10-10 the aircraft can be safely cleaned-up, and will then accelerate to the recommended climbing speed of 180 knots, following an engine failure.

(iii) For variations in AUW adjust the safety speed by 2 knots/1,000 lb.

(iv) For increases in temperature above ISA, increase safety speed by 3 knots/5°C increase in temperature.

▶◀

8 Checks after take-off

Carry out the Checks after take-off listed in the Flight Reference Cards.

WARNING: Operation of the wheelbrakes, either during retraction or when fully up can lead to a failure of the undercarriage pre-shortening mechanism which may lead to partial collapse of the oleo on landing. Braking of the wheels after take-off should be left to the automatic braking system. If a failure of this system is detected after the undercarriage has been selected up, the wheels should either be left rotating in the wheel bays or, if circumstances permit, the undercarriage should be re-cycled and the brakes applied with the undercarriage down and locked. Rotation of the wheels in the wheel bays will cause no physical damage but is undesirable particularly in wet, muddy or slush conditions.

9 Engine failure during take-off

NOTE: The recommended procedures for engine failures during take-off and landing pre-suppose that drills are frequently practised. Unless prompt and correct action is taken the safety heights and speeds quoted may not be adequate for recovery.

(*a*) If an engine fails during take-off, in the blown or unblown configuration, the take-off must be abandoned. Close the HP cocks, lower the arrester hook, extend the airbrakes and apply the wheelbrakes. If sufficient runway length is available, braking should be slightly delayed until the speed is less than the maximum brake-on speed of 120 knots to avoid burning out brakes. Immediate braking should only be used when absolutely necessary.

(*b*) The arrester hook takes 2-3 seconds to lower, therefore the selection must be made 300 yards before the wires. Aim for the centre of the wires and assist engagement by releasing the wheelbrakes and pulling the stick back. If the hook fails to engage the wire, re-apply the wheelbrakes, steer for a clear grass area and, if space is limited, retract the undercarriage.

10 Engine failure after take-off

(*a*) *Unblown*

If the engine fails after take-off, the undercarriage must be raised as soon as it is safe to do so. The aircraft will yaw and moderate application of rudder is required to oppose it. In ISA conditions, at 39,000 lb. AUW, in the unblown configuration, the aircraft will climb from the normal unstick speed of 156 knots provided that the undercarriage is retracted immediately. At 43,500 lb. AUW, the aircraft will climb away at a speed of 175 knots provided that the ◀undercarriage is retracted. For safety speeds refer to para. 7(c). ▶

(*b*) *Blown*

The undercarriage must be raised as soon as it is safe to do so. The aircraft tends to yaw and roll towards the dead engine, initially, but application of rudder induces a roll in the opposite direction. Control movements to oppose the yaw and roll should be made gently and kept to a minimum. If the failure occurs before safety conditions are achieved the aircraft may not climb away. If height is available it may be used in an attempt to gain the airspeed/configuration required. If height is not available land ahead or abandon the aircraft. At 39,000 lb. AUW, if the failure occurs after the safety conditions have been achieved immediately retract the configuration to 15-10-10. A moderate increase in incidence, requiring a firm backward movement of the control column, will be needed to maintain height. Height should then be maintained until the airspeed has increased to 170 knots, when the remaining flap and droop may be retracted and the climb begun. During this recovery the audio low note will be heard. This must be accepted but care is required to avoid over-rotation. The airspeed must not be allowed to stabilise below 170 knots. At 43,500 lb. AUW the aircraft should be allowed to accelerate to 180 knots before retracting the remaining flap and droop and climbing away. If below 180 knots stores should be jettisoned to allow the aircraft ◀ to accelerate. For safety speeds refer to para. 7(f). ▶

PART III — HANDLING

Chapter 2 — HANDLING IN FLIGHT

Contents

1 Climbing

Climb at full power, within the JPT limitations, at 400 knots converting to 0·82M when that figure is reached. Speed increases slowly after take-off and the climbing speed should be established during the initial climb to 2,000 ft.

2 Engine handling in flight

(a) Whenever the blowing system is switched on or off, a muffled thud may be heard as the turbine cooling valves operate.

(*b*) The engine RPM will be governed at the selected setting, but at settings above 90% a 1% wander may occur occasionally.

(*c*) During throttle movements in flight, and in the course of the normal checks of engine instruments, the IGV indicators should be checked to confirm the serviceability of the IGV's.

(*d*) Under certain operating conditions, engine intake oanging may be experienced. This is more likely to occur at high altitude when flying in the buffet or when excessive incidence is applied, or if slam accelerations are made, but also occurs at low altitude when G is applied at comparatively low airspeeds, e.g. 2½G at 250 knots. At high altitude it can become severe, accompanied by rumbling from the engine(s), and airframe vibration. It may be followed by one or both engines flaming-out. In all cases it should be eliminated by reducing incidence and/or engine RPM. After landing, the occurence should be reported.

◀(*e*) At engine speeds between 54 and 77% RPM the fourth stage compressor discs are subjected to high fatigue stresses. Whenever possible power settings within this range should be avoided. ▶

3 Flying controls

(*a*) *Ailerons*

(i) Spring feel provides an increasing force with stick displacement. Some adverse aileron yaw is experienced when aileron is applied; this is more marked when the ailerons are drooped. Aileron forces are light and response is good, but deteriorates above 0·9M and at low speeds when the ailerons are drooped.

(ii) Selection of low-speed aileron gearing when ailerons are drooped serves to improve control response at low speeds. Low-speed gearing must not be used above 300 knots as the rates of roll achieved can exceed the aircraft's structural limitations.

(*b*) *Tailplane*

Below 0·9M tailplane response is sensitive and pitch auto-stabilisation must be used to prevent overcontrolling at high IAS. The Q-feel mechanism ensures that the control column forces increase with an increase in airspeed. Above 0·9M tailplane response is reduced.

▶◀

(*c*) *Rudder*

(i) The Q-feel ensures that the response to rudder force remains constant throughout the speed range. Rudder response is adequate for all normal manoeuvres. In asymmetric flights the forces are moderate, becoming heavy at low airspeeds.

(ii) There are no limitations on the use of rudder trim. However, to avoid exceeding design limitations, furtber rudder angle must not be applied with the pedals after full trimming has taken place, except at low speed.

(*d*) *Airbrakes*

(i) The airbrakes are powerful in effect and take approximately 6 seconds for full movement. Extension at high speed causes slight buffet. Unless the airbrakes are in use, the switch should be left at IN.

(ii) Prior to the embodiment of mod. 1044, using high power with the airbrakes more than half open may lead to skin cracking.

(iii) During airbrake operation the airbrakes position indicator may move erratically and, due to the momentary reduction of hydraulic pressure within the GS system, either or all of the following may occur: —

The fuel inlet pressure and proportioner failure magnetic indicators temporarily sbow cross-hatched. The flowmeter indicates zero. A reduction of engine speed is sometimes accompanied by IGV instability. The reduction in engine speed whicb is caused by the reduction in fuel inlet pressure and aggravated by fuel pump cavitation, remains while the airbrakes are moving after which normal power returns. This condition is not dangerous and the airbrakes may continue to be used but the aircraft should be inspected after the flight.

(iv) The jet efflux impinging on the airbrake surfaces also causes slight buffet when they are more than one half open. At low airspeeds this will mask the onset of airframe buffet. In the approacb configuration the airbrakes buffet is marked above datum speed, but becomes mild as datum speed is reached.

4 Autostabilisation

(*a*) The undamped stability characteristics of the aircraft make the use of autostabilisation essential if other than gentle manoeuvres are to be executed smoothly. Although the undamped stability of the aircraft is better at low altitudes, due to the dutch rolling characteristics of the aircraft in the approach configuration, autostabilisation is essential to ensure accurate control. Also at high speed, low level, pitch autostabilisation is essential for accurate height keeping and to avoid induced oscillations.

(*b*) Either yaw autostabilisation or the yaw damper must be on at all times. The yaw damper is primarily a stand-by system and should not normally be used with the yaw autostabiliser, otherwise its life will be shortened.

(*c*) It can be seen from the above that, unless circumstances demand otherwise, all available autostabilisation should normally be used during flight.

5 Tailplane trimming

(*a*) The all-moving tailplane is trimmed by the datum shift method in that the angle of the tailplane is varied in relation to the control column position. Therefore the control column always takes up the central (neutral) position when the tailplane stick forces are trimmed out.

(*b*) The neutral position of the control column is constart irrespective of the trim setting. when a hand force is trimmed out, the control column should be allowed to return to neutral as the trimmer is operated.

(*c*) The tailplane trimmer is powerful and as the stick forces about the neutral (no-force) position are light, accurate trimming may be difficult until experience is gained.

(*d*) For control column authority, trim range and tailplane range, see Part I, Chapter 6.

(*e*) If a tailplane trim runaway occurs, instinctive action will be to oppose the trim change by normal movement of the control column. Attempt to re-trim by using the stand-by trimmer and instruct the observer to remove the normal tailplane trim fuse. This fuse is either F6/C-AE or F7/CQ and is marked by yellow triangles on the adjacent fuse holder cover, pointing to the correct fuse.

6 Trim changes

Condition	*Trim change*
Increase/decrease of power	Negligible
Undercarriage down ...	Very slight nose-up
Undercarriage up	Very slight nose-down
Extension of flap/aileron droop/tailplane flap, blow-on, levers operated together	15—10—10 selected, slight nose-down 30—20—20 selected, slight nose-up 45—25—25 selected, slight nose-up
Blow-off	Nose-up (marked at low airspeeds)
Airbrakes out (low altitude, high IAS)	Slight yaw, then slight to moderate nose-up The degree of trim change increases with speed
Airbrakes in	Slight to moderate nose-down.

At high Mach Nos. the trim change on airbrake extension becomes negligible or slight nose-down.

7 Aileron and tailplane flap — emergency operation

(*a*) *Indications*

Failure of either aileron droop or tailplane flap, or both, to operate when selected.
Either service running away.

(*b*) *Immediate action*

Make a momentary up or down selection of either the aileron droop or tailplane flap standby selectors. This isolates the normal actuator and prevents further movement of the surfaces.

(*c*) *Considerations*

The normal selector will be inoperative. The reset button must not be used to revert to the normal actuators. If any aileron droop or tailplane flap is selected separately, a trim change results, becoming severe if the operation exceeds 5°.

WARNING: If the separation exceeds 10°, full tailplane movement plus full trim movement is sufficient to counteract the trim change, and longitudinal control of the aircraft will be lost until the separation is reduced.

(*d*) *Subsequent actions*

The aileron droop and tailplane flap can be lowered subsequently by the standby controls. This action uses tbe emergency battery, therefore the standby controls should be used with economy. Aileron droop and tailplane flap sbould be selected alternately in small steps to avoid excessive trim changes.

8 Rudder trim failure

If the rudder trim actuator "runs away", airspeed must be restricted to 300 knots at which speed the foot load is moderate and, if released, will not overload the fin. At higher speeds excessive fin loading will occur. There is no standby rudder trimmer.

9 Rudder Q-feel failure

Indications

Failure of the starboard flying control hydraulic system. Rudder feel becomes light.

Considerations

The fin strength may easily be exceeded at high speed by only light rudder loads.

Action

No more than usual rudder deflections should be used. Slipping and skidding manoeuvres must be avoided.

10 Flying at reduced airspeed

Prolonged flight at reduced airspeed will be most comfortable if it is carried out at 250 knots with flap configuration of 15—10—10 selected, blow on. Roll and yaw ◀ autostabilisers sbould be selected to APPROACH and ▶ the aileron gear change selected to low speed (fully up). Use of blow is limited to a maximum of 20 minutes in any one flight.

11 Low speed handling and stalling

◀ (*a*) Deliberate stalling is prohibited. In straight and level flight the approach to the stall is permitted in the 0—0—0 configuration. It must not be continued beyond tbe ADD steady note, or the onset of buffet or intake banging, whicbever occurs first. ▶

◀(*b*) *Minimum flying speeds*

The minimum permitted speed in the landing circuit is the datum speed for the relevant weight and configuration. Slow-flying practice may be carried out in the landing configuration at the corresponding datum speeds minus 5 knots on two engines, and to the appropriate datum speed on one engine, at heights between 4,000 and 8,000 ft. above mean sea level provided that the minimum blow pressure of 20 PSI is available.

NOTE: Deliberate single-engine flying is prohibited except for relighting practice.

(*c*) *Effect of blow, on low speed handling*

(i) In the full landing configuration the stalling speed is dependant upon the amount of blow pressure available and occurs at 28-29 units on the ADD indicator. Behaviour at the stall varies but usually consists of a mild pitch-up and wing-drop. The stall is preceded by a region of very poor lateral control at ADD indications above 24 units.

(ii) At a given airspeed, reducing blow pressure has the effect of increasing wing incidence, thereby reducing the margin above the stall. Conversely, increasing the blow pressure reduces the wing incidence and increases the stall margin.

(iii) For example, *at a constant* IAS, at 20 units ADD, the effect of reducing the blow pressure from 30 PSI to 15 PSI is to increase wing incidence to approx. 22 units ADD reading. ▶

(*d*) (i) *20,000 ft. Clean aircraft—no stores carried—weight 36,000 lb.*

Aircraft trimmed at 200 knots. Engine power set to idling RPM.

As speed is reduced below 200 knots both tailplane and aileron response deteriorate slightly. At approximately 170 knots the steady note of the audio pattern is heard. At 150 knots a slight tremor of the aircraft is felt and by 145 knots this has increased to a gentle buffet. As speed is reduced below 140 knots a slight increase in buffet is experienced and, as 135 knots is approached, some wing rocking occurs together with an increase in aircraft response to small tailplane movements. A moderate pull force is required to hold these low speeds and it is easy to overcontrol. Reducing airspeed to below 135 knots will eventually lead to a pitch-up and probahle flame-out.

(ii) 8,000 *ft.* 2 *engines — approach configuration — weight* 33,000 *lb.*
At 5 knots below datum speed some slight deterioration in control response is experienced. As speed is further reduced the rate of descent will increase. At 5-10 knots below datum the control response is sluggish and the aircraft is difficult to trim and fly accurately. Small disturbances to the flight path require large control movements to correct, and it is easy to overcontrol.

(iii) 8,000 *ft.* 1 *engine — approach configuration — weight* 32,000 *lb.*
As speed is reduced below the datum, control response deteriorates. At 5 knots below datum speeds it is not easy to maintain the precise amount of rudder required and some slight yawing occurs. This in turn leads to a small degree of wing rocking. Owing to the reduction in control response it is easy to overcontrol during any corrections to the flight path. These characteristics become slightly more marked as speed is further reduced.

12 G-stalling

◀**WARNING:** Speed must not he reduced, nor G applied, beyond the ADD steady note or the onset of buffet or intake banging or when 6 G is indicated. At speeds below 300 knots buffet warning is reduced ▶

(*a*) Buffet will be induced as G is increased. At high altitude it will occur at approximately 1¼G hut variations in AUW and Mach No. will cause variations of this figure. At high altitude the huffet will increase slightly with G until slight wing rocking and/or intake banging occurs. Further increase of G may result in flame-out of one or both engines. The probability of flame-out is reduced as height is decreased, but intake banging may still occur. The wing rocking characteristic becomes more marked at the lower altitudes and during flight in heavy buffet the aircraft may roll quickly either way.

(*b*) When accelerations of 4G and above are applied, the airspeed decreases rapidly and in the 350/400 knots speed band care should be taken to avoid an inadvertent speed decrease to below 300 knots with excessive G applied.

(*c*) At low altitude below 300 knots the onset of buffet is less marked and the increase with G is negligihle. Incidence increases rapidly with small increases in the pull force applied to the control column, and excessive incidences are easily achieved. The ADD audio limitation must be observed.

(*d*) *Typical limiting accelerations. Clean aircraft, ¾ internal fuel*

Height	*Mach No./IAS*	*Buffet*
35,000	·85	1¼G
30,000	·9	1½G
25,000	·9	1¾G
20,000	·9	2 G
15,000	·9	2½G
10,000	500	4½G
5,000	500	5 G
5,000	300	3¼G
2,000	580	No buffet at 6G
2,000	300	3¾G

(*e*) In all cases recovery to normal flight conditions is immediate upon easing the control column forward.

13 Spinning

Intentional spinning is prohibited

(*a*) Model tests indicate that normal swept-wing spin-recovery techniques are effective. The rate of descent of approximately 20,000 ft./min. can be expected and both engines may flame-out, with consequent loss of flying control power. If the minimum airspeed/maximum angle of attack limitations are observed, an inadvertent spin is extremely unlikely.

(*b*) Should a spin occur, the following actions are recommended:
Apply full opposite rudder and, *with the aileron central* move the control column progressively forward. Centralise aileron trim. An inverted spin may result if the control column is moved too far forward. The initial movement should therefore be restricted to half the available travel.

(*c*) Retract undercarriage, airbrakes and flap configuration and jettison external stores.

(*d*) The spin is very oscillatory and full recovery action must be maintained until rotation has finally ceased. Centralise the rudder immediately the rotation stops and allow the airspeed to increase to 250 knots before easing out of the dive.

(e) If the recovery action has not been effective by 15,000 ft., the aircraft should be abandoned.

14 Aerobatics

NOTE: Aerobatic manoeuvres are resricted by the limitations in Part II, Chapter 1.

(*a*) *Rolling manoeuvres*

WARNING: Using full stick deflection (post-mod. 793) or, pre-mod. 793, ¾ stick deflection (the maximum permitted) the rate of roll starts gently but increases rapidly. If a roll of more than 360° were to be carried out, the rate of roll would continue to increase (maintaining that aileron) until the aircraft became subjected to inertia coupling. This could lead to loss of control, resulting in severe structural damage or even break-up. For mod. 793 refer to Pt. I, Ch. 6, para. 7.

(i) When making rolling manoeuvres the following should be observed:

As aileron is applied, slight adverse yaw is experienced, this should be accepted. The rudder should not be used coarsely in an attempt to control the yaw, or to keep the nose up when the wings are vertical. Use of the rudder and/or tailplane to maintain an accurate flight-path, following coarse use of aileron to initiate a rolling manoeuvre, can result in either excessive side-slip, negative-G, or a combination of both; any of these may lead to unpredictable manoeuvres with the risk of structural damage to the aircraft. At speeds above 500 knots manoeuvres should be carried out carefully because the adverse yaw becomes marked and the rudder is powerful in effect.

(ii) Providing no external stores are carried, full stick deflection (¾ stick deflection, pre-mod. 793) may be used to perform 360° rolls between 300 knots and 0·85M in 1G flight. The autostabilisers must be on and aileron gear change set at high speed. Once the roll has been started the stick must be kept in the same fore-and-aft position throughout and should be moved to apply aileron only. Slight yaw and barrelling will be experienced; the yaw should be corrected carefully and the barrelling accepted. Subsequent correction to height should be made when the wings are level. If external stores are carried, the second half of a 360° roll must be completed with gentle and reduced use of aileron.

(iii) At speeds below 300 knots or above 0·85M full stick deflection (¾ stick deflection, pre-mod. 793) may be used in 1G flight to reverse a turn by rolling through the upright position. A significant pause must be made before reversing the roll, and the aileron must not be applied rapidly. The roll must be stopped with less than 90° of bank applied.

(iv) In flight conditions of less than 1G the ailerons should be used gently, and the application of full stick deflection avoided. Rolls should be restricted to 90° of bank except that a roll-off-the-top may be executed.

(v) Simultaneous coarse application of tailplane and aileron must be avoided as this will induce severe cross-coupling. Loss of control of the aircraft will almost certainly follow. To avoid the effects of cross-coupling the following technique should be used to execute rolling pull-outs:

Apply G and then the required amount of aileron, taking care not to exceed 90° of bank. Subsequent alterations to the flight-path may then be made by using the tailplane and aileron together so long as the controls are used gently. It is emphasised that any increase in G should be made carefully and 4G should not be exceeded.

(vi) When drop tanks are carried and are empty, rolling manoeuvres may be carried out within the limitations described above. It should be borne in mind that drop tanks reduce the aircraft's longitudinal and directional stability thus calling for additional care, particularly when carrying out rolling pull-outs. Until the drop tanks are empty, 60° of bank must not be exceeded except that a roll-off-the-top may be carried out with gentle use of ailerons. During rolling pull-outs, +3G must not be exceeded and the roll rate should be moderate.

(vii) It may be necessary to carry out a "round the corner recovery" manoeuvre immediately after releasing the stores in a LABS attack. In this manoeuvre the aircraft is turned steeply away from the target and rolled past the vertical to enable a rapid return to a reciprocal flight path with minimum gain in height and minimum loss of speed. The limitations above are still to be observed except that, for this one manoeuvre the angle of bank may be increased to 110° whilst the nose of the aircraft is above the horizon. When the nose of the aircraft falls to the horizon the angle of bank should be limited to 90° and the final phase of the recovery made with gentle use of aileron.

(viii) In the normal circuit configuration (flaps/aileron droop/tailplane flap extended) full aileron may be used regardless of the modification state, to execute normal circuit manoeuvres.

(*b*) *Looping manoeuvres* ▶◀

(i) Simulated LABS manoeuvres, only, are permitted providing the following entry conditions are observed.

Max. AUW *lb.*	Max. entry height *ft.*	Min. entry speed *Knots*
40,000	3,000	530
42,000	1,500	550

For each 10°C above ISA conditions reduce AUW by 1,000 lb.

◀ Simulated LABS manoeuvres only are permitted providing, with 1013 mb. set on the altimeter, the following entry conditions are observed: ▶

(ii) From an airspeed of 530/550 knots at a maximum height of 1,500 ft. AMSL, with full power applied on initiation and applying $4\frac{1}{2}/4\frac{3}{4}$G as demanded by the weapon sight, the airspeed over the top will be approximately 270/250 knots. If manoeuvres are made without the sight in operation an initial application of 5G should be made. The limitation imposed by the steady audio tone must be observed. Allow the nose to fall to 45° below the horizon and confirm that the slip indicator is central and airspeed is above 350 knots before rolling out. If the airspeed is rolled out at low airspeeds considerable sideslip may occur.

◀ NOTE: The preferred escape manoeuvre is "Round the Corner". If the half loop manoeuvre is essential, the bomb door must remain *closed* when stores (other than slipper tanks and clean pylons) are carried on the wing stations. ▶

(*c*) *Inverted flight*
Deliberate sustained inverted flight is prohibited.

(*d*) *Flight under conditions of less than* +1G *indicated*
Flight under conditions of less than +1G indicated is limited to a maximum period of 10 seconds.

15 Inertia cross-coupling

(i) Inertia cross-coupling can be induced if coarse application of aileron is used to initiate a rolling manoeuvre, thereby resulting in an excessive rate of roll. It can also be induced by exceeding the maximum permissible angle of roll, particularly with less than 1G indicated.

(ii) If either of these conditions occur the aircraft's inertia will override the effect of controls and generate violent gyrations in yaw and pitch. These occur without warning and result in sudden loss of control. At high IAS severe structural damage may result.

(iii) If inertia cross-coupling is experienced all controls must be centralised smoothly. This can be best achieved by releasing the controls. The tailplane and rudder controls must not be used in an attempt to control pitch and yaw as this may aggravate the situation and induce a stall and possible spin on recovery from cross-coupling.

(iv) If a recognisable spin develops, the recovery action of paragraph 10 must be taken immediately.

16 High speed flight

(*a*) *Above* 30,000 *ft.*

The maximum Mach No. obtainable in level flight at full power will vary with height, between approximately 0·89M and 0·92M. The limiting Mach No. of 0·95 can then be achieved in a gentle dive. Some slight intermittent buffet may be experienced between 0·88M and 0·91M, flight above these speeds becoming smooth. Any accelerations applied during turns or recovery from a dive will probably induce airframe buffet and intake banging. The latter can be severe and may cause flame-out. If intake banging occurs, altitude, incidence or engine speed should be reduced until the engine behaves satisfactorily.

(*b*) *Low level* (2,000 *ft.*)

The limiting airspeed of 580 knots can be achieved with less than full power. The aircraft is pleasant to fly at high indicated airspeeds. View, control and manoeuvrability are good. At 580 knots 6G can be applied without inducing buffet.

17 Engine failure in flight

(a) Mechanical

If an engine fails due to obvious mechanical causes, shut down the engine as follows:—

Close the HP cock fully.

Close the engine master cock.

Switch off the generator of the affected engine.

Open the inter-tank transfer valves.

Manage fuel in accordance with the drills on the Flight Reference Cards.

Do not attempt to relight.

◀ NOTE: The possibility of fire following a mechanical failure must be considered and speed should be reduced initially. ▶

(b) Flame out

If a flame-out occurs, a relight may be attempted immediately, while the RPM are decreasing, by pressing the relight button with the throttle lever at its set position. If no relight occurs within 20 seconds, release the button and close the HP cock. Further attempts at a relight should be made in the normal way.

(c) Double flame-out

Immediate actions

Press both relight buttons for 20 seconds.

Subsequent actions

If the immediate relight attempt is unsuccessful, switch off all unnecessary services.

Descend below 27,000 ft.

Carry out the normal relight procedure.

If no relight is obtainable, glide to a suitable area and abandon the aircraft.

Considerations

Provided that both engines are windmilling and control movements are kept to a minimum a sufficient degree of control is afforded by the flying controls hydraulic systems at a minimum gliding speed of 250 knots. In any case the RPM should not be allowed to fall below 13%.

18 In-flight refuelling

(*a*) When Mods. 881, 992 and 5089 are embodied, in-flight refuelling in the Receiver role is permitted against Sea Vixen, Scimitar, Buccaneer S Mk. 2 and Victor tankers equipped with Mk. 20A, B, C or E pods and collapsable drogue, within the following limitations:—

Speed: 230-290 knots (250 knots recommended)

Height: Up to 35,000 ft.

NOTE 1: When receiving from a Victor tanker the maximum speed decreases linearly from 290 knots at 27,000 ft. to 265 knots at 35,000 ft.

NOTE 2: Sorties may be limited by engine oil consumption or LOX capacity.

(*b*) *Checks before contact*

Select flight refuelling switch ON (OFF for dry contacts). Observer check overload fuel transfer switch OFF.

Unless the refuelling switch is set on before contact is made, bigh surge pressures will be experienced when it is set on.

(*c*) *Approach and making contact*

◀**WARNING:** Engine malfunctioning may occur if the drogue is allowed to approach the engine intakes. ▶

(i) Making contact below 20,000 ft. is straight forward at the recommended speed of 250 knots. When the tanker is ready, fly the aircraft towards the drogue smoothly in a slight climb with an overtaking speed of 2-3 knots. In order to reduce any tendency to follow the small random movements of the drogue it is advisable not to focus on the drogue but to look through it at the tanker aircraft. Last minute corrections to the flight-path will not usually be necessary and should be avoided as they are likely to impose heavy loads on the drogue after contact.

(ii) Above 20,000 ft., making contact becomes progressively more difficult with increasing altitude and this increases the risk of damage due to the drogue striking the radome. When approaching the drogue for contact above 20,000 ft., control will be easier if the ROLL and YAW channels of the autostabilisers are selected to APPROACH. In the event of a missed contact, throttle back and ease back about 5 yards, then make a further approach.

(*d*) *In contact*

(i) Whilst in contact, normal formation flying techniques should be applied. With a Vixen tanker fly at the normal trailing position of the hose; with a Scimitar tanker it is more comfortable to fly about 4 ft. below this position in order to take the receiver's tailplane out of the tanker's jet wake.

(ii) *Fuel contents indications*

The pounds remaining indicator will 'wind up' while refuelling is taking place and will indicate total contents at the time. While receiving fuel, check the fuel contents gauges at an early stage to ensure that fuel is being received in each of the four master/slave tank combinations. In the event of refuel valve failure it will not be possible to get fuel into the affected master/slave combination. If wing tanks are carried they will fill automatically after all internal tanks are full. The fuel contents for the wing tanks may be monitored from the observer's cockpit. When all tanks are full, the amber light by the hose reel will come on.

(*e*) *Breaking contact*

When refuelling is complete, withdraw slowly by reducing power. Take care to fly slightly below the trailing line of the hose. This is important in order to avoid the danger of the receiver's radome being struck by the drogue after withdrawal. If the receiver aircraft disengages from the drogue before the hose reaches the full trailed position, heavy loads will be thrown on the brake mechanism. This can result in the loss of the hose on either this or subsequent withdrawals. Therefore, on withdrawal, every effort should be made not to exceed 3 knots opening speed. This will ensure that the hose winds out to full trail before disengagement occurs. If the withdrawal opening speed is not very slow, premature disengagement can occur without either the receiver or tanker pilot being aware of it. Emergency break away practices are not to be made. When clear select:

Flight refuelling switch off
Overload fuel transfer switch on (if appropriate)

(*f*) *Refuelling valve failure*

It is possible for a single refuel valve failure to occur resulting in one set of fuselage tanks failing to receive fuel. Subsequent engine demand could exhaust the affected tanks of fuel. Since the automatic shut-off of the fuel-no-air valve cannot be relied on, two proportioner cells could run dry and air could be admitted to the engine fuel system.

(*g*) *Action in the event of a refuel valve failure*

(i) If a refuel valve failure occurs, the fuel-no-air valve of the affected tank should be shut-off and the inter-tank transfer valve opened, before the tank runs dry. This will ensure the affected proportioner cells are supplied with fuel from the adjacent master tank.

(ii) *Further considerations.* With the inter-tank transfer valves open it is possible that the other pair of main tanks may go out of balance due to a difference in heads of fuel. If this occurs it will be necessary to monitor the fuel gauges carefully and maintain a reasonable balance by shutting off the appropriate fuel-no-air valve.

19 Descent

(*a*) The airbrakes are very effective and allow steep descents to be made without incurring high airspeeds.

(*b*) Normal descents should be made at 85% RPM, airbrakes out, at 300 knots. This gives a rate of descent of approximately 12,000 ft./min.

(*c*) *Maximum rate descent*

Maintain a minimum RPM of 60%, airbrakes out and descend at 0·85M/400 knots. This gives a high rate of descent and care should be taken when descending in conditions of poor visibility.

20 Flying in severe turbulence

The recommended speed for crew comfort considerations is 400 knots.

21 Flight in rain

(*a*) Neither the windscreen wiper nor the rain clearance air jet are fully effective in heavy rain.

(*b*) *Windscreen wiper*

The windscreen wiper must not be used on a dry windscreen and, after use, must be parked on the starboard side of the windscreen. It must not be used above 350 knots.

(*c*) *Windscreen rain clearance air jet*

(i) The rain clearance system must not be switched on until rain is encountered.

(ii) If the following limitations are not observed damage to the windscreen may occur.

Condition	Ambient Air Temperature		
	Below 20°C	20°C to 25°C	25°C to 30°C
take-off	Use permitted to max. speed of 275 kts.	Use permitted to max. speed of 185 kts.	Not permitted
Circuit/landing			Use permitted below 185 kts.
Overshoot			Not permitted
Cruising flight.	Use permitted up to max. speed of 450 kts.		
Following rapid descent.	System should not be switched on until low altitude flight (2000 ft.) has been sustained for 5 minutes.		
Ground running.	Use permitted for a maximum period of 1 minute.		

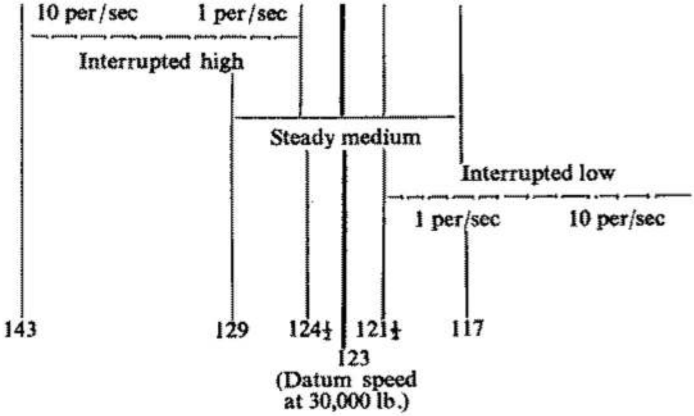
22 Flight in icing conditions

Flight in icing conditions should be avoided. The engine and engine aux. anti-icing may be used. Engine RPM must not be reduced below 82% and if the engine(s) is run at 82% it must be opened up to 90% RPM for 30 seconds every ten minutes in icing conditions. There is no airframe anti-icing. In emergency, the use of wing and tailplane blow will give considerable protection from leading edge icing.

23 Airstream direction detector

(a) Audio tone pattern

When correctly set up the audio tone pattern at 30,000 lb. AUW corresponds to the speeds shown below. An allowance for weight variation must be made at the rate of 2 knots per 1,000 lb.



(*b*) *Calibration*

(i) To check that the audio pattern and ADD indicator are correctly set up, the aircraft must be flown in the following conditions to ensure correct IAS/incidence relationship: —

Configuration: 45-25-25
Clean wing or pylons only*
Undercarriage down
Full airbrake
Blow on

Weight: 35,000 - 37,000 lb.

Power: As necessary to maintain an indicated BLC pressure of 35 PSI.

Height: Commence at 2,500 ft. or below.

(ii) Smooth air conditions are essential and G must not be applied. Fly at approximately 2,500 ft. and reduce airspeed to about datum speed then set up and maintain an accurate ADD indication of 20 units in a steady controlled descent; check that the rate-of-descent is approximately 700 ft./min. and that the steady audio note is obtained. Observe the reading of the deck landing ASI. When the ADD is correctly set up, this reading, corrected for instrument error only, and not for position error, should be within ± 3 knots of the calculated datum speed for the weight. When it does not, the ADD cannot be used as a stall warning device and must be

◀ adjusted on the ground in accordance with AP.101B-1201-1B.

* If the ADD is calibrated with wing tanks on, the steady note should be obtained when the deck landing ASI, corrected for instrument error only, is reading within $^{-0}_{+6}$ knots of the calculated datum speed for the weight.▶

PART III — HANDLING

Chapter 3 — CIRCUIT PROCEDURE AND LANDING

Contents

1 Fuel allowance

At least 1,000 lb. of fuel must be available when 'downwind' for the final landing. An overshoot, circuit and landing will normally require 500 lb. The final landing must be made with at least 500 lb. of gauged fuel available.

2 Joining

When lowering aileron droop and tailplane flap to the landing configuration, the selector should only be moved one stage at a time. The extension of the surfaces should be checked for synchronisation at each stage.

3 Downwind

Until mod. 756 is embodied, an application of wheelbrakes during a down selection of the undercarriage must be avoided. A specific check should be made to ensure that no pressure is indicated at the brakes after the undercarriage is down and if pressure exists, the undercarriage should be re-cycled to eliminate it.

4 Checks before landing

Carry out the checks before landing listed in the Flight Reference Cards.

5 Datum speeds

The datum speed is the correct speed for approach and landing. It will vary for different configurations and weights as shown in the following table.

Flap configuration	Datum speed (kts.) at 30,000 lb.*
◀ *Two engines* (*with full airbrake*)	
45-25-25 Blow on	123
30-20-20 Blow on	126
0-25-25 Blow on	135
45-10-10 Blow off	140
0-10-10 Blow off	152
One engine (*with not more than ½ airbrake*)	
45-10-10 Blow off	140
30-10-10 Blow on	140
0-10-10 Blow off	152

*For other weights adjust speed by 2 knots/1,000 lb.

NOTE: In the flapless approach, with BLC on, severe airbrake buffet will be experienced. ▶

6 Approach and landing (with blow)

(*a*) *Approach*

The turn on to the final approach should be made at 10 knots above the datum speed, with ½ airbrake extended. Control response deteriorates in the landing configuration and in turbulent conditions some care is required to prevent overcontrolling during corrections to the flight path. All control movements should, as far as is possible, be made slowly and smoothly. When the mirror path is intercepted select full airbrake and reduce speed progressively to the datum, maintaining at least 80% RPM (for blow), and observing the ADD limitations. Alterations to the power setting should normally be of the order of 2% RPM and time allowed for these changes to take effect. Large power changes will result in difficulty in establishing the datum speed quickly and accurately. A height of 600 ft. at the datum speed is required to effect a safe overshoot if one engine fails on the approach. (See para. 11).

(*b*) *Landing*

(i) The no-cut technique should be adopted, the aircraft being flown on at the datum speed. The aircraft can be flared at these speeds but power must not be reduced to below 80% RPM before touchdown. If the throttles are closed before touchdown, the resultant loss of blow will cause a rapid sink, accompanied by a pitch-up and probable wing-drop. At AUW's in excess of 34,500 lb. the touchdown should be made carefully, so as not to exceed a vertical velocity of 14 ft/sec.

(ii) If the throttles are closed quickly immediately after touchdown, a slight increase in aircraft attitude will result. After touchdown, when sufficient runway length is available and/or the wind strength is significant, brake wear will be reduced hy holding the nose clear of the runway until speed has decreased to 110 knots. Lower the nose gently at this speed, aiming to place it on the runway at approximately 95 knots. The aircraft should be allowed to roll for the full available landing run; nosewheel steering may be engaged as soon as all three wheels are firmly on the runway. From a landing at 30,000 lh. at datum speed, and commencing braking at 90 knots, the application of 300/500 PSI brake pressure to each wheel results in a landing run of approximately 1,800 yards.

(iii) The anti-skid units will normally prevent the wheels locking when excessive pressure is applied hut, unless the shortest possible landing run is required, more gentle use of the hrakes is recommended. If excessive hrake pressures are used, tyre wear will be increased. With the anti-skid units operating, the landing run may feel slightly 'rough'. The units need to be 'spun-up' after touchdown and will not operate at maximum efficiency until the aircraft is firmly on the ground. They will not prevent scuffing of the tyres if brakes are applied immediately after the aircraft has landed. On both wet or dry surfaces with the anti-skid units operating, it is possihle to scuff the tyres and/or lock the wheels if maximum hrake pressure is continuously applied. If slip or skid is felt or if difficulty is experienced in keeping straight release the hrakes momentarily. Continuous application of brake during slip or skid can lead to wheel locking with consequent scuffing and possible bursting of tyres.

(iv) A short landing run may be achieved by lowering the nose immediately after touchdown, applying a maximum hraking pressure of 1,100 PSI to each wheel and holding the stick back. Application of brake pressures above 1,100 PSI may lead to continuous operation of the anti-skid units, resulting in an increase in the landing run.

7 Tubulent conditions

In severe turhulence, increase the datum speed by 5 knots. Control will be improved hy selecting the flap configuration 30-20-20 and further increasing the approach speed according to para. 5.

8 Asymmetric store

(*a*) *Landing*

When in an asymmetric underwing store configuration the aircraft has, at approach speeds, a tendency to "overbank" in the direction of the store. In addition, turns away from the store will require a mnderately large application of rudder to initiate. Therefore, when deck landing in this configuration care should be taken to avoid late corrections in lining-up.

(*b*) *Bolting*

At very low airspeeds, i.e. prior to unstick, the aircraft has a tendency to yaw towards the store. If a "bolter" occurs this yaw should be anticipated and a gentle correction made.

9 Crosswind landing

(*a*) The maximum recommended crosswind component is 25 knots, hut until experience is gained in handling the aircraft under crosswind conditions, normal operation should be limited to a 20 knot component. The crah technique is recommended.

(*b*) *Final approach*

Allow a slightly longer final approach than normal in order to stabilise the airspeed and drift. The final correction, to line up with the runway before touchdown, should be made firmly and smoothly; gentle use of aileron is sufficient to counteract any tendency to roll.

(*c*) *Landing*
Immediately after touchdown, lower the nose gently to the runway. In crosswind conditions there is a marked tendency for the "into wind" wing to lift if a nose-up attitude is maintained. After lowering the nose the nosewheel steering must not be engaged until the aircraft is firmly on the ground and the rudder bar is central. Sufficient rudder control is availahle to cater for the initial crosswind landing run and nosewheel steering need not be engaged until the speed has reduced to approximately 60 knots. The wheelbrakes should not be used until all three wheels are firmly on the ground.

10 Approach and landing (without blow)

(*a*) Complete the standard checks before landing, hut with blow selected off, engine hlow valves closed and flap configuration 45-10-10. Switch off the ADD.

(*b*) Make a wide circuit and long final approach. This will eliminate the necessity for excessive bank in the circuit and will allow ample time for the airspeed to be reduced. Complete the turn on to the final approach at 20 knots above the datum speed. The airspeed will therefore be in the region of 155 knots and, even with full airbrake extended, will decrease comparatively slowly. Power should then be reduced by small amounts, i.e. 2%-3% RPM until datum speed is achieved.

(*c*) A normal landing should be made. After touchdown use aerodynamic braking to reduce airspeed to below 120 knots before applying the wheelhrakes. The landing run is increased hut only moderate hraking is required to stop within 2,000 yards. In crosswind conditions when it may not be possihle to use aerodynamic hraking, the nose should be lowered after touchdown and the airspeed allowed to decrease to below 120 knots before the brakes are applied.

(*d*) At weights above 37,000 lb., the minimum runway length should be 3,000 yd. and, to avoid hrake hurnout, the maximum use of aerodynamic hraking should be made.

11 Engine failure in the approach configuration (blown)

(*a*) *General*
The overshoot capahility of the aircraft is critically depen-

dant on the AUW and temperature. To ensure a positive rate of climb in the 30-20-20 blown configuration, with undercarriage up, airbrakes retracted, no external tanks or stores, one engine cut and the other at full power, the AUW must be less than the following: —

35,400 lb. at SL, ISA conditions
33,000 lb. at SL, ISA + 10°C conditions
30,500 lb. at SL, ISA + 20°C conditions

If an engine fails in the blown configuration, loss of thrust and a reduction in blow pressure will produce an immediate increase in incidence and a loss of speed of about 5 knots. Considerable height may be lost in raising the flap configuration to enable a single engine blown approach to be made to the runway threshold, or to permit an overshoot. It will not be possible to overshoot if an engine fails below the safety height if the aircraft is at datum speed for a two engine blown landing. Whenever possible a landing should be made and not an overshoot.

(*b*) *Safety heights*

The safety height for a 45-25-25 blown landing is 600 ft.
The safety height for a 30-20-20 blown landing is 400 ft.

(*c*) *Engine failure in the 45-25-25 blown configuration*

The procedure to be adopted, to overshoot or to land, in the case of an engine failure in the 45-25-25 blown configuration is detailed in the Flight Reference Cards. There will be a height loss incurred of approximately 350 to 400 ft. with underwing tanks fitted and slightly less if they are not fitted. If a decision to overshoot has been made it is important to maintain the ADD steady note and to climb carefully to 200 ft. above all obstacles before retracting the configuration to 15-10-10 when a height loss of about 50 to 100 ft. may occur.

(*d*) *Engine failure in the 30-20-20 blown configuration*

If an engine fails during a 30-20-20 blown approach there is no need to alter the flap setting to regain level flight. It will be necessary to increase this speed by 3 knots to maintain the ADD steady note whilst level flight is being regained. It is emphasized that it is most important to maintain the ADD steady note, rather than to concentrate on an increase in speed. Whilst the undercarriage is retracting and speed is being gained, a height loss of about 300 ft. will occur with underwing tanks fitted and approximately 200 ft. if they are not fitted. Before retracting the configuration to 15-10-10 the conditions detailed in para. (c) must be observed.

(*e*) *Bolting*

If an immediate landing, rather than an overshoot, is attempted following an engine failure, a bolter will not be possible unless the AUW is below: —

30,500 lb. at SL, ISA conditions
28,500 lb. at SL, ISA + 10°C conditions

If the AUW is at or below these weights there will be sufficient performance to bolt and achieve a rate of climb of approximately 100 ft/min. in the 30-20-20 blown configuration with the undercarriage down and the airbrakes retracted.

WARNING: The above drills and techniques must not be practised with an engine at idling RPM, as no low level datum switch is fitted to the engine fuel control system. Without this switch it may be impossible to accelerate the engine from idle.

◀**12 Engine failure in the approach configuration (unblown)**

(*a*) The overshoot capability of the aircraft is critically dependant on the AUW and temperature. To ensure a positive rate of climb in the 45-10-10 unblown configuration, with the undercarriage up, the airbrakes retracted, no external tanks or stores, one engine cut and the other at full power, the AUW must be less than the following: —

37,400 lb. at SL, ISA − 10°C
35,200 lb. at SL, ISA conditions
32,900 lb. at SL, ISA + 10°C
30,700 lb. at SL, ISA − 20°C

(*b*) *Safety heights*

(i) The safety height following an engine failure during a twin-engine, 45-10-10, unblown approach is 400 ft.

(ii) The safety height to permit an overshoot during a single-engine, 45-10-10, unblown approach is 300 ft. ▶

◀(c) *Engine failure in the* 45-10-10 *unblown configuration*
The procedure to be adopted, to overshoot or to land in the case of an engine failure in the 45-10-10 unblown configuration is detailed in the Flight Reference Cards. There will be a height loss incurred of up to 250 ft. If a decision to overshoot has been made it is important to maintain the ADD steady note until the undercarriage has been retracted and the external stores jettisoned. Thereafter an increase of speed of 10 knots will result in a climb of at least 100 ft/min. in the configuration 45-10-10 so long as the critical weights and temperatures at para. 12(a) are observed.

(d) *Overshoot from an intentional single-engined unblown approach*
No more than half airbrake should be used for a single-engined unblown approach and landing. If the landing is baulked and an overshoot necessary the procedure to be adopted is detailed in the Flight Reference Cards. The height loss incurred will be up to 180 ft. therefore the safety height is 300 ft.

13 Flapless landing

(a) The aircraft handles quite satisfactorily in the flapless configuration and landings may be made 0-25-25 (BLC ON) or 0-10-10 (BLC OFF).
The datum speeds are detailed in para. 5 and these speeds correspond to the ADD steady note.

(b) *Tailplane trim settings*
More nose-down trim is required than for a normal approach thus limiting the remaining available tailplane movement. However sufficient nose-down tailplane movement remains to permit an overshoot.

(c) *Circuit*
After selecting the landing configuration the circuit should be flown at 10 knots above the approach speed. Deceleration is slow in the flapless configuration and care in speed control is required to achieve the correct approach speed. At no time should the aircraft be flown at less than the ADD steady note. ▶

14 Instrument approaches

NOTE 1: The settings opposite are for the normal approach configurations. The datum speeds are the basic speeds and must be adjusted for weight.

NOTE 2: The single engine settings are for the actual condition — with one engine stopped. For practice single engine instrument approaches increase the airbrake setting by approximately ¼ of the airbrake range, i.e. increase the descent setting from ½ air-brake to ¾.

NOTE 3: Before commencing the descent, select the engine blow valves switch to OPEN.

(a) 2 engines — (blown) — datum speed 123 *knots at* 30,000 *lb.* AUW

Stage	% RPM	*Speed (knots)*	*Action*
QGH	85	300	Full airbrake
Slow descent	85	250	Full airbrake
Level	86 (approx.)	190	½ Airbrake Select 15-10-10 Blow ON
'Check cock-pit'	87 (approx.)	160/150	½ Airbrake Select 30-20-20 U/C down
Glidepath	87 (approx.)	Datum + 10	Select 45-25-25
Visual with mirror	87 (approx.)	Datum	Full airbrake

(b) 1 engine — (blown) — datum speed 140 *knots* (133 *carrier) at* 30,000 *lb.* AUW.

Stage	% RPM	*Speed* (knots)	*Action*
QGH	90	300	½ Airbrake
Slow descent	90	250	½ Airbrake
Level	93 (approx.)	190	Airbrake IN Select 15-10-10 Blow ON
'Check cock-pit'	93 (approx.)	160/150	Airbrake IN 15-10-10 U/C down
Glidepath	93 (approx.)	Datum + 10	½ Airbrake Flap to 30°
'1 mile to go'	93 (approx.)	Datum	Approx. ¾ air-brake
Visual with mirror	93 (approx.)	Datum	Airbrake as re-quired

◀ NOTE: Power must be maintained at a level which will give a minimum blow pressure of 20 PSI; this is approx. 91% RPM. ▶

15 Overshooting

(*a*) Open the throttles fully, selecting airbrakes in. Raise the nose and when climbing, select undercarriage up. At a safe height (approximately 200 ft.) raise the landing flap configuration, in steps, observing that droop and tailplane movements are synchronised. Before cleaning up to 15-10-10, a minimum speed of 160 knots should be attained and 175 knots before cleaning up completely. When settled into the climb, but before the airspeed reaches 250 knots, select the aileron gear-change to high speed (down).

(*b*) If a further circuit is intended, the aircraft can be climbed away in the landing configuration with the airbrakes closed. It must be noted that if an overshoot is made in the landing configuration an engine failure may lead to a critical situation.

(*c*) Unless circumstances dictate otherwise, e.g. low fuel state/bad weather, it is prudent to treat an overshoot as a normal take-off. After full power has been applied, raise the undercarriage and select the configuration in steps to 15-10-10. The aircraft is then in a suitable configuration to enter the downwind leg.

16 Checks after landing

Carry out the checks after landing listed in the Flight Reference Cards.

17 Shut-down procedure

Carry out the procedure listed in the Flight Reference Cards.

PART III — HANDLING

Chapter 4 — ASYMMETRIC FLYING

Contents

1 Stopping one engine

For asymmetric flying, proceed as follows: —

Generator switch ... ... Closed.

HP cock ... ... OFF on side of failed engine.

For fuel system management refer to paras. 3 to 5.

2 Single-engine flying

(*a*) (i) Deliberate single-engine flying is only permitted for the purpose of carrying out relighting practice.

(ii) Single-engine flying may be simulated with one engine idling and ¼ airbrake extended at heights above 2,000 feet.

WARNING: During simulated single-engine operation in the blown configuration, the idling engine may fail to accelerate when the throttle is opened. The RPM may remain at idling, accompanied by a rapid rise in JPT. If this occurs the throttle must be closed, and a further attempt made in the clean configuration with blow off.

(*b*) *Flying Controls*

(i) The single remaining flying control hydraulic system fulfils all normal demands, but the power of the PFCU's is reduced and response to a sudden demand may be slower. The maximum permissible speed for flight, using a single flying control system, is 550 knots/0·93M.

(ii) The flying control integration valves permit General Services hydraulic pressure to be applied to either of the flying control hydraulic systems, in the event of failure of the system driven by the live engine. Speed must not exceed 350 knots or 0·6M.

(*c*) *Services lost*

(i) *Port engine stopped*
Roll autostabiliser facility on port aileron.
Pitch and yaw stabilisation.
Autopilot facility on port aileron.

NOTE: The standby yaw damper remains available.

(ii) *Starboard engine stopped*
Roll autostabiliser facility on starboard aileron.
Standby yaw damper.
Autopilot facility on starboard aileron.
Q-feel.

(*d*) *Handling*
With the port engine stopped, the standby yaw damper must be switched on. It will not be possible to trim out all the foot-load on the rudder pedals during the circuit and landing. Foot-load varies with speed and configuration but does not exceed about 90 lb. using full rudder at circuit speeds. Approximately ¼ rudder is required to maintain asymmetric flight at low airspeeds and, due to the footloads, prolonged asymmetric flight under circuit conditions is tiring.

3 Fuel system management

(*a*) *General*

(i) If an FNA valve fails to close when its master tank becomes empty, and the inter-tank transfer valves are open, air from the empty tank will be drawn in sufficient quantities to cause either malfunctioning or flame-out of one or both engines. With the inter-tank transfer valves closed, no hazard exists.

(ii) When the two master tanks supplying an engine become empty, if the cross-feed cock is opened to supply fuel from the other proportioner, the dry proportioner will overspeed and can, under certain conditions, pump sufficient air to affect both engines.

(iii) The FNA valve switches can be used to balance fuel between two associated master tanks or between engine tank groups.

(iv) Unusable fuel is 300 lb. This is distributed between the four master tanks and allows for variations between aircraft and for gauge readability and accuracy. Whenever a gauge reads 75 lb. its tank must be considered to be empty.

(*b*) *One engine failed*

If an engine fails, use fuel from the failed side by opening the inter-tank transfer valves and then closing the FNA valves of the live engine side. Reopen both FNA valves of the live engine side just before the first master tank on the failed side indicates 75 lb. Then close the inter-tank transfer valves. Any fuel remaining in the failed engine side is now unusable.

4 Single-engine circuit and landing (blown)

(*a*) *Circuit*

Fly the downwind leg at 1,000 ft. AGL in the normal way, with flap configuration 30-10-10, blow on, maintaining a minimum blow pressure of 20 PSI (approx. 91% RPM). Lower the undercarriage. Adjust the speed by use of the airbrakes, aiming to turn crosswind at 10 knots above the datum speed.

NOTE 1: If the flaps are lowered by their standby control, 45° of flap will be extended.

NOTE 2: By selecting blow on, marginally more thrust is available and, at the same time, a lower datum speed is permitted.

(*b*) *Approach and landing*

(i) Make a gentle turn on to a long, straight approach. Select about ½ airbrake when on the mirror glide-path. Adjust the airbrake position to give the correct datum speed, and follow the mirror glide-path.

(ii) A normal power-on landing should be made taking care not to apply the brakes in excess of 120 knots.

(iii) Minimum permissible blow pressure of 20 PSI will be maintained at approximately 91% RPM.

NOTE: If flaps are lowered to 45°, the decision height is 300 ft.

5 Overshoot (blown)

(*a*) The single-engine performance is critically dependent on all-up weight. The aircraft will overshoot on one engine in the flap configuration 30-10-10, blow on, at the datum speed, provided that the airbrakes are fully in and the undercarriage is retracted.

(*b*) The decision to overshoot must be made by 200 ft. to allow time for the airbrakes and undercarriage to retract.

(*c*) Provided the all-up weight is less than 31,000 lb. the aircraft has a touch-and-go capability under ISA conditions.

(*d*) The speed must not be allowed to fall below the correct datum on the approach, or during an overshoot, otherwise the subsequent climb performance will be adversely affected.

(*e*) To overshoot, proceed as follows: —

1. Open throttle fully on the live engine.
2. Close the airbrakes.
3. Raise the undercarriage.
4. Climb initially at datum speed.
5. An improved rate of climb will result if the speed can be increased by 10 knots.

◀6 Single-engine circuit and landing (unblown)

(*a*) The weight/temperature limitations at Part III, Ch. 2, para. 12 should be observed.

(*b*) The safety height for a single-engine unblown approach is 300 ft.

NOTE: Not more than ½ airbrake should be used for a single-engine unblown approach.

7 Overshoot (unblown)

The aircraft will overshoot on one engine so long as the aircraft is cleaned up and the underwing stores and tanks are jettisoned. The speed must not be allowed to fall below datum speed on the approach and during the overshoot the speed should be allowed to increase by 10 knots after the aircraft has been cleaned up. Failure to do this will adversely affect the subsequent climb performance.

NOTE: The weight/temperature limitations at Part III, Ch. 3, para. 12 should be observed. ▶

8 Relight procedure

(*a*) 1. Check engine master cock on.

2. Check blow off, except in emergency.

3. Press the relight button and open the throttle to ground idling.

4. After a light-up is indicated on the JPT gauge and idling RPM achieved, a pause of 10 seconds must be allowed with the throttle at the idling position.

5. Switch on the generator switch.

6. If no relight is achieved after 30 seconds, release the relight button and close the HP cock.

7. Wait at least 1 minute before making a second attempt, to allow excess fuel to drain.

8. Light-up may be accompanied hy a slight thump.

(*b*) *Recommended maximum speeds*

30,000 ft.	230 knots
20,000 ft.	320 knots
10,000 ft.	410 knots
SL	500 knots

NOTE: If a relight is not achieved at the first attempt, a second attempt should be made at a lower altitude.

(*c*) During the relight, check: —

JPT	Not above 600°C.
Oil pressure magnetic indicator	Black
Fire warning light	Out

9 Engine acceleration

(*a*) When the aircraft is at a low airspeed, in the circuit configuration and with blow on, it is probable that the idling engine will fail to accelerate when the throttle is opened. The RPM may remain at idling, accompanied by a rapid rise in JPT. If this occurs the throttle must be closed, and a further attempt made after the aircraft has been cleaned up and hlow is off. On completion of practice single-engine flying, height must not be reduced to below 2,000 ft. AGL until the idling engine has been accelerated.

(*b*) After landing, the occurence should be reported.