PART III

HANDLING

LIST OF CHAPTERS

PART III—HANDLING

Chapter 1—PREPARATION FOR FLIGHT

Contents

◀1 Preparation for flight

(*a*) Carry out the checks given under PREPARATION FOR FLIGHT in the Flight Reference Cards. During the▶ External checks systematically check the outside of the aircraft for signs of damage and for the security of panels, filler caps, doors and hatches. The engine intakes must be free from obstruction and the starter fairings secure, the fuel drain pipes protruding and undamaged, and the jet pipes free from distortion.

(*b*) In winds above 25 knots it is advisable to leave the external rudder locks in for taxying, and in winds above 35 knots, the aileron locks should also be fitted. If aileron locks are left in for taxying, the flaps must be fully up before the locks are fitted and the flap selector must be locked in the up position by its locking pin until the pre-take off checks.

WARNING: The flaps will be damaged if the flap selector is operated whilst the aileron locks are in. The rudder trimmer must not be operated while the rudder locks are in.

◀2 Cockpit checks

Carry out the checks given under COCKPIT CHECKS in the Flight Reference Cards. ▶

3 Starting the engines

Carry out the Starting Procedure given in the Flight Reference Cards.

4 Failure to start

(*a*) If an engine fails to accelerate to idling RPM close the HP cock immediately. If the starter has been loaded with more than one cartridge, a further attempt to start may be made as soon as the engine has stopped rotating and the starter button has reset. If it is necessary to reload the starter wait until the engine has stopped rotating and ensure that the master start switch and the ignition switch are OFF.

(*b*) If a starter fails to fire carry out the same procedure as in (*a*) except that a minimum time of 60 seconds must elapse before reloading or firing a second cartridge. If a second cartridge fails to fire have the electrical circuit checked.

WARNING: When charged, the capacitor in the high energy ignition unit possesses a lethal voltage. The unit must be isolated and at least one minute allowed to elapse before any adjustments may be made near the unit.

(*c*) After failure to start, if the HP cock is closed without delay there should be no necessity to "blow through" the engine. If in doubt, excess fuel may be removed by firing another cartridge as follows:—

Master starting switch	ON
Ignition switch	OFF
HP cock	Closed

If an internal fire is suspected the LP cocks and pumps for that engine must also be put off.

5 Checks before taxying

(*a*) Carry out the Checks Before Taxying given in the Flight Reference Cards.

(*b*) When checking the aileron, rudder and tailplane trimmers proceed as follows:—

(i) *Aileron trimmer*

Operate over full range and return to neutral.

(ii) *Rudder trimmer*
Test for a live circuit by ensuring that no movement occurs when either rudder trim switch is operated independently. Then operate the trimmer over the full range and return to neutral.

(iii) *Tailplane actuator*
Test for a live circuit by ensuring that the tailplane does not move when the thumb-flap is lifted. Operate the tailplane over the full range and return to neutral.

(iv) During the above checks ensure that no overrun occurs when trimmers are stopped at the neutral position from each direction. The aircraft must not be flown if a live circuit exists or if trimmer operation is faulty.

6 Taxying

(*a*) Check the operation of the brakes, which are powerful, as soon as possible.

(*b*) Check serviceability of flight instruments during turns.

(*c*) Rudder and control column loads can be high when taxying in strong wings. ▶◀ (See para. 1 (*b*)).

(*d*) At aft CG's avoid high speed taxying, owing to the tendency for the nose to lift.

(*e*) In order to prevent excessive side loads on the undercarriage, particularly at higher weights, speed must be reduced when turning or manoeuvring. Turning with one wheel locked is prohibited.

(*f*) Under high cross-wind conditions the engines may stall during acceleration. In these conditions take care when opening the throttles.

(*g*) If it is necessary at any time to stand tail into wind run the engines at sufficient RPM to maintain JPT's within the limits.

(*h*) Fuel consumption while taxying is about 30–40 lb. per minute.

7 Checks before take-off

Carry out the Pre-Take-off Checks given in the Flight Reference Cards.

PART III—HANDLING

Chapter 2—HANDLING IN FLIGHT

Contents

1 Take-off

(*a*) Extract the take-off information from the ODM. Provided that runway and temperature conditions are suitable, at weights of 47,000 lb. and below, the gap between unstick and safety speed is reduced by keeping the aircraft on the ground until a speed of 130 kts. is reached. In this case, calculate the take-off information assuming a weight ◀of 47,000 lb. When taking-off at high AUW from a high altitude airfield in high ambient temperature conditions, it may be necessary to use the short run unstick speed quoted in the ODM in order to avoid exceeding the tyre limiting speed of 147 knots ground speed.

(*b*) Align the aircraft on the runway and apply the brakes. Open up the engines to 7,400 RPM; poor throttle and JPT▶ synchronisation indicate a swirl vane malfunction. If an engine is suspect, increase power; throttle and JPT de-synchronisation will be more evident and the engine will show a tendency to overspeed. If these symptoms are present do not take-off; have the fault investigated. If the above check is satisfactory release the brakes and open the throttles fully.

(*c*) During the take-off run, check the tendency for the nose-wheel to rise early. At 10 knots before the unstick speed move the control column steadily backwards and fly the aircraft off the ground at the correct unstick speed.

At high weights or high altitudes acceleration on the runway is reduced and care should be taken not to raise the nose too early or the take-off run will be prolonged. At the worst combination of weight and altitude the nose of the aircraft should be raised approximately 5 knots before the unstick speed.

Take-off weight (lb.)	*Unstick speed (knots)*
35,000	110
40,000	115
45,000	125
50,000	135
55,000	140

(*d*) When comfortably airborne, apply the wheelbrakes and retract the undercarriage. There is little change of trim but care must be taken at high weights not to exceed 190 knots before the wheels are locked up. If 190 knots is reached before the doors are closed it is possible that they may not close at all. There is no visual indication that the doors are open but buffeting will be felt. If this happens, reduce speed to about 170 knots to allow the doors to close.

(*e*) The aircraft accelerates rapidly with an increasing nose-up change of trim.

(*f*) If a climb to altitude is intended, set 7,750 RPM and climb at 330 knots. When remaining in the circuit 7,000 RPM/180 knots is adequate.

(*g*) *Aborted take-off*

If a take-off is aborted below the stop speed it is possible to stop the aircraft in the remaining distance available. The emergency maximum braking speed must be observed, as the brakes will overheat and fail if they are applied at a higher speed. The drill for a barrier engagement is given in the Flight Reference Cards. If the take-off is aborted between the stop and unstick speeds the following points must be considered; their applicability will depend upon the speed and weight of the aircraft, weather conditions, and runway length.

(i) To delay applying the brakes until the aircraft decelerates to the maximum braking speed may result in the aircraft leaving the end of the runway without the brakes having been applied. In these circumstances the use of aerodynamic braking, combined with wheel braking above the emergency maximum braking speed should be attempted. If aerodynamic braking is used and an arrester barrier is to be engaged, the nose must be lowered some 400 yards before the end of the runway.

(ii) Jettisoning the underwing stores can reduce the weight thus improving the braking performance, and reducing the entry speed into the overshoot. As this procedure is likely to be extremely hazardous, it is not recommended except in the direst emergency.

(iii) In the last resort, and after the external stores have been jettisoned, the undercarriage may be raised when operating from an airfield with no arrester barrier and with a hazardous overshoot area. When operating an aircraft with a gun pack fitted the undercarriage should not be raised unless it is absolutely essential as, at high speeds, the aircraft may ground loop or even roll over. If runway level ejection is considered (Type 2CB Mk. 1 seat), it should be done above 90 knots.

◀(*h*) *Engine failure after take-off*

Following an engine failure after take-off the aircraft yaws and rolls towards the dead engine. The rates of yaw and roll increase rapidly if recovery action is delayed, particularly in the clean wing configuration but, due to the lower rolling inertia, recovery to level flight is more easily effected. Aircraft weight, by affecting the acceleration immediately following an engine failure, affects the speed from which a safe recovery can be made. In all cases, following an engine failure, apply full opposite rudder immediately, and then corrective aileron; application of aileron before rudder adversely affects the recovery. To assist recovery, apply a small amount of bank towards the live engine and, if necessary, reduce power on the live engine. Under high temperature and/or altitude conditions the thrust is less which alleviates the handling difficulties but reduces the acceleration and rate of climb. The safety speed at all weights in all configurations is 175 kts, but subject to the correct actions being taken promptly it should, under certain conditions, be possible to recover at lower speeds, as follows:

(i) *Aircraft with full internal fuel and wing tip tanks/wing stores (AUW approx.* 50,000 *lb. or above*)

It should be possible to regain control at or above the safety speed of 175 kts. without reducing power on the▶

live engine. The subsequent acceleration will be very poor and it may be necessary to jettison the wing stores (including tip tanks). It may be possible to regain control at speeds down to 165 kts. by jettisoning the wing stores and wing tip tanks immediately, but it is emphasised that the yaw and roll must be arrested first, if necessary by reducing power on the live engine and applying a small amount of bank towards that engine.

(ii) *Clean aircraft, full internal fuel (AUW* 40–45,000 *lbs.)*

Due to the high longitudinal acceleration, the effects of engine failure at speeds down to 165 kts. may be contained without reducing power on the live engine provided that the acceleration to the safety speed of 175 kts. is allowed to remain high (i.e. the aircraft must be maintained in level flight or in a slight descent depending on the prevailing conditions). It may prove possible to contain the effects of engine failure at lower speeds provided immediate recovery action, including reduction of power on the live engine and application of a small amount of bank towards the live engine, is taken.

(iii) *Clean aircraft light weight (AUW less than* 40,000 *lb.)*

Due to the high longitudinal acceleration the effects of engine failure may be contained at speeds down to 165 kts. without reducing power on the live engine, provided that the acceleration to the safety speed of 175 kts. is allowed to remain high. An engine failure may be contained at speeds as low as 155 kts. provided corrective action, including reduction of power on the live engine, is taken immediately. In this configuration and at these speeds aircraft response to engine failure is extremely rapid and it is emphasised that the hand must not be removed from the throttle lever of the live engine until it is certain that the aircraft is under control and accelerating through 165 kts.

(iv) *Action after recovery*

When the aircraft is under control, trim as necessary and climb away when speed has increased above safety speed. Carry out the appropriate engine failure drill.

(v) *Clean aircraft, light weights (AUW approx.* 40,000 *lb. and below)*

At the lighter weight the safety speed is 165 kts. Engine failure may however be contained at speeds as low as 155 kts. provided corrective action, including reduction of power on the live engine, is taken immediately. In this configuration and at these speeds aircraft response to engine failure is extremely rapid and care is required to maintain control until 175 knots is reached.

2 Climbing

◀(*a*) The optimum climbing speed is 330 knots until▶ 0·72M is reached at about 20,000 feet. Thereafter, maintain 0·72M until reaching the desired altitude.

(*b*) RPM tend to increase with altitude and must be restrained by careful throttling. At high altitudes the precise setting of desired RPM is not easy. Jet pipe temperatures remain approximately constant up to about 30,000 feet, above which they may increase slightly at constant RPM.

◀(*c*) In heavy rain, particularly if the aircraft has been standing on the ground tail-into-wind, water may collect in the region of the aileron beaks and icing could restrict aileron movement during any subsequent rapid climb in temperatures below 0°C. In these circumstances avoid prolonged periods with the controls static and exercise the ailerons gently during the climb. ▶

(*d*) *Climbing checks*

At 10,000 feet intervals on the climb, and periodically thereafter carry out the climbing checks given in the FRC's.

3 Engine handling in flight

(*a*) *Engine acceleration*

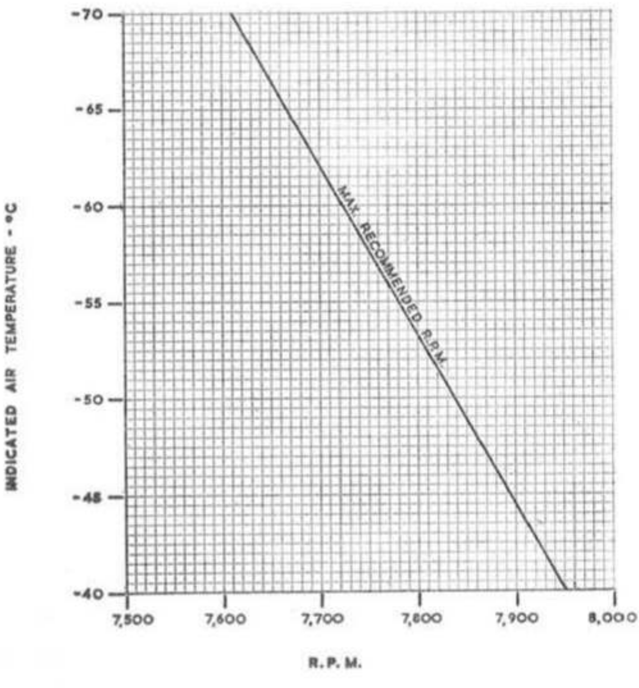
(i) Operate the throttles smoothly at all times and avoid slam accelerations.

(ii) ▶◀ Acceleration to full power from 4,500 RPM can be obtained within 5 seconds; accelerations from below this figure take considerably longer and care must be taken when opening up again otherwise it is possible to stall the compressor, particularly when the speed is low and the aircraft is sinking.

(*b*) RPM *surge at altitude*

(i) While the ACU is designed to operate at all altitudes its action and, therefore, engine acceleration, deteriorates progressively with altitude and care is required when increasing power at high altitudes, especially for the early stages of throttle opening at low IAS. Too rapid throttle opening may cause surge which may lead to severe overheating or flame-out. If surge occurs the throttle must be closed and speed increased before another attempt is made to open up the engine(s) using a slower throttle movement.

(ii) In extremely cold temperature conditions, generally associated with high altitude flight in tropical theatres, there is a risk of surge followed by flame-out when using high RPM at low indicated air speeds. This risk can be obviated by restricting maximum RPM according to variations in indicated air temperature as shown in the following graph.



(iii) Any factor which disturbs the airflow through the engine, such as turbulence, turns at high angles of attack and increase of power, can also induce a surge. When operating close to the surge line, more delicate engine handling is recommended and if steep turns are made or light to moderate turbulence is encountered, greater safety will be obtained by reducing the RPM of one or both engines by up to 200 RPM below the recommended RPM shown in the graph.

4 General flying

(a) Controls

(i) The controls are well harmonised and smooth in operation at all altitudes. The rudder is light and effective at small deflections and should be used with care at high IAS. Forces increase rapidly as deflection is increased and, at all speeds, a marked roll occurs when rudder is applied.

(ii) The ailerons are light and effective at low speeds but become heavier as speed is increased; they give good response up to 0·80M, but above this Mach No. effectiveness decreases.

(iii) The elevator is powerful and forces are light, becoming heavier at high speeds.

(b) Trimmers

(i) Tailplane incidence control is powerful at all speeds and it becomes very sensitive at high speeds. The rudder trimmer is powerful and rapid in operation; it requires care in use. The aileron trimmer is the least powerful of the trimmers.

(ii) Lateral trim is sensitive to asymmetric thrust and rudder trim; a deliberate yawing of the aircraft produces a pronounced rolling motion in the direction of yaw. It may be stopped by clamping the rudder and using aileron to regain lateral level.

(c) Use of tail trim and cut-in switches

Tailplane runaway can only occur if there is a double failure. By raising the cut-in switch flap in anticipation of trimming, the safety factor provided by the double circuit is removed; therefore, the flap must not be raised in anticipation of trimming and it must be released as soon as trimming is completed. If, on raising the flap and before operating the tail trim switch, the tailplane moves, the flap must be released immediately. No further attempt to trim must be made and the aircraft must then be restricted to a maximum speed of 250 knots and landed as soon as possible.

(*d*) *Limited tailplane travel*

If the tailplane runs away to the fully nose-down trim position, the aircraft will be in trim longitudinally at a speed between 425 knots and 450 knots. (See Pt. I, Ch. 5, para. 2(*c*)).

(*e*) *Airbrakes*

At high IAS the airbrakes are effective, even when in the MID position, but below about 300 knots their effectiveness decreases until at approach speed their effect is negligible. At high mach numbers their use causes increased buffeting with little deceleration. The use of FULL airbrakes causes noticeable buffeting over most of the speed range, becoming more marked near the limited speed for its use. (See Pt. II, Ch. 2).

(*f*) *Changes of trim*

Undercarriage down ...	Slight nose-up
Undercarriage up	Little change
Flaps down	Strong nose-up
Flaps up	Strong nose-down
Airbrakes out	Little change except for nose-down at high mach numbers
Airbrakes in	Little change
Bomb doors open or closed	No change

(*g*) *Buffeting*

(i) When lowering flaps fully, slight buffeting occurs which decreases as speed is reduced.

(ii) When bomb doors are opened at high airspeeds and mach numbers some buffeting occurs. Buffeting is correspondingly less with lower airspeeds and mach numbers.

5 Flying at reduced airspeed

Reduce speed to approximately 170 knots and keep the flaps up.

◀6 Flight in turbulence ▶

(*a*) *High altitude*

Investigations into cases of flame-out at high altitude caused by turbulence, indicate that the risk is greatest when the variable inlet guide vanes are at the minimum swirl position and forward speed is low. The best protection is obtained by setting the engines at 7,000 RPM and maintaining 270 kts./0·72M. At light weights, surplus speed may be used for a gentle climb out of the turbulent area, but under no circumstances should the normal climbing RPM be set. At heavier weights, if the recommended speed cannot be maintained at 7,000 RPM, a gradual reduction in height should, if practicable, be accepted.

(*b*) *Low altitude*

Below 25,000 feet there is little danger of engine surge and ◀flame-out caused by turbulence. However, the following speed ranges should be adhered to in moderate to severe turbulence:— ▶

Below 10,000 feet	250-300 knots
10,000-25,000 feet	270-300 knots

7 Operating in icing conditions

(*a*) *General*

(i) Anti-icing equipment is provided for the engines only and flight in icing conditions should be avoided wherever possible. Ice is particularly likely to form on the airbrakes when they are extended fully, and on the bomb doors if these are opened, and it may be impossible to close them again. Rate of ice accretion also increases rapidly at true airspeeds above 250 knots.

(ii) Icing may occur both on the ground and in the air, when the visible moisture content reduces visibility to 1,000 yards or less and the ambient air temperature is ◀below +5°C, with a relative humidity of 90% or more.▶

(iii) With anti-icing in operation all throttle movements must be made smoothly and at least 10 seconds allowed to elapse after switching OFF anti-icing before making any throttle adjustments. There is a loss of thrust and economy and, usually, a rise of approximately 20°C in the JPT. At full throttle, e.g. on take-off, this rise in JPT may necessitate a reduction in RPM to maintain JPT's within the limitations. Ground accelerations will be slower than normal and there is slightly less margin from surge.

(*b*) *Starting-up and taxying*

If icing conditions exist (see para. 7 (*a*) (ii)) switch ON anti-icing after starting the engines, and leave ON for taxying.

(*c*) *Take-off*

When icing conditions prevail, if the runway length is sufficient, take-off with the anti-icing ON. With anti-icing ON the take-off distance may be increased (refer to ODM). If this precludes the use of anti-icing on take-off, run the engines with anti-icing ON at 7,250 RPM for one minute immediately before take-off and switch OFF anti-icing before starting the take-off run. As soon as practicable after take-off switch ON anti-icing and leave it ON until clear of icing conditions.

(*d*) *Climb*

Climb at 250 kts. until coincident with 0·72M, thereafter maintaining 0·72M until reaching the desired altitude. If an alteration in RPM is essential move the throttles smoothly.

(*e*) *In flight*

(i) The protection given by the anti-icing system is not adequate for continuous flight in icing conditions. When icing conditions are met, switch ON anti-icing immediately and clear the icing region as quickly as possible. Wait 2 minutes after leaving the icing conditions before switching anti-icing OFF.

(ii) Whenever anti-icing is switched ON, RPM must be maintained at 7,200 RPM, or above, or in the lower range between 5,800 and 6,600. However for maximum protection in the lower range 6,100 RPM is the best setting. If conditions necessitate changing the RPM from the lower to the higher range, or vice-versa, the throttles should be moved smoothly and without hesitation through the interim range. RPM should not be reduced below 5,800 RPM until committed to land, as inadequate heating is obtained below this setting.

(*f*) *Descent and landing*

(i) For descent and landing involving the use of anti-icing down to airfield level the times of undercarriage and flap operation should be modified as necessary so that the engine RPM quoted in the previous paragraph are maintained.

(ii) If the recommended RPM figures are not maintained and icing is moderate to severe, flame-out may result. If this occurs an immediate relight on an engine (see Pt. III, Ch. 4, para. 3) may be attempted; if this fails, and conditions permit, the normal relighting drill should be carried out.

8 Stalling

(*a*) The approximate stalling speeds in knots are:—

Weight (lb.)	*Flap and UC up*	*Flap and UC down*
30,000	81	71
40,000	98	88
50,000	113	102

(*b*) Warning of the approach to the stall is given by slight buffeting which starts some 10 to 15 knots above the stall and becomes moderate as the stall is reached. Just before the stall either wing may drop gently; aileron is effective enough to raise the wing but finally, as the stall occurs, the nose and either wing drop gently together. Use of aileron as the stall occurs aggravates the wing drop. Recovery from the stall is straight-forward on releasing backward pressure on the stick with ailerons neutral, although in the initial stage of the ensuing dive slight buffeting may again be encountered and care is required to avoid inducing a further stall through too harsh a recovery to normal flight. If corrective action is taken at any time up to the stall little or no height is lost; if it is taken after the stall has occurred recovery can be effected in about 1,000 feet.

(*c*) When wing-tip tanks are fitted the stall warning characteristics are generally similar but occur about 5 knots earlier. In addition the pre-stall buffeting is more marked and is accompanied by slight aileron snatch, felt as trembling in the aileron control; the snatching becomes marked if aileron is used to raise a dropped wing. With vortex generators fitted the aileron snatching is less marked; no benefit will be gained, however, unless both the wing tip tanks and the wing tips are modified.

(*d*) If underwing stores are fitted the wing drop is sharp, the ailerons become less effective and rudder control will be required to correct the roll. If corrective action is delayed the roll and pitch down can be severe and recovery may take 1,500–2,000 feet.

(*e*) At any time when G is applied ample warning of the approach of a stall is given by buffeting which increases down to the stall proper, at which there is a tendency for either wing to drop. Recovery is immediate upon releasing the pull force on the control column.

(*f*) Because of the great care necessary in engine handling at high altitude, practice stalling at heights above 25,000 feet is not recommended.

9 High speed flight

NOTE 1: The limitations are laid down for structural reasons and must not be exceeded.

NOTE 2: The high mach number characteristics may vary slightly from aircraft to aircraft; they also depend, particularly at high altitude, on the angle of dive (rate of increase of airspeed), on G and on the condition of the aircraft.

NOTE 3: With wing tip tanks fitted the compressibility effects described below will occur at slightly lower mach numbers, and even lower if they are badly fitted. If complete loss of control occurs recovery may be more difficult.

(*a*) *Below* 15,000 *feet*

The speed limitation is 450 *knots or* 0·75M *whichever is the lower. The speed limitation with tip tanks is* 365 *knots.* The aircraft is easily capable of exceeding its airspeed limitation, even in level flight. As speed increases there will be a slight change of longitudinal trim and, at the maximum speed or mach number, slight intermittent buffeting may occur. If a rapid longitudinal oscillation develops at or near the IAS or mach number limitation, reduce speed as soon as possible until the oscillation ceases. If speed is inadvertently increased above 450 knots a marked vibration may develop. If this occurs, speed must be reduced immediately. The air brakes are effective at high IAS but their use is accompanied by noticeable buffeting especially when OUT is used.

(*b*) *Between* 15,000 *and* 25,000 *feet*

The speed limitation clean is 0·79*M*. *The speed limitation with wing tip tanks is* 365 *knots or* 0·79*M*. As speed is increased buffeting commences at about 0·77M and increases in strength as speed rises. If the limitation of 0·79M is exceeded there is a tendency for lateral unsteadiness to develop.

(*c*) *Above* 25,000 *feet*

The speed limitation clean is the speed at which a nose-up change of trim occurs, i.e. about 0·84*M*. *The speed limitation with wing tip tanks is* 0·80*M*.

(i) Up to about 35,000 feet warning of the approach of severe compressibility effects is given by a nose-up change of trim which occurs at about 0·84M to 0·85M. Below this speed the first symptoms are given by slight buffeting which commences at about 0·78M to 0·80M. At about 0·81M the buffeting increases in intensity and at 0·83M a slight nose-down change of trim occurs followed by a nose-up change at about 0·85M. The lateral trim becomes sensitive at these speeds and lateral unsteadiness may be encountered.

(ii) Above 35,000 feet warning of the approach of severe compressibility effects is given by lateral unsteadiness and the tendency for one wing, generally the port, to drop slowly at about 0·84M. This tendency occurs at slightly lower speeds, between 0·82M and 0·83M at about 45,000 feet. When rockets are fitted the wing heaviness is preceded by aileron snatch. Below these speeds the symptoms are much the same as in sub-para. (i).

(iii) Above 35,000 feet, if the aircraft is accelerated past the speed at which there is a wing drop, aileron snatching and a loss of aileron effectiveness usually occurs making it difficult to restore lateral level. At the same time elevator effectiveness falls off markedly and severe buffeting sets in. Should control be lost great care must be taken to avoid overstressing the aircraft during subsequent recovery at the lower altitudes, when the airspeeds may be high. Avoid the use of the tail trimmer during recovery if possible but if it has to be used extreme care must be taken.

(iv) The behaviour under compressibility will vary between aircraft and is also likely to vary on individual aircraft depending on the CG position and the external condition of the aircraft. Although the wing drop case above is given as being the most critical from the point of view of possible temporary loss of control, other effects such as strong nose-up or nose-down changes of ◀trim, heavy buffeting, lateral rocking and directional▶

instability, may be apparent and are equally critical. As soon as compressibility effects become marked, particularly at the highest altitudes, speed must be reduced, as the consequences of increasing the speed still further are unpredictable and may be serious. The remarks in this paragraph refer to the clean aircraft and when wing tip tanks are fitted.

(v) Recovery from mild compressibility conditions is best made by throttling back and easing the aircraft out of the dive, care being taken to avoid high G which will aggravate matters.

(vi) If loss of control is experienced the engines must be throttled right back and the airbrakes extended to the MID position; on no account may the OUT position be used. About 10,000 feet may be lost before the mach number has fallen to a figure at which control can be regained. During recovery, G loads must be kept low. Avoid the use of the tail trimmer during recovery if possible, but if it has to be used extreme care must be taken.

(vii) At all heights, if the engine power is high, only a shallow dive is needed to reach limiting speeds.

10 Descent

◀(*a*) *Emergency descent*

The recommended technique for making an emergency descent following cabin pressurisation failure is to close the throttles, extend the airbrakes, open the bomb doors and descend at 0·79M above 40,000 ft. and 0·75M/350 knots below to less than 25,000 ft.

(*b*) *Rapid descent*

For a rapid descent, close the throttles, extend the airbrakes and descend at 0·79M above 40,000 ft. and 0·75M/350 knots below. ▶

(*c*) *Normal descent*

For a normal descent, throttle fully back, put airbrakes fully out and descend at 0·75M until a coincident speed of 250 knots is reached, maintaining that speed thereafter.

(*d*) *Descent in icing conditions*

If icing conditions require the use of the engine anti-icing system maintain engine RPM at 6,100 and descend as rapidly as is practicable.

PART III—HANDLING

Chapter 3—CIRCUIT AND LANDING PROCEDURES

Contents

1 Approach and landing

(*a*) *Checks before landing*

Carry out the drills given under Approach and Landing in the Flight Reference Cards.

◀(*b*) *Normal landing*

Ascertain the threshold speed corresponding to aircraft weight. The initial approach should be made at threshold speed plus 30 knots (line A). This speed should be attained by the time the aircraft is lined up with the runway, flap being lowered as required at any time after the start of the final turn. When the aircraft is lined up with the runway with flaps down, reduce speed progressively to the minimum approach speed—threshold speed plus 10 knots (line B). Until a decision to land has been made the RPM must be kept above 4,500. Once the decision is made speed should be reduced gradually so that the runway threshold is crossed at threshold speed and the throttles closed just before touchdown.

(*c*) *Short runway landing*

When the landing run available is limited, or the runway is wet or icy use the following technique. Make the approach▶

◀ using the normal line A and B speeds. When the decision to land has been made reduce speed gradually to cross the threshold at the short runway threshold speed, power being maintained until just before touchdown. There is a marked tendency to sink if the throttles are closed prematurely or too quickly. ▶

(*d*) *Approximate all-up weights* (*lb.*)

Crew only	26,500
Full fuselage tanks	37,500
Full fuselage and integral tanks ...	44,700
Full fuel including tip tanks	48,800
2,400 lb. remaining	29,100

NOTE: No armament equipment is included in these weights.

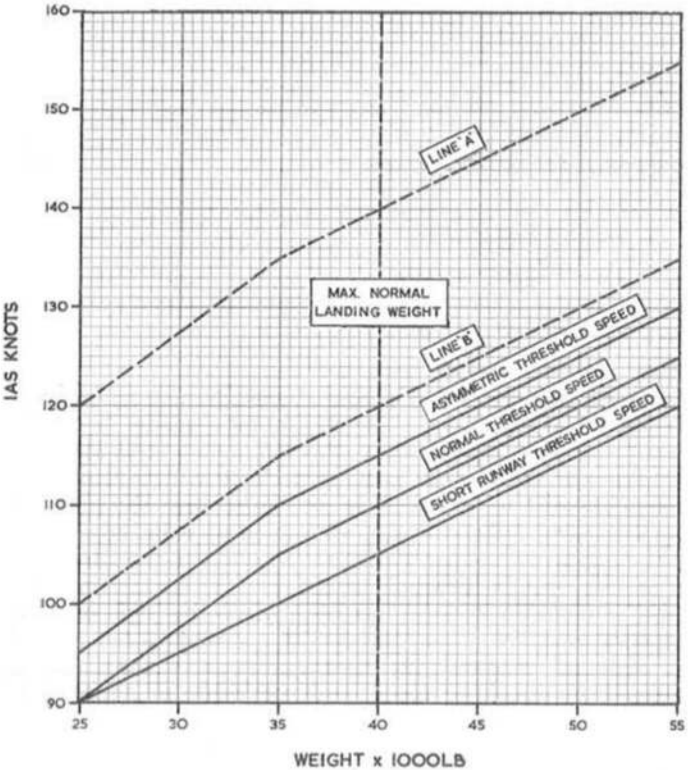


Fig. 1. Approach and Threshold Speeds

(*e*) If landing with a forward CG, increase the threshold speed by 5 knots above the normal speed for the weight. This can only happen if bombs are hung up or the fuel drill is not correctly followed or has not functioned properly. In cases of doubt ascertain the extent of control in the landing configuration at a safe height and determine the approach speed accordingly. If a landing has to be made at or near the forward CG limit, avoid steep final approaches as there may be insufficient elevator control to round out.

2 Flapless landing

(*a*) Before making a flapless landing, reduce weight as much as practicable, using the normal fuel drill.

(*b*) The initial approach should be made at the normal threshold speed plus 30 knots (line A). Once lined up with the runway reduce speed further to not less than 20 knots above the normal threshold speed. The approach should be longer and slightly flatter than normal.

(*c*) Throttle back early, aiming to cross the threshold 10 knots faster than the normal speed. Lower the nose onto the runway immediately after touchdown and apply the brakes. (See para. 5)

(*d*) On a 2,000 yard runway a flapless landing may be carried out comfortably, following a correctly executed approach, at weights up to 40,000 lb. At weights above 35,000 lb., if the runway is wet, use one of 3,000 yards if possible.

3 Crosswind landing

A crosswind landing presents no special difficulty; and "crab" technique is recommended. The maximum recommended crosswind component for landing is 25 knots.

4 Landing with one wing tip tank full

If one wing tip tank does not feed and the other is empty, determine, at a safe height, the lowest speed for *adequate* control, i.e. the speed at which rolling manoeuvres can be executed safely in both directions with the undercarriage and flaps down. The threshold speed should be the speed for adequate control plus 5 knots.

5 Braking

(*a*) Braking efficiency will be improved, especially on wet runways and/or at low weights, if the control column is moved rearwards as braking commences, thus transferring weight onto the main wheels. When the nosewheel has lowered on to the runway the brakes can be used, dependent upon runway conditions, as follows:—

(i) *Dry surfaces*

On dry surfaces the maxaret units will normally prevent the wheels from locking when excessive brake pressure is applied but, unless the shortest possible run is required, more gentle use of the brakes is recommended. The aircraft must be firmly on the ground before the brakes are applied as the maxaret units do not operate unless the wheels are rotating. As a safeguard against locking of the wheels during a bounce the maxaret units remain operative for several seconds. If a slip or skid is felt or if difficulty is experienced in keeping straight release the brakes momentarily. In normal circumstances it should not be necessary to apply the brakes at speeds above 90 kts.

(ii) *Wet surfaces*

Retardation may be considerably reduced, depending upon the degree of wetness and the type of runway surface. Maximum braking efficiency is obtained by making a firm touchdown, then applying light intermittent braking as soon as the aircraft is firmly on the ground and the wheels have had time to spin up. Once positive braking action has been established continuous braking should be used as necessary to bring the aircraft to rest using the full length of the runway. Although the maxaret units are designed to prevent skidding, under the worst conditions even light braking may cause the wheels to spin down and eventually lock.

(iii) *Flooded surfaces*

With an appreciable depth of water on the runway (i.e., approximately 0·2 in. or more) friction between the tyres and the surface is drastically reduced and aquaplaning may occur. In these circumstances braking action is virtually nil and, even though the brakes are not applied, the wheels may spin down and stop. The speed at which total aquaplaning occurs is dependent upon the type of runway surface and the tyre tread pattern but, given the right conditions, the tyres may aquaplane at ground speeds above approximately 95 kts. At lower speeds partial aquaplaning may still be present, but braking action will improve as speed is reduced further. Due to this drastic loss of braking effect, flooded runways should be avoided whenever possible; if, however, a landing must be made, the recommendations in para. (ii) above still apply, but aerodynamic braking should be used for as long as possible, depending upon runway length. When pools of water exist, the brakes, if they have been applied, should be released before the aircraft enters a pool and the stick, if back, should be moved forward to prevent the nose wheel lifting.

(iv) *Icy runways*

Whenever possible these conditions should be avoided due to the certainty of the drastic reduction in braking effectiveness. However, if a landing has to be made, extreme caution is required. The brakes must be used most carefully, as excessive application of continuous pressure can lead to wheel locking and subsequent tyre damage. Aerodynamic braking may be used for as long as possible, depending on runway length.

(*b*) Make every effort to avoid overheating the brakes by using the brakes judiciously according to the length of the runway.

(*c*) The maximum brake-on speeds given in the ODM apply to the use of brakes in emergency only, as, if the brakes are applied at these speeds, they may be severely damaged. If the brakes are applied at higher speeds, they will overheat and fail before the aircraft is brought to rest. If heavy braking has been used, subsequent taxying should be reduced to a minimum; if possible, the aircraft should be parked for up to 30 minutes to allow the brakes time to cool down.

(*d*) If, when the aircraft has stopped after landing, the brakes are observed to be smoking or on fire, do not shut the HP cocks until fire appliances are available; this is a precaution to prevent dumped fuel igniting beneath the aircraft. If fire appliances are not readily available, the engines may be shut down by switching off the appropriate LP cocks and pumps, leaving the HP cocks open, but if this method is used it must be reported, so that the fuel system may be primed before the next start.

6 Instrument approach

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

TWO ENGINES—ALL UP WEIGHT 30,000 lb.

	RPM	U/C	FLAP	IAS
Pattern	6,300	Down	Up	150
Final	6,300	Down	Up	150
Glide Path	6,300	Down	Down	◀ 128 ▶ reducing to threshold speed

TWO ENGINES—ALL UP WEIGHT 40,000 lb.

	RPM	U/C	FLAP	IAS
Pattern	6,600	Down	Up	150—160
Final	6,600	Down	Up	150—160
Glide Path	6,600	Down	Down	◀ 140 ▶ reducing to threshold speed

ONE ENGINE—ALL UP WEIGHT 40,000 lb.

	RPM	U/C	FLAP	IAS
Pattern	6,700	Up	Up	160
Final	6,700	Up	Up	160
Glide Path	6,700	Down	Up	150
Glide Path, decision height	6,700	Down	Down	150 reducing to asymmetric threshold speed

NOTE 1: When the glide path is intercepted and flap is lowered, the rate of descent tends to be reduced. To maintain the desired rate of descent push the control column forward against the trim until the flaps are fully down and the aircraft is trimmed into the descent. With full nose-down trim applied a residual push force will remain until the speed is below approximately 125 knots.

NOTE 2: *Asymmetric approach in icing*

At the maximum landing weight of 40,000 lb. approximately 6,700 RPM are required when making an instrument approach on one engine. In these circumstances when icing conditions prevail at the pattern and final approach altitudes it is recommended that fuel be burnt off in order to reduce the AUW to below 35,000 lb. before descending into the icing region. This procedure will permit a more satisfactory engine RPM setting not exceeding 6,500 to be used during the latter stages of an instrument approach. If it becomes necessary to overshoot care must be taken to open the throttle smoothly and without hesitation through the range of 6,600-7,200 RPM. If circumstances dictate that a landing has to be carried out at weights requiring a power setting between 6,600 and 7,200 RPM great care must be taken to operate the throttle smoothly and without hesitation.

◀NOTE 3: The recommended minimum speed at the start of an instrument overshoot is threshold speed plus 20 knots. ▶

7 Overshooting

(*a*) An overshoot followed by a GCA and landing requires approximately 1,250 lb. fuel.

◀(*b*) Open throttles smoothly to 7,400 RPM and check that symmetrical power is being obtained; raise the undercarriage and flaps and, if necessary, increase power. If the thrust at 7,400 RPM is not symmetrical due to swirl vane▶ malfunctioning, the thrust of the serviceable engine must be increased only within the limits of rudder control. There is a strong nose-down change of trim during the last half of the flap travel; anticipate this by progressive application of nose-up trim as the flaps retract. The aircraft will accelerate quickly and any tendency to sink is easily held.

(*c*) Practice "roller" landings are not recommended because of the possibility of compressor stall and engine surge while opening up from the fully throttled position, especially in cross-wind conditions. If it becomes necessary to go round again from the runway, observe the following precautions:—

(i) When opening the throttles particular care must be taken up to 6,500 RPM and allowance made for some difference in response from each engine.

(ii) Keep the nose-wheel on the runway until the engines ◀have reached 7,400 RPM.

(iii) Check at 7,400 RPM that symmetrical thrust is▶ being obtained before opening the throttles further.

8 Checks after landing

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

◀(*b*) After parking for an "engines-running" crew change the aircraft must be made "Safe for Parking". The "Crew Change-over Checks" in the FRC's must be carried out by the relieving crew before taxying. ▶

9 Shutdown procedure

(*a*) Before stopping the engines trim the tailplane to full nose-down and then give one "blip" up on the tail trim switch to ease tension on the tailplane micro-switch spring. This will prevent ingress of moisture to the actuator jack.

(*b*) Carry out the checks given in the Flight Reference Cards.

PART III—HANDLING

Chapter 4—ASYMMETRIC FLYING

Contents

1 Stopping an engine in flight

◀When closing down an engine in flight deliberately, first apply the Load Shedding drill given in the Flight Reference Cards and then switch off the generator OFF LINE switch. Stop the engine by closing the throttle and shutting the HP cock; switch off the appropriate LP pumps and engine air switch. ▶

2 Flying on one engine

The aircraft has a good single-engine performance and the rudder trimmer is powerful enough to trim out all foot loads at normal cruising speeds.

3 Relighting an engine in flight

(*a*) *Immediate relight*

If an engine flames out, an immediate relight may be attempted at any altitude by pressing the relight button for 5 seconds and then releasing it, leaving the throttle and HP cock at their set positions. A successful relight will be indicated by the RPM stabilising and then commencing to rise. It will probably be necessary, particularly at higher altitudes, to close the throttle after the RPM have stabilised in order to stop the JPT rising. If JPT increases without a corresponding increase in RPM, close the throttle and open up more slowly. An immediate relight is more likely to be successful if carried out below the maximum altitude recommended for normal relighting given in sub-para. (*c*).

(*b*) *Flame out*

If an immediate relight fails or is impracticable, carry out the following flame out drill and then make a normal relight as in (*c*) and (*d*):—

(i) Close the throttle and HP cock.

◀(ii) Switch off the generator

(iii) Apply the Load Shedding drill given in the Flight Reference Cards.

(iv) Switch off the engine air switch.

(v) Monitor DC volts. ▶

(*c*) Normal relighting is practicable at heights up to 35,000 ft. and at speeds up to 200 knots, but if range is of paramount importance one attempt may be made at higher altitude. Relighting becomes progressively more certain with reduction of altitude and airspeed; therefore attempting relighting above 35,000 feet is not recommended. Below 25,000 feet relighting may be attempted at any speed.

(*d*) *Normal relight*

(i) Above 25,000 ft. reduce speed to below 200 kts.

(ii) Close the throttle and HP cock. Check the DC volts.

(iii) Ensure that at least one LP pump and one cock are on and that the fuel pressure warning light is out.

(iv) Press the relight button whilst opening the HP cock.

(v) When the RPM start to rise, release the relight button; check that the JPT and oil pressure are within limits and that the fire warning light is out.

(vi) Switch the generator to NORMAL, check DC volts and generator warning light.

◀(vii) Switch on the engine air switch. ▶

(*e*) If the engine RPM fail to build up within 30 seconds of pressing the relight button, release the relight button and close the HP cock immediately. Another attempt may be made to relight the engine after allowing a period of two minutes for the engine to dry out and, if the height is critical, after descending to a lower altitude. If igniter failure is suspected check the appropriate fuse in the starboard fuse panel. (No. 289 port, No. 290 st'bd.)

4 Double flame-out

(*a*) If a double flame-out occurs, a relight on one engine may be attempted immediately, while the RPM are decreasing, by pressing the relight button for 5 seconds and then releasing it, leaving the throttle at its set position. A successful relight will be indicated by the RPM stabilising and then commencing to rise. Ensure, by throttling back if necessary, that the maximum allowable JPT is not exceeded. The likelihood of obtaining a successful relight is increased if the height and airspeed are below the permitted maxima for relighting.

NOTE: If attempting an immediate relight below the maximum recommended height for relighting, first select another LP cock and pump.

(*b*) If an attempt to relight an engine as above is unsuccessful, carry out on each engine in turn the flame-out drill at para. 3(*b*) and reduce electrical consumption to an absolute minimum. Descend as rapidly as possible, commensurate with the need to avoid trimming, to the relight height, and carry out on one engine only the relighting drill given in 3(*d*) preceding. When that engine has relit, relight the other engine.▶

5 Asymmetric landing and overshoot

(*a*) *Landing*

Carry out the normal pre-landing checks; if at high weight, sustained flight under high asymmetric power may be avoided by lowering the undercarriage towards the end of the down-wind leg. Do not reduce speed below 150 knots nor height below 600 ft. AGL until the final decision to land is made. When committed to a landing the flaps should be lowered as required; with the flaps down there is a marked increase in drag and care should be taken not to lower them to early, especially in strong wind conditions. Once the flaps have taken effect power should be reduced progressively to cross the threshold at the speed recommended for a normal landing plus 5 knots.

(*b*) *Overshooting*

(i) An overshoot can be made comfortably provided that the flaps are up, the speed is at least 150 knots and the altitude is 600 ft. AGL at the start of the overshoot.

(ii) Thrust rises rapidly in the higher RPM range and great care must be taken during the overshoot; a too rapid increase in power can result in a marked yaw and loss of height. As soon as the decision is made, increase power on the live engine within the limits of directional control, raise the undercarriage and check that the flaps are up. Increase speed, if necessary by diving slightly, and gradually increase power as more directional control becomes available; climb away when safety speed has been reached.

6 Relighting in icing conditions

If an engine flames-out when flying in icing conditions an immediate relight as described in para. 3(*a*) may be attempted; if this fails and conditions permit, the normal relighting drill should be carried out. If this also fails any further attempts to relight may cause damage to the engine.


MIG PILOT
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