

Part IV

Chapter 2—Taxying, Take-Off and Handling in Flight

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1 Taxying

(a) At the normal operating weight and on level concrete, about 47%—58% RPM will be required to start the aircraft moving, thereafter sufficient thrust for taxiing is obtained with all engines idling. Very little turning effect is achieved by the use of asymmetric thrust, and the throttles should be moved symmetrically. Care should be taken not to increase the power on one engine above 52.5% while the other engine on the same side is below this figure. As soon as the aircraft has begun to move, check that the brakes are operating evenly and efficiently and then at the earliest opportunity test the nose wheel steering.

(b) Differential braking may be used with the nosewheel steering to initiate turns, but thereafter the nosewheel steering system alone should be sufficient. The aircraft can be steered by using the toe brakes independently but this procedure should not normally be used since the force required to caster the nosewheel results in harsh changes in direction with resultant strain on undercarriage components.

(c) The minimum turning circle can be achieved at full steering lock. However when small radius turns are essential it may be necessary to assist the nosewheel steering with slight application of brake.

(d) The total fuel consumption when taxiing with all engines idling is 95lb./min.

(e) The wing tips cannot be seen from the pilot's seats, but the crew members can give guidance for clearance. Ground crew surveillance should always be given when taxiing in confined spaces.

2 Take-off

(a) Carry out the pre take-off checks.

(b) Align the aircraft on the runway and apply foot brakes. With maximum brake pressure at the wheels, open up the engines.

Depending on their condition, the brakes may slip before maximum engine speed is achieved. If brake slip occurs at an engine speed of less than 93% RPM, the brakes must be considered unserviceable. As soon as full throttle is applied the following checks should be made:

Engine speed	99% to 100.5% RPM
JPT	660°C max.
Oil pressure	25-38 PSI
Electrical power circuits	Functioning normally

(c) When the brakes are released the initial acceleration is slow, particularly at the heavier all-up weights, and the aircraft will swing into any cross-wind. At forward and mid CG loadings the aircraft can be kept straight with nosewheel steering initially and then by rudder as this becomes effective at 90 knots. At aft CG, nosewheel steering is less effective, and it may be necessary to use the wheel brakes to hold a straight run until the rudder becomes effective. The nosewheel should not be raised until 10 knots below the unstick speed, when slight backward pressure of the control column should be applied and the aircraft flown off.

(d) *Table of unstick speeds*

<i>Take-off weight (lb.)</i>	<i>Unstick speed (kts.)</i>
100,000	115
110,000	120
120,000	125
130,000	130
140,000	135
150,000	140
160,000	145
170,000	150
180,000	155

3 Safety speeds

If an engine fails with the remaining engines at take-off power, the aircraft can be held straight using nosewheel steering until at about 80 knots, assuming no cross-wind, rudder alone may be used. The safety speed therefore will always be below the unstick speed and the decision to continue or abandon the take-off will depend on the aircraft weight and prevailing runway conditions as determined by the Operating Data Manual. Longitudinal trim is not affected by engine failure.

4 After take-off

(a) When safely airborne select undercarriage UP. In Mk. 1 aircraft apply the parking brake and wait 5 seconds before retracting the undercarriage. Speed must not exceed 185 knots until the undercarriage and main flaps are fully retracted. To avoid a steep angle of climb, RPM should be reduced to maintain 625°C JPT (or slightly less at low AUW's) immediately after the undercarriage has been selected UP.

(b) At a safe height, and when the undercarriage is fully retracted, select main flaps UP, and select nose flaps to AUTO. When the main flaps are fully retracted select climbing power and accelerate to climbing speed. The nose flaps will retract automatically when the main flaps are fully retracted provided that the aircraft is not in a high CL condition.

(c) Complete the after take-off checks.

5 Climbing

(a) The recommended climbing speed is 300 knots. However, from considerations of aircraft fatigue life, speed should not be increased above 250 kts. until reaching 10,000 ft. Thereafter climb at 300 kts. until this speed is coincident with 0.83 M, and then continue to climb at 0.83M.

(b) When maximum rate of climb is required the engines should be left at take-off power for up to 10 minutes. Normally climbing power (98% RPM, 625°C JPT) should be selected and CLIMB selected on the JPT controller (if fitted).

(c) For the cruise climb the engines should be set as computed for prevailing conditions, but the maximum continuous power setting is 96% RPM. The maximum permissible JPT at this power setting is 600°C. With JPT control fitted the engine speed will decrease as altitude is increased.

6 Flying controls

(a) Ailerons

The ailerons are effective and forces are light throughout the speed range. The stick forces increase with speed and also with aileron control surface movement. At speeds above 150 knots, the ailerons give very good response. Below 150 knots, response deteriorates, but control in the approach configuration is still good.

(b) Elevators

The elevators are effective throughout the speed range with good response. Stick forces increase with speed and with increased elevator angle but remain reasonable.

(c) Rudder

The rudder is effective throughout the speed range down to approximately 80 knots. The pedal forces increase with speed and deflection and at high speed are very heavy.

(d) Effect of airbrakes

The airbrakes may be extended at any speed. Extension at high power settings produces light airframe buffet. They are very effective at high speeds and remain sufficiently effective at low speeds to permit effective drag control on the approach.

(e) Changes of trim

Lowering and raising the undercarriage	Negligible
Main flaps from fully up to fully down .	Moderate nose-down
Main flaps up from fully down . . .	Moderate nose-up
Main flaps up from take-off . . .	Slight nose-up
Main flaps from up to take-off . . .	Slight nose-down

NOTE: The main flaps are of the Fowler type which, when selected down, first travel rearwards and then rotate downwards. Following the selection of take-off or landing flap there is a delay of about 13 seconds, during which time the flaps are moving rearward, before any trim change is felt.

Nose flaps out or in	Negligible
Airbrakes in and out	Negligible
Bomb-doors open or closed	Negligible with moderate buffet at high IAS

(f) Fixed droop leading edges (post-Mod. 2352)

The handling characteristics of aircraft fitted with fixed droop leading edges are similar to those of aircraft fitted with nose flaps. A slight reduction in longitudinal stability is noticeable when flying with an aft CG, and this characteristic is more pronounced when flying at low indicated airspeeds. Speed must not be reduced below the recommended threshold speeds or the onset of pre-stall buffet which occurs at approximately 5 knots lower than with nose flaps when main flaps are retracted and at the same speed as with nose flaps when main flaps are extended.

7 Stalling

(a) Stalling is not permitted and speed must not be reduced below the onset of pre-stall buffet. With wings level, an exaggerated nose-up attitude will be apparent before the onset of pre-stall buffet. If it is intended to approach the buffet region the nose-flaps should be selected OUT. With nose-flaps selected IN, and particularly at aft CG loadings, a slight lightening of elevator loads

and mild pitch-up may occur some 5-10 knots before the onset of pre-stall buffet. With the aircraft in the clean configuration (or with nose-flaps lowered) the initial pre-stall buffet is an unmistakable light buffet of moderate frequency. With undercarriage and flaps lowered the initial pre-stall buffet may be masked by general airframe buffet. If the initial buffet is felt, recovery must be made immediately by lowering the nose and opening the throttles to increase speed. If recovery action is not taken and speed is further reduced, the buffet will become moderate before changing to a heavier and more irregular "lumpy" buffet. However, the controls should remain effective and the aircraft remain controllable, though with some difficulty. On aircraft with fixed droop leading edges the onset of pre-stall buffet may occur at airspeeds some 5 knots lower than on unmodified aircraft when main flaps are retracted, but the rate of increased buffet intensity with further reduction in speed will be greater.

(b) *Stalling in turns*

Approach to the stall in turning flight is indicated by the onset of light buffet which is followed by moderate buffet. It is possible for buffet to be encountered before the G limitations are reached. Recovery action, which is effected by reducing the backward pull on the control column, must be taken as soon as buffet is experienced.

(c) *Recovery from a stall or superstall*

If recovery action is not taken early enough, the aircraft may stall and then possibly enter a spin or a stable stalled glide (Superstall). The latter condition is most easily recognised by the extremely high rate of descent (up to 10,000 or 15,000 fpm) combined with low IAS, with the nose remaining on or near the horizon, and with all controls apparently useless. In either event, the stick should be held fully forward and full rudder applied against any rotation. Ailerons should remain about neutral and power should be reduced. The aircraft should then recover. If, however, the above recovery action is ineffective, the braking parachute should be

streamed. Because of the very high aircraft incidence, this will produce a large nose-down moment and unseat the aircraft. The parachute is likely to break away during the ensuing dive, recovery from which should be made as gently as possible.

8 High-speed flight

(a) *At high indicated airspeeds*

The IAS limitation is 330 knots. Flight at high indicated airspeeds presents no special difficulties. At low altitude the aircraft is easily capable of exceeding the limiting speed in level flight. Therefore, when accelerating to the limiting speed care must be taken to throttle back early to avoid exceeding this speed. Elevator movements should be made smoothly and deliberately, otherwise pitching will develop and accurate speed control will become difficult.

(b) *At high mach numbers*



(i) *Auto-mach trimmer operative*

The auto-mach trimmer provides a progressive nose-up trim change as speed is increased above 0.85M, although the trimmer magnetic indicator may not go white until 0.87M is reached. If the magnetic indicator does not show white when 0.88M is reached, speed should be reduced to 0.85M and the auto-mach trimmer switched OFF. Careful trimming is required to maintain a steady speed in the region of 0.85M, but at slightly higher speeds trimming is easier. The aircraft should not normally be trimmed at speeds in excess of 0.92M. Flight at high mach numbers should be carried out with the wings reasonably level and in any case bank angles should not exceed 30° at speeds above 0.90M.

(ii) Because of the ease with which the aircraft may be accelerated, care must be taken not to exceed the limiting mach ▶

number. However, in case this speed should be exceeded inadvertently, the following description of flight at mach numbers above 0.93M is given. Above 0.93M slight buffet occurs and there is a decrease in control effectiveness. This decrease in effectiveness is most marked on the ailerons, particularly below 40,000 ft. and is due to aileron jack stalling. (Rapid heavying of the control hinge movements restricting the aileron deflection which can be achieved with the full output of the power control units). A moderate push force is required to maintain 0.95M. Above 0.95M a slight wing drop may occur; this can be checked with the ailerons although aileron control, particularly below 40,000 ft., is then very limited. Above 0.97M aileron control is negligible and there is little benefit to be gained by forcing the control wheel against the over-travel spring. Above 0.93M to 0.94M the sense of roll induced by side-slip is reversed (i.e. application of top rudder lowers a depressed wing rather than raises it) and in certain conditions the rolling moment resulting from application of top rudder can completely counteract that produced by the ailerons. In order to avoid the possibility of instinctive and unwitting applications of top rudder when rolling the aircraft at high mach number the rudder pedals should be freed if 0.93M is exceeded with any bank applied. Recovery from high mach number is best accomplished by closing the throttles, extending the airbrakes and applying up-elevator, maintaining the wings level or rolling level with aileron and leaving the rudder pedals free.

(c) *Auto-mach trimmer inoperative*

As speed is increased beyond 0.87M a slight, though progressive, nose-down trim change occurs and speed must only be allowed to

exceed 0.90M when exceptional circumstances require such higher speeds. As speed increases above 0.90 M an increasing pull-force is required to control the aircraft.

9 Descent

(a) *Cruise descent*

Close the throttles and with airbrakes, flaps and undercarriage retracted, descend at a constant speed of 210 kts. The nose flaps should be selected to AUTO and allowed to extend when the speed decreases below 0.70M. The descent from 50,000 ft. to sea level will take about 35 minutes.

(b) *Other descents*

In all other descents the airbrakes should be out, with undercarriage and all flaps retracted. With the throttles closed, select the speed appropriate to the type of descent:

Normal QGH	0.84M/240 knots (4000 fpm)
Rapid descent	0.90M/300 knots (7000 fpm)

◀ Max. rate descent	0.93M/330 knots ▶
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WARNING: A max. rate descent should only be made in extreme emergency; the rate of descent must be reduced if the fuel tank pressure warning light comes on.

10 Flying in turbulent conditions

The recommended speed for flight in conditions of severe turbulence is 220-250 knots or 0.87M, whichever speed is achieved first.

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