

PART 3

CHAPTER 4—STALLING AND SPINNING

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Stalling

WARNING: Intentional stalling is prohibited and speed is not to be reduced below the minimum speed limitations (Part 2, Chapter 1). During any manoeuvres below 200 knots, maintain engine RPM above 60% to ensure rapid acceleration to full power.

1. *Characteristics.* The following sequence applies on aircraft carrying two missiles and with undercarriage and flaps up:

220 knots — Slight buffet begins

180 knots — Gentle wing rock may occur

170 knots — Buffet increases in intensity. In the F Mk 6, the aircraft will probably sink straight ahead, even with the control column fully back

140 knots — In the F Mk 3 and T Mk 5 the aircraft begins to wander in roll, yaw and pitch. The wander becomes more pronounced as speed is reduced

115 knots — In all marks, the aircraft yaws rapidly followed by wing drop and entry to a spin

Note: In all marks, the rate of descent can increase to over 6000 ft/min as the stall is approached. The IAS at which sink commences varies according to the rate at which the control column is moved aft.

2. *No Missiles Carried.* With missiles off, the buffet level is higher and there is some stick force lightening as speed is reduced below 125 knots, which gives a 'knife edge' feeling.

3. *Overwing Tanks Carried.* With overwing tanks fitted, *moderate* buffet is felt at 220 knots which reduces to *mild* buffet as the speed falls to 150 knots.

4. *Recovery.* Recovery from the stall is immediate upon centralising the control column and increasing IAS. However, coarse use of aileron or rudder could easily result in a spin. If the aircraft has already reached the stage of yawing rapidly, centralising the control column may not prevent a spin developing.

5. *g-Stalling.* Speed can be lost rapidly as g is applied. With a gradual application of g, the onset of moderate buffet occurs before the stall. Further evidence may be provided in the form of gentle wing rocking and directional wandering. If the aircraft fails to respond normally to control movements or starts to deviate from its flight path without pilot action, centralise the controls immediately or the aircraft is likely to flick roll. Instinctive use of aileron to oppose any roll aggravates the situation and will probably cause the aircraft to roll and yaw in the opposite direction to the applied aileron. (With missiles removed, the flick manoeuvre is less predictable and usually more severe.) If g is applied suddenly by harsh control movement, the aircraft may pass rapidly through the buffet zone into the flick manoeuvre. Avoid coarse use of the controls when manoeuvring in the buffet zone.

Spinning

WARNING: Intentional spinning is prohibited. The following information is to acquaint pilots with spin characteristics and the recovery from inadvertent spins.

6. *General.* The characteristics of the incipient spin vary considerably and depend on the type of manoeuvre and control positions at the moment the aircraft departs

from controlled flight. If control is lost during manoeuvre, the fully developed spin may be preceded by one or more rapid rolls; if the control column and rudder are centralised at this stage, the aircraft may recover. Spin characteristics differ with the various missile configurations but the recovery behaviour is not affected.

7. *Spin Characteristics.* Generally, at stalling incidence the aircraft yaws rapidly and then begins to roll, the higher the g on departure, the greater the rate of roll. In the spin the nose tends to drop after the first half turn and then rise towards the end of the first turn. The second and subsequent turns are steeper and the spin remains oscillatory in roll, yaw and pitch. The fully developed erect spin is fairly steep, with the aircraft nose 40° to 60° below the horizon. The rate of rotation is quite slow, being one turn every six to eight seconds. The rate of descent is approximately 20,000 feet/min (2000 to 2500 feet/turn). The ASI fluctuates between off-scale and 140 knots once per turn.

8. *Recovery.* The spin recovery actions and considerations are listed in Table 1.

WARNING: If the aircraft is not under control by 10,000 feet AGL (ie responding normally to control inputs and accelerating through 200 knots) — *Eject.*

Table 1 — Spin Recovery

<i>Actions</i>	<i>Considerations</i>
Centralise the controls	Recovery may result. If not, maintain the controls central during the next two actions
Positively confirm that the aircraft is spinning	Indications: Sustained rotation in yaw and ASI fluctuating between off-scale and 140 knots
Positively assess the direction of rotation	External references only are available. Do not apply rudder unless the direction of spin is definitely established. If in doubt, maintain rudder and control column central; there is a high probability that this action will achieve recovery within three to four turns (8000 feet)
Apply full rudder against direction of rotation	A force of 200 lb is required to apply full rudder
Monitor height and speed	The aircraft is slow to respond initially but recovers within two turns after applying full rudder

Centralise the rudder when IAS rises through 150 knots	The best indication that the aircraft is recovering is the IAS increasing through 150 knots
At 200 knots oppose any residual roll with aileron. Smoothly roll the wings level	Do not apply aileron before 200 knots otherwise the aircraft may re-enter a spin
Recover from dive	Not more than +3g below 250 knots

WARNING: It is essential that full rudder application can be achieved. Pilots are therefore to adjust their sitting positions before flight accordingly.

9. *Recovery Considerations*

a. *Disorientation.* Disorientation or confusion is likely during an unintentional spin (eg from combat manoeuvring). It is essential that the controls be centralised and maintained in that position until the direction of rotation is positively established, or the aircraft recovers of its own accord, or the decision to eject is made.

b. *Engine Effects.* The engines should not flame out or surge in a spin although reheat (if in use) may extinguish. Varying the power setting in a spin has negligible effect on recovery and therefore the throttles should be left at the pre-spin position until recovery from the dive is started.

c. *Control Column Position.* Full out-spin aileron prevents recovery. More than ½ in-spin aileron, though resulting in an extremely rapid recovery, can easily produce a reversal into a spin in the opposite direction. Neutral aileron should therefore be used; the control system 'feel' assists in achieving this position. Tailplane position has no effect on recovery rate but, with the control column fully forward, an uncomfortable bunt results after rotation ceases; a too-far aft position could result in a further stall after rotation ceases.

d. *Airbrakes.* Airbrakes have little effect on spin recovery.

e. *Overwing Tanks.* Overwing tanks, with or without fuel, have little effect on spin characteristics or recovery. Do not jettison them in a spin.

f. *Brake Parachute.* Do not attempt to stream the brake parachute as an aid to spin recovery as it is unlikely to be effective and may foul the flying controls.

g. *Instruments.* Gyro instruments may topple during a spin. Therefore the MRG and compass cannot be relied on after recovery until they have been checked and re-erected.

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