

PART 4: SECTION 2

CHAPTER 3

MULTI-ENGINE AIRCRAFT—FAILURE OF ONE OR MORE ENGINES

Introduction

1. The handling techniques for flying twin-engine aircraft on asymmetric power apply equally to aircraft having four or more engines. On multi-engine propeller-driven aircraft the torque, slipstream, and other effects result in a higher critical speed when these effects act in the direction which adds to the yawing action of the live engine. If the effects act to oppose the yawing action of the live engine the critical speed is reduced. Because of these characteristics, the live engine realizing the maximum adverse yaw is known as the "worst" engine for asymmetric power. If the aircraft has counter-rotating propellers, then torque, slipstream, and other effects are neutralized and the critical speed is the same for opposite engines and there is no "worst" engine.

2. As the failure of one engine on a four-engine aircraft deprives the pilot of only a quarter of the total power available, the ability to maintain height and climb is less impaired than by the failure of one engine on a twin-engine aircraft.

3. The failure of an inner engine on a four-engine aircraft should not lead to serious control difficulties because of the smaller moment arm producing correspondingly small asymmetric effects. As far as ease of handling is concerned, the effect of a failure of an outer engine is comparable to, though in general less severe than, the failure of one engine on a twin-engine aircraft. If both engines on one side have failed a four-engine aircraft can be considered as a twin-engine type with one engine failed.

Failure of One Engine During Take-Off

4. The principles outlined in Chapters 1 and 2 of this section are applicable to failure of an outer engine, except that the power available for climbing away is reduced by only 25 per cent. as opposed to 50 per cent. in the case of a twin-engine aircraft.

5. The safety speeds given in Pilot's Notes apply to the failure of the worst outer engine. If an inner engine fails, the safety speed is much lower.

6. If an outer engine fails below the critical speed, it is always necessary to close, at least partially, the throttle of the opposite outer engine to maintain directional control. It may then be possible to complete the actions outlined in Chapter 1, paras. 37 and 38, and then, consistent with rudder control, to increase power on the live outer engine and climb away. If a landing becomes inevitable, power should be used within the limits of rudder control to govern the rate of descent and to select the best possible landing area.

7. If an inner engine fails it is usually possible to complete the emergency actions and climb away.

Failure of More than One Engine During Take-Off

8. If the aircraft is still on the ground, the actions detailed in Chapter 1, paras. 34 to 36, as applicable, should be carried out. If the speed at the time of failure is above the refusal speed given in the Operating Data Handbook, the undercarriage should be raised.

9. If airborne, but at a low altitude at the time of engine failure, a crash landing ahead is almost inevitable if the A.U.W. is high. Such power as can be countered with the rudder should be used to check the rate of descent, and to assist in choosing a suitable landing area.

10. In the later stages of the take-off, if there is height and speed in hand it may be possible to continue climbing after completing the immediate actions detailed in Chapter 1, paras. 37 and 38.

Failure of One or More Engines in Flight

11. The principles are the same as those outlined in Chapter 1, paras. 39 to 43. With any three engines still available it should be possible to maintain height at all but the highest altitudes, using maximum continuous power. If it is necessary to fly at the highest possible altitude, some load may have to be jettisoned.

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12. An engine failure may not be apparent at once (this applies both to piston-engine and turbo-jet types) and may pass unnoticed for some time unless a frequent check is made on engine temperatures and the aircraft performance. On piston-engine aircraft, the r.p.m. and boost on the failed engine may not change since the propeller still attempts to constant-speed and the automatic pilot, if engaged, may mask any tendency to yaw. At moderate airspeeds, the failed engine can be detected by setting the propeller speed controls to give maximum r.p.m. and noting which engine does not respond fully. In other circumstances a continuous fall in engine temperatures will show the failed engine. Alternatively, the tendency to yaw should be trimmed out and the throttles of the engines on the side of the suspected failure independently closed and then opened again. When the throttle of the failed engine is closed there will be no further tendency to yaw, thus indicating which engine has failed. If the automatic pilot is in use when engine failure is discovered, it should be disengaged. On turbo-jet

aircraft, engine failure is shown immediately by a fall in j.p.t. and r.p.m. on the engine concerned.

Landing

13. A circuit and landing on three engines should be carried out exactly as for a normal circuit and landing, keeping the airspeed above the critical speed for go-around power until the decision to land has been made.

14. Going round again on three engines should present no difficulty (see Chapter 2, paras. 12 to 16).

15. When both engines on the same side have failed, a circuit and landing may be made using the technique described in Chapter 2, paras. 4 to 11.

16. Going round again on two engines is usually only possible if the aircraft is at a light landing weight and has an adequate rate of climb ; Pilot's Notes give advice on this point.

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