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AVIATION RESEARCH INVESTIGATION REPORT
B2005/0085

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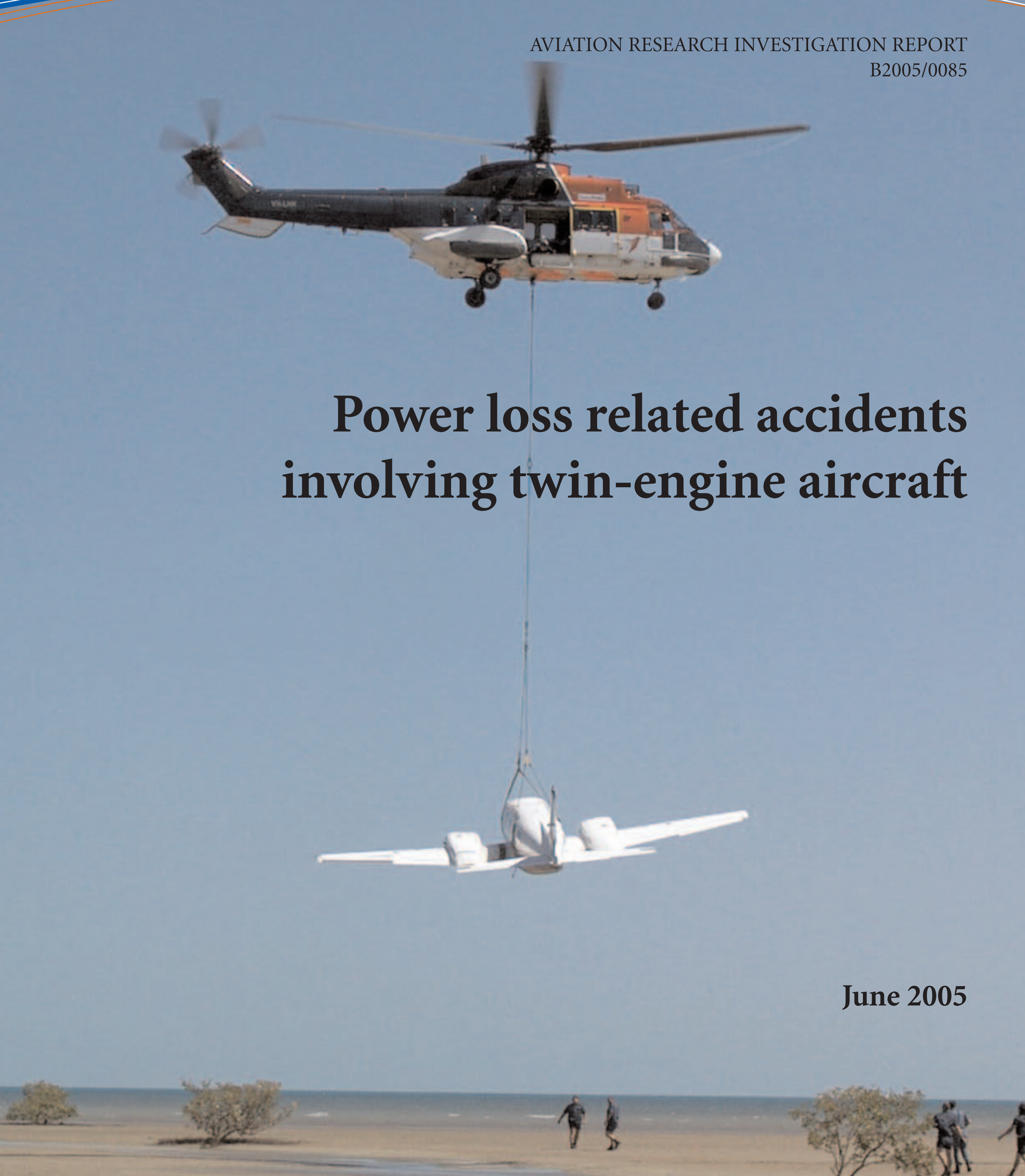

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# Power loss related accidents involving twin-engine aircraft

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# EXECUTIVE SUMMARY

A number of serious accidents occurred during the years 2001 to 2004 involving twin-engine fixed-wing aircraft following a loss of some or all engine power. This study of the 63 twin-engine fixed-wing aircraft power loss accidents (11 fatal) during the period 1993 to 2002 identifies common themes and provides information that could enable the implementation of mitigating strategies to reduce the risks associated with power loss events.

The study was limited because not all power loss events are reported to the ATSB. This data limitation did not permit the examination of power loss incidents and hence analysis is restricted to the power loss accidents reported to the ATSB.

To obtain an overall view of the risk of twin-engine fixed-wing power loss accidents, twin- and single-engine power loss accident and fatal accident rates were compared. The twin-engine fixed-wing power loss accident rate was found to be almost half of the rate for single-engine fixed-wing aircraft. However, a power loss accident in a twin-engine fixed-wing aircraft was more likely to be fatal than a power loss accident in a single-engine fixed-wing aircraft. Without comprehensive power loss incident data it is not possible to determine the actual risks of an accident or incident resulting from a power loss event for both single- and twin-engine fixed-wing aircraft.

The twin-engine fixed-wing power loss accidents were analysed to identify the types of accidents that occurred. Ten of the 11 fatal accidents subsequent to a power loss in twin-engine aircraft were the result of an in-flight loss of control. In contrast, the majority of non-fatal accidents subsequent to a power loss were primarily the result of degraded aircraft performance and resulted in aircraft being forced landed.

When a twin-engine fixed-wing aircraft sustains a loss of power, the resulting power output can produce a power condition that is either asymmetric or non-asymmetric. The twin-engine fixed-wing power loss accidents were grouped based on whether the aircraft was being powered asymmetrically or non-asymmetrically when the accident occurred.

The analysis of the data showed that:

- Just over one-third of power loss accidents in twin-engine fixed-wing aircraft occurred during a non-asymmetric power loss. The majority of these were related to fuel management, and no benefit was derived from the presence of a second engine.
- The vast majority (86 per cent) of non-asymmetric power loss accidents occurred following a power loss in either the en route or approach phases and resulted in aircraft being forced landed.
- Almost two-thirds of power loss accidents in twin-engine fixed-wing aircraft occurred during an asymmetric power loss. The reasons for these power losses were more varied than those in the non-asymmetric power loss group, with fuel management, fuel system problems, engine and propeller malfunctions, perceived power losses, simulated engine failures and power losses for undetermined reasons all identified as causes of power loss.
- More accidents (46 per cent) occurred following an asymmetric power loss in the take-off phase than in any other phase of flight.

NOTE: in response to comments received on this report the definition of $V_{mca}$ was refined on 14 September 2005.

# 1 INTRODUCTION

## 1.1 Definitions

Australian VH-registered fixed wing twin-engine aircraft involved in power loss accidents between 1993 and 2002 have been examined in this report. The data have been further restricted to aircraft with a maximum take off weight of less than 5,700 kg.

Where accident rates of twin-engine and single-engine aircraft have been compared, the single-engine aircraft included meet the same criteria as the twin-engine aircraft described above.

For the purpose of this report, the following definitions have been used.

**Power loss**

An event where an aircraft sustained a partial or complete loss of engine power. Power loss events include: loss of power production by the engine, propeller problems, perceived losses of engine power, in-flight engine shut downs and simulated engine failures.

**Power loss accident**

An accident that occurred subsequent to a power loss event, or those occurrences where the damage sustained by an aircraft during a power loss event met the criteria for an accident.

**Asymmetric power**

An asymmetric power condition exists when a multi-engine aircraft’s net centre of thrust is laterally displaced from the net centre of drag.

**In-flight loss of control**

An event where the pilot could not maintain the aircraft’s attitude.

**Performance**

Performance refers to an aircraft's ability to climb, and factors that affect that ability.

**Accident associated with asymmetric power**

An accident involving an asymmetric power condition was considered to be one where the aircraft was being powered asymmetrically at the time the accident occurred (i.e. when control of the aircraft was lost or damage was sustained). Also included are those accidents where the remaining power was shut down during asymmetric flight when the accident became inevitable.

**Accident associated with non-asymmetric power**

An accident involving non-asymmetric (symmetric) power was considered to be one where the aircraft was not under asymmetric power at the time of the accident, except when the remaining power was shut down during asymmetric flight when the accident became inevitable. In this report, only those accidents associated with non-asymmetric power loss are considered; accidents where all engine power was available are not considered.

## 1.2 Background

Following a number of accidents[1] in recent years involving twin-engine aircraft under asymmetric power, the ATSB implemented a data analysis investigation of all the twin-engine asymmetric power loss accidents and a comparison of single- and twin-engine operations.

A loss of power event in a fixed-wing aircraft requires different pilot responses based on whether the aircraft has one engine or two and the degree of power loss.

Limited options are available to the pilot of a single-engine aircraft in the event of a complete loss of power. The pilot must retain control of the aircraft, maintain appropriate airspeed and execute a forced landing, the result of which is highly dependent on the height of the aircraft at the time of the power loss and the terrain in the vicinity. If the aircraft's engine does not fail, but shows signs of impending failure, the pilot will want to land as quickly as possible because of the high risk associated with an engine failure.

More options are available to a pilot of a twin-engine aircraft after a power loss event when one engine remains operational or both engines have partial power available. The benefit of having additional options is more advantageous in some phases of flight compared with others.

The aerodynamics of twin-engine aircraft with wing-mounted engines can result in asymmetric power due to a power loss event. Unlike a power loss in a single-engine aircraft or a symmetrical power loss in a twin, asymmetric power requires significant coordinated rudder and aileron inputs to retain aircraft control while maintaining airspeed at or above $V_{mca}$[2].

There are various events that can lead to a complete or partial loss of engine power in an aircraft. Unplanned power losses typically result from fuel mismanagement, fuel system failures, engine or propeller malfunctions and in-flight engine shut downs. A planned power loss event is a simulated loss of power for the purpose of pilot training.

Between 1993 and 2002, twin-engine aircraft were involved in 54 accidents associated with unplanned power losses and nine accidents associated with planned power losses.

## 1.3 Limitations

Due to Australia's relatively good aviation safety record and small industry, limited numbers of accidents are available for analysis. The small number of accidents,

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[1] ATSB investigation reports 200102253, 200105618, 200300224, 200303579 and 200400242.

[2] $V_{mca}$ is the calibrated airspeed at which, when the critical engine is suddenly made inoperative it is possible to maintain control of the aeroplane with that engine still inoperative, and thereafter maintain straight and level flight at the same speed with an angle of bank of not more than 5 degrees. Vmca must be determined with: the most unfavourable weight and centre of gravity position with the aeroplane airborne; maximum power initially on each engine; flaps in the take-off position; trimmed for take-off; landing fear retracted; and the propeller controls in the recommended position for take-off.

especially fatal power loss accidents involving twin-engine aircraft, increases the difficulty in identifying common safety issues. Not all of the results can be considered conclusive because the population of these accidents is small; however, they do indicate trends over a ten-year period.

Some of the twin-engine power loss accidents involved factors such as loss of power at night which complicates analysis of the accidents. This report focuses on the power loss event only and does not address other factors that may have influenced the occurrence or severity of the accident.

### Reporting of incidents

Not all power loss incidents are reported to the ATSB. Also, power loss in a single-engine aircraft is a more significant risk than power loss in one engine in a twin-engine aircraft. It is therefore likely that a higher proportion of incidents involving power loss in a single-engine aircraft are reported to the ATSB than incidents involving power loss in one engine in a twin-engine aircraft. For these reasons power loss incident data cannot be used.

### Reporting of accidents

The nature of fatal accidents makes it imperative that they are reported to the ATSB. However, not all non-fatal accidents are reported despite regulatory requirements to do so. The analysis of power loss accidents is therefore limited to those reported to the ATSB. The analysis incorporates the assumption that there is no significant difference between the reporting of non-fatal accidents involving single-engine and twin-engine aircraft.

# 2 OBJECTIVES

The project was conducted:

- to examine the risks of accidents and fatal accidents occurring after an unplanned or planned loss of power event in twin-engine aircraft compared with single-engine aircraft; and
- to examine accidents involving twin-engine aircraft after a power loss and provide descriptive information about the nature of the accidents and, if possible, isolate common issues.

The objectives required the examination of:

- available data that were comprehensive enough to allow valid comparisons between twin- and single-engine operations, including rates for power loss events;
- the types of twin-engine accidents that occurred subsequent to a power loss event;
- whether asymmetric power was a factor in twin-engine power loss accidents and fatal accidents; and
- the phases of flight that preceded an accident involving twin-engine aircraft power loss events.

The information that has been derived from this study is intended to be of benefit to those associated with the operation of twin-engine aircraft. This group includes:

- the regulator;
- those who set training syllabi and pilot performance criteria for twin-engine operations;
- those who conduct twin-engine training to ensure that their training priorities are aligned with evidence on risks associated with twin-engine operations; and
- the pilots themselves so they can be aware of the risks they are exposed to during asymmetric flight, and measure and prioritise their skills against the identified risks.

# 3 SCOPE

The project initially attempted to analyse multi-engine asymmetric training and one-engine inoperative accidents. However, the project was widened to examine all accidents associated with asymmetric power losses in twin-engine aircraft as well as non-asymmetric powerlosses. This expansion increased the number of accidents, especially fatal accidents, available for analysis to identify common features. A comparison of twin- and single-engine aircraft accidents and power loss accidents was also included to provide a means of evaluating the risk of twin-engine power loss accidents.

All of the multi-engine aircraft with a maximum take-off weight not exceeding 5,700 kg involved in powerloss accidents extracted from the ATSB’s aviation safety database involved twin-engine aircraft. To reflect the fact that only twin-engine aircraft are included in the datasets analysed in this report, the term ‘twin-engine’ is used to describe the aircraft rather than ‘multi-engine’.

# 4 METHOD

The ATSB's Occurrence Analysis and Safety Information System (OASIS) database was queried to isolate twin-engine power loss accidents between 1993 and 2002. At the time the project commenced, 1993-2002 was the most recent ten-year period where all relevant investigations had been completed.

The accidents included in the twin-engine power loss dataset for analysis were selected using events and factors (or outcomes and defences) attributed to the accidents when they were entered in the OASIS database. The associated accident reports were examined to identify accidents that specifically occurred following a loss of engine power, propeller problem, perceived power loss, in-flight engine shut-down or simulated engine failure.

The same process was used to produce a dataset of single-engine aircraft power loss accidents. This dataset was compared against the dataset for twin-engine power loss accidents.

Classification of the twin-engine power loss accidents into those that occurred during non-asymmetric and asymmetric power was achieved by consensus in an expert group. Where the circumstances of the accident were not conclusive, the known information was used to make a classification that was most likely to reflect the circumstances of the accident.

The process described above was also used to categorise twin-engine aircraft accidents that occurred during non-asymmetric and asymmetric power situations into the different accident types within their individual groupings.

# 5 SINGLE- AND TWIN-ENGINE AIRCRAFT ACCIDENT RATE COMPARISON

## 5.1 Data overview

In order to compare operations in twin-engine aircraft with operations in single-engine aircraft, it is necessary to use comparable categories of occurrences[3] and event types. Ideally, a comparison would be made using all occurrence reports involving power loss accidents and incidents, as this would allow a rate for power loss events to be calculated for twin- and single-engine aircraft. Data on all power loss events could also be used to compare the proportion of power loss occurrences involving twin-engine aircraft which resulted in an accident with the proportion of power loss occurrences involving single-engine aircraft resulting in an accident. This would enable an assessment of the effect on flight safety of having a second engine on a light aircraft.

However, not all incidents, including those involving loss of power, are reported to the ATSB. In some cases, particularly those involving twin-engine aircraft with a single engine power loss where the pilot has been able to land the aircraft safely, the incident may have been unreported. The under-reporting of incidents, in the case of power loss events, would affect twin-engine aircraft to a greater extent and therefore does not permit valid comparisons of total power loss occurrences involving twin-engine aircraft with single-engine aircraft. Consequently, the effect on flight safety of a second engine cannot be assessed and other measures must be sought.

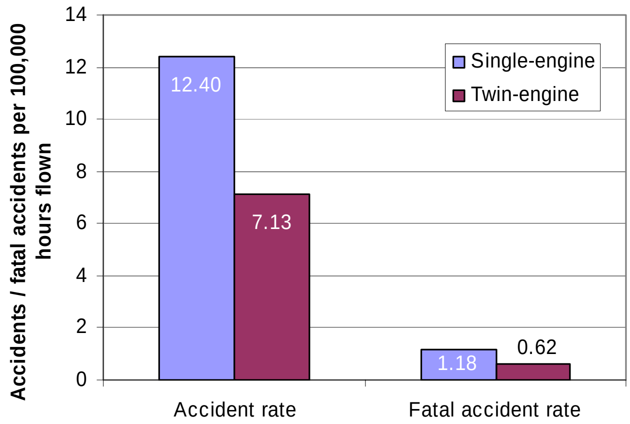
Accident data are more accurate than incident data. All fatal accidents are reported to the ATSB, but not all non-fatal ones are despite requirements to do so. However, it is reasonable to assume that the proportion of total non-fatal accidents reported for single- and twin-engine aircraft would be similar. This should therefore enable a reasonable comparison of all accidents with accidents subsequent to a power loss, as well as a comparison of accidents involving twin-engine aircraft with those involving single-engine aircraft.

[3] Aviation safety occurrences include accidents, serious incidents and incidents. The term incident is commonly used to refer to both serious incidents and incidents collectively.

## 5.2 Single- and twin-engine aircraft accident and fatal accident rates

The accident and fatal accident rates for twin- and single-engine aircraft less than 5,700 kg for the period 1993 to 2002 were compared to obtain a general overall view of the relative safety of twin- and single-engine aircraft.

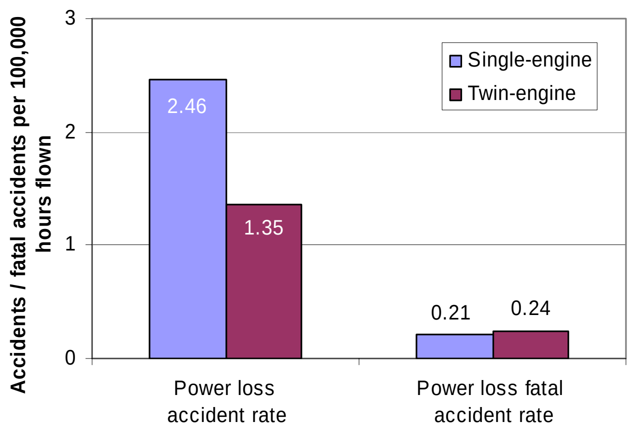
**Figure 1: Accidents and fatal accidents per 100,000 hours flown, 1993 to 2002**




The twin-engine accident rate is approximately 60 per cent of the single-engine accident rate and the twin-engine fatal accident rate is approximately 55 per cent of the single-engine fatal accident rate (Figure 1). Hence, twin-engine aircraft were just over half as likely to be involved in an accident or fatal accident compared with single-engine aircraft per hour flown. The rate is probably better per distance flown because twin-engine aircraft generally fly faster than single-engine aircraft.

## 5.3 Single- and twin-engine aircraft power loss accident and fatal accident rates

**Figure 2: Power loss accidents and fatal accidents per 100,000 hours flown, 1993 to 2002**



The rate at which power loss accidents involving twin-engine aircraft occurred was about 60 per cent of the single-engine rate: this is similar to the ratio for all accidents. However, when considering only fatal accidents subsequent to a power loss, the accident rate for twin-engine aircraft was approximately the same as that for single-engine aircraft (0.24 and 0.21 respectively). Hence, while a twin-engine aircraft was just over half as likely to be involved in an accident when a loss of power has occurred compared with a single-engine aircraft per hour flown, both twin- and single-engine aircraft were about equally likely to be involved in a fatal accident after a power loss per hour flown.

In addition, eighteen per cent of single-engine fatal accidents involved a power loss, while the proportion more than doubled to 38 per cent for twin-engine aircraft.

However, this result should be interpreted with caution. While a greater proportion of twin-engine aircraft power loss accidents were fatal compared with single-engine aircraft power loss accidents, the proportion of all power loss events resulting in an accident is not accurately known for twin- and single-engine aircraft. What can be assumed is that when an accident subsequent to a power loss occurs in a twin-engine aircraft, it is generally more severe because a greater proportion of these accidents are fatal compared with single-engine aircraft.

Caution should also be used when interpreting the results due to the low number of twin-engine fatal accidents (11) that occurred over the 10-year period. However, the finding is supported by an *NTSB Special Study*[4] on twin-engine aircraft engine failures which also found that twin-engine aircraft accidents subsequent to a power loss are more likely to be fatal compared with single-engine aircraft.

[4] NTSB 1979, *Light twin-engine aircraft accidents following engine failures*, 1972-1976 Special Study, National Transportation Safety Board, Washington

# 6 TWIN-ENGINE AIRCRAFT POWER LOSS ACCIDENTS

## 6.1 Types of accidents

During the period 1993 to 2002 there were 63 power loss related accidents involving twin-engine aircraft. There were 1.35 power loss accidents per 100,000 hours flown. Eleven of these accidents were fatal, with the fatal accident rate being 0.24 accidents per 100,000 hours flown.

The two main issues for a pilot of an aircraft when a loss of power occurs are maintaining aircraft control and maximising the aircraft's performance. To assess the significance of control and performance in accidents that occurred after a twin-engine aircraft sustained a loss of engine power, the accidents were collated into categories based on the most significant control or performance issue that led to the development of the accident. Those accidents that were not directly a result of a control or performance issue were also grouped.

The categories of accident types are described below.

- **In-flight loss of control (LOC)**: Accidents where there was an in-flight loss of control.

- **Performance**: Accidents where aircraft performance was degraded by the loss of power itself and includes cases where the aircraft was not configured for optimal performance for the power available. Aircraft control was not a major issue in the development of the accident.

- **Control Difficulty**: Accidents where significant difficulty in maintaining aircraft control was a factor, including cases where the aircraft was not configured for optimal control or performance. In these accidents there were difficulties with both control and performance.

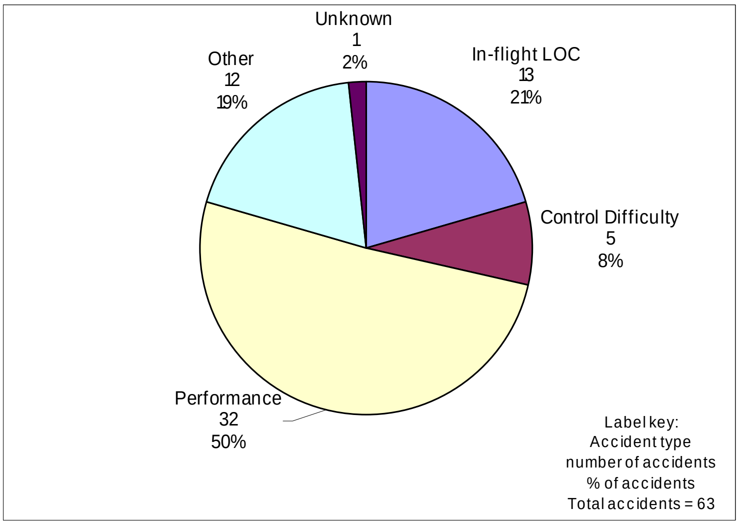
- **Other**: Accidents that were classified as such because aircraft damage associated with the power loss itself met the criteria of an accident (e.g. an in-flight engine shut down following a birdstrike); and those accidents which were not a direct consequence of a performance or control issue (e.g. aircraft landing wheels-up after a loss of power).

- **Unknown**: Accidents where there was insufficient information to enable a classification to be made.

### 6.1.1 Twin-engine aircraft power loss accident types: all accidents

Classification of all the twin-engine power loss accidents, using the categories defined in section 6.1, is shown in Figure 3.

**Figure 3: Types of accidents involving power loss (all accidents)**




Twin-engine aircraft power loss accidents are most likely to happen due to the reduced performance of the aircraft (50 per cent). Accidents in this group include those where the aircraft's performance was degraded by the loss of power itself and cases where the aircraft was not configured for optimal performance for the power available (including complete loss of power). As a result, the aircraft's capacity to climb or maintain altitude was the principal factor contributing to the development of the accident.

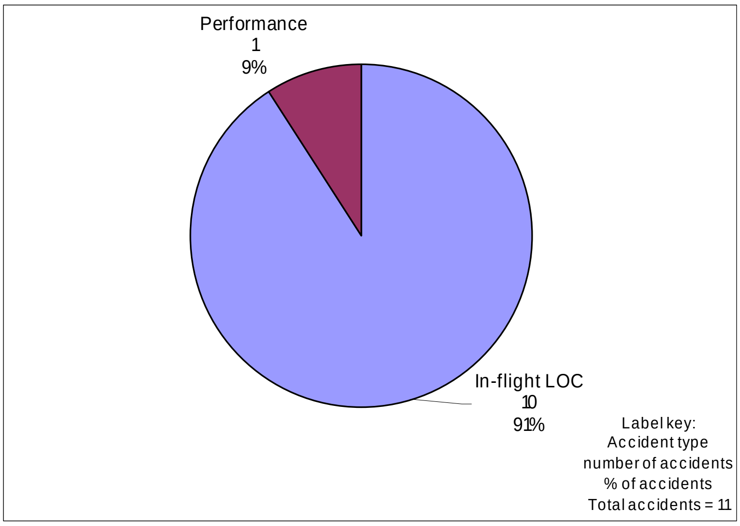
In-flight loss of control was the next biggest category. Twenty-one percent of twin-engine aircraft accidents involving a power loss resulted in a loss of control in-flight.

Accidents not directly related to aircraft control or performance (i.e. those categorised as *Other*) accounted for 19 per cent of accidents. Accidents where the aircraft's performance problems were compounded by significant control difficulties (*Control Difficulty*) accounted for eight per cent. One accident could not be classified.

The accidents were separated into non-fatal and fatal accidents to examine the accident types associated with each group.

### 6.1.2 Twin-engine aircraft power loss accident types: fatal accidents

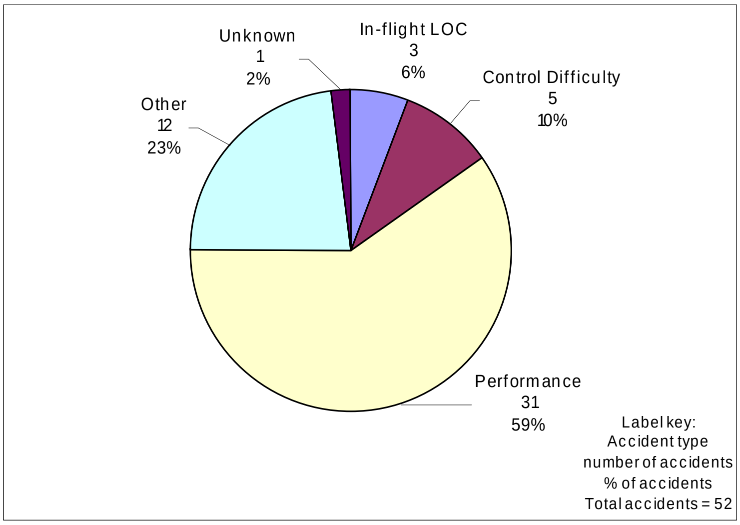
**Figure 4: Types of fatal powerloss accidents**




Ten of the 11 twin-engine aircraft fatal powerloss accidents involved an in-flight loss of control. The other fatal accident occurred when an aircraft was ditched at sea at night following a dependent double engine failure (the failure of the first engine and the subsequent aircraft management affected the probability of the second engine's failure). There were no fatal accidents in the other accident classification groups.

### 6.1.3 Twin-engine aircraft power loss accident types: non-fatal accidents

**Figure 5: Types of non-fatal power loss accidents**




In contrast to the fatal accidents, the majority of the non-fatal accidents (59 per cent) were primarily the result of degraded aircraft performance. In-flight loss of control and those accidents where control was a significant problem (*Control Difficulty*) accounted for six per cent and 10 per cent of non-fatal accidents respectively. Accidents not related to control or performance issues (i.e. those categorised as *Other*) accounted for 23 per cent of non-fatal accidents. One accident could not be classified.

This categorisation shows a disproportionately high risk of a twin-engine aircraft power loss accident associated with in-flight loss of control being fatal.

Five of the accidents classified as *Other* were defined as an accident purely because of the damage sustained during a power loss. However, the aircraft was successfully recovered without any further damage. An example was an in-flight engine shut down following a birdstrike, when the aircraft was subsequently landed without further incident.

The next chapter analyses those accidents in which there was further aircraft damage after the powerloss event and does not include the five accidents previously described.

# 7 NON-ASYMMETRIC AND ASYMMETRIC POWER LOSS ACCIDENTS

## 7.1 Power loss conditions

The aerodynamic features of twin-engine aircraft with wing-mounted engines create an asymmetric power condition when the power output from both engines is different. For a twin-engine aircraft with a loss of power resulting in asymmetric power, significant coordinated rudder and aileron control inputs are required to retain aircraft control in addition to maintaining airspeed above $V_{mca}$.

In contrast, if there is a similar (including complete) power loss in both engines of a twin-engine aircraft with wing-mounted engines, the aircraft will not be powered asymmetrically. As a result aircraft control can be maintained by maintaining airspeed without significant reliance on rudder and aileron control inputs.

Twin-engine aircraft with centre line thrust engines will not be powered asymmetrically with any combination of engine power loss.

Examining twin-engine aircraft accidents with an asymmetric power loss condition separately from those without an asymmetric power loss condition provides information on issues associated with these different power loss conditions. However, dividing the data in this way is not always a clear-cut process. While accidents involving a total and irretrievable loss of power in one engine are clearly related to an asymmetric power condition, some accidents were not so easily classified due to the fluctuating power output during the accident sequence.

When a twin-engine aircraft with wing-mounted engines has lost total power, there will typically have been a period when the aircraft was powered asymmetrically because the loss of power to both engines does not normally happen simultaneously. Further problems can ensue as there is a change from asymmetric power to a total power loss.

The fatal accident data quality is affected by the fact there can be difficulties in investigating a fatal twin-engine power loss accident to determine the sequence and degree of engine failure and to ascertain the power output at the time of the accident.

After consideration of the issues described above, the twin-engine power loss accidents were classified as being asymmetrically or non-asymmetrically powered at the time the accident occurred. Where the sequence of events was not conclusive, the known information was used to make a classification most likely to reflect the circumstances.

**Table 1: Twin-engine power loss accidents by phase of flight of power loss and power loss condition**

| Phase of flight of power loss | Asymmetric power | Non-asymmetric power | Power condition unknown | Total |
|---|---|---|---|---|
| Take off | 16 (3 fatal) | 2 (1 fatal) | | 18 (4 fatal) |
| En route | 9 (1 fatal) | 10 (1 fatal) | | 19 (2 fatal) |
| Manoeuvring | 1 (1 fatal) | 1 (1 fatal) | | 2 (2 fatal) |
| Approach | 7 (1 fatal) | 9 | 1 (1 fatal) | 17 (2 fatal) |
| Go-around | 2 (1 fatal) | | | 2 (1 fatal) |
| Total | 35 (7 fatal) | 22 (3 fatal) | 1 (1 fatal) | 58 (11 fatal) |

Table 1 shows twin-engine aircraft accidents subsequent to a power loss by the phase of flight associated with the power loss and by the type of power loss when the accident occurred (i.e. when an in-flight loss of control occurred or the aircraft was damaged).

Overall, the greatest proportion of accidents in which an aircraft was being powered asymmetrically occurred after a power loss during the take-off phase (16 accidents in a total of 35), nine accidents occurred after a power loss while the aircraft was en route and seven during the approach phase.

Accidents while the aircraft was not being powered asymmetrically occurred most often after the loss of power while the aircraft was en route or on approach.

One fatal in-flight loss of control accident occurred while the aircraft was on approach at night. Both engines had failed due to fuel starvation prior to impact with the ground. The investigation could not determine which engine failed first and at what stage the pilot lost control of the aircraft. As there was no indication of whether the aircraft was being powered asymmetrically or not when control was lost, the power condition was categorised as *Unknown.*

Different analytical groupings were used for non-asymmetric and asymmetric power loss accidents to identify more clearly the predominant factors associated with each power loss type.

## 7.2 Non-asymmetric power loss accidents

### 7.2.1 Non-asymmetric power loss accidents: all

**Table 2: Twin-engine non-asymmetric power loss accidents by phase of flight of power loss and accident type**

| Phase of flight of power loss | In-flight LOC | Control Difficulty | Performance | Other | Unknown | Total |
|---|---|---|---|---|---|---|
| Take off | 1 (1 fatal) | | 1 | | | 2 (1 fatal) |
| En route | | | 10 (1 fatal) | | | 10 (1 fatal) |
| Manoeuvring | 1 (1 fatal) | | | | | 1 (1 fatal) |
| Approach | | | 8 | 1 | | 9 |
| Go-around | | | | | | 0 |
| Total | 2 (2 fatal) | 0 | 19 (1 fatal) | 1 | 0 | 22 (3 fatal) |

Just over one-third (22 accidents in a total of 58) of the twin-engine accidents subsequent to a power loss involved a loss of power that was not asymmetric (Table 1). The reasons for the failure in these cases typically related to factors where the presence of more than one engine did not reduce risk. As such, in these cases no benefit was gained from the aircraft having two engines.

The vast majority (19 accidents in a total of 22) of these accidents with non-asymmetric power arose because both engines lost total power (including a centreline thrust aircraft with a double loss of power). Seventeen were the result of fuel starvation or exhaustion and one was due to fuel contamination. The remaining aircraft had a double engine failure that was unrelated to fuel.

Some power was available to the other three non-asymmetric power loss aircraft, but there was no asymmetric power condition. Two of these aircraft had a centre line thrust design and the other had wing-mounted engines with partial power to both engines. None of these three partial power losses related to fuel.

### 7.2.2 Non-asymmetric power loss accidents: fatal

Three of the 22 accidents involving twin-engine aircraft with a non-asymmetric power loss were fatal. Both of the aircraft involved in loss of control in-flight fatal accidents had a centre line thrust design. The third fatal accident was an aircraft ditching accident.

### 7.2.3 Non-asymmetric power loss accidents: in-flight loss of control

Two of the 22 accidents in which there was a total/non-asymmetric loss of power involved an in-flight loss of control. Both of these accidents were fatal. One accident involved an in-flight loss of control of a centre line thrust aircraft. The aircraft was manoeuvring at low level in a maximum performance turn when all power was lost and an in-flight loss of control occurred. The second fatal accident also involved a centreline thrust aircraft that took off with only one engine operating and a loss of control ensued.

### 7.2.4 Non-asymmetric power loss accidents: performance

Nineteen accidents were the result of the aircraft being force landed or ditched and were categorised as *Performance* related accidents. Sixteen of these power loss situations arose due to fuel management issues.

Only one of the 19 accidents resulted in fatalities, being a ditching accident at night after a double engine failure. One propeller was turning at impact and may have been producing a small amount of power; however, this was classified as a non-asymmetric accident because any power production was not considered significant. Ten of these emergency landing accidents happened after a power loss while the aircraft was en route, eight after a power loss during approach and one after a power loss on take-off (during circuit practice).

### 7.2.5 Non-asymmetric power loss accidents: other

The one remaining accident was not related to control or performance issues and was classified as *Other*. An engine failure was simulated while a centre line thrust aircraft was on approach. The aircraft was subsequently landed wheels-up.

## 7.3 Asymmetric power loss accidents

### 7.3.1 Asymmetric power loss accidents: all

**Table 3: Twin-engine asymmetric power loss accidents by phase of flight of power loss and accident type**

| Phase of flight of power loss | In-flight LOC | Control Difficulty | Performance | Other | Un-known | Total |
|---|---|---|---|---|---|---|
| Take off | 4 (3 fatal) | 3 | 7 | 1 | 1 | 16 (3 fatal) |
| En-route | 1 (1 fatal) | 1 | 4 | 3 | | 9 (1 fatal) |
| Manoeuvring | 1 (1 fatal) | | | | | 1 (1 fatal) |
| Approach | 3 (1 fatal) | 1 | 1 | 2 | | 7 (1 fatal) |
| Go-around | 1 (1 fatal) | | 1 | | | 2 (1 fatal) |
| Grand Total | 10 (7 fatal) | 5 | 13 | 6 | 1 | 35 (7 fatal) |

Just under two-thirds (35 accidents in a total of 58) of twin-engine accidents subsequent to a power loss involved aircraft being powered asymmetrically.

The reasons for these power losses were more varied than those in the non-asymmetric power loss group. These reasons were:

- fuel management (six accidents);
- fuel system malfunction (six accidents);
- simulated engine failure (six accidents, in two of these cases, the engine did not restart when power was re-applied);
- engine malfunctions (two accidents);
- perceived power loss followed by in-flight engine shut down (two accidents);
- propeller malfunction (one accident); and
- power loss for undetermined reasons (12 accidents).

### 7.3.2 Asymmetric power loss accidents: fatal

All seven of the fatal accidents that occurred during asymmetric power were the result of in-flight loss of control. This indicates that a large amount of the human risk associated with asymmetric operations derives from the probability of loss of control, and other risks are relatively small by comparison.

### 7.3.3 Asymmetric power loss accidents: take-off

Forty-six per cent (16 accidents in a total of 35) of the accidents occurred subsequent to a power loss that developed during the take-off phase of flight. While the take-off phase of flight generally accounts for a small portion of the overall flight time, almost half of all accidents involving asymmetric power happened after power loss during take-off.

Four of these 16 accidents involved an in-flight loss of control, three accidents were fatal, and one resulted in serious injury. The 12 remaining accidents after an asymmetric power loss during the take-off phase mostly involved a lack of performance.

The greatest proportion of accidents occurred after an asymmetric power loss during the take-off phase. This is consistent with the lower aircraft height and energy associated with this phase, thereby reducing options available to the pilot for a successful recovery.

### 7.3.4 Asymmetric power loss accidents: en route

The en route phase of flight generally accounts for the greatest portion of flight time. One-quarter of all accidents (9 accidents in a total of 35) during asymmetric power occurred subsequent to a loss of power during the en route phase.

One accident resulted from an in-flight loss of control. This was also the only fatal accident after an asymmetric power loss while an aircraft was en route. The loss of control occurred after the aircraft rolled to the left and inverted and was consistent with the right engine suddenly surging to high power when the aircraft was flying at a low airspeed and low height (due to fluctuating engine power output) while the left engine was delivering little or no power.

Four accidents were the result of forced landings (*Performance*) after asymmetric power developed en route.

Three of the four remaining accidents that occurred after an asymmetric power condition developed en route were categorised as *Other* because the accident was not related to a control or performance issue. In these cases, the aircraft returned to aerodromes due to an engine problem (fuel system failures and a mechanical problem) and conducted wheels-up landings: two due to landing gear problems and one where the pilot did not lower the landing gear.

The final accident in this group involved an aircraft that was returned to an aerodrome after asymmetric power loss occurred en route; and during a single-engine go-around, aircraft control was temporarily lost and a heavy landing off the runway followed (*Control Difficulty)*.

It was considered probable, however, that many en route power loss events would not be reported to the ATSB if a safe landing ensued, so it was not possible to comment on the frequency or overall risk associated with en route power loss events.

### 7.3.5 Asymmetric power loss accidents: approach

Seven accidents (20 per cent) occurred after an asymmetric power condition developed during the approach phase. Considering the relatively small portion of the overall flight, this was considered a more risky time, again with low altitude, and only a little more energy available than during the take-off phase.

Three of these accidents involved an in-flight loss of control, including the only fatal accident after an asymmetric power loss during the approach phase. The fatal accident involved a pilot practicing a VOR[5] approach at night when asymmetric power developed (probably due to a loss of power in the right engine while changing fuel tanks) and an in-flight loss of control occurred.

The two remaining in-flight loss of control accidents were non-fatal. In one case, the pilot lost control of the aircraft on late final approach after asymmetric power developed during the approach phase for undetermined reasons. The second accident happened when control of the aircraft was lost during a practice asymmetric approach in windy conditions.

The remaining four accidents after an asymmetric power condition developed during the approach phase occurred when:

- a pilot experienced aircraft control difficulties on approach (due to a fuel starvation event) and attempted a one engine go-around (Control Difficulty);
- an aircraft was landed heavily, short of a runway (Performance); and
- two aircraft were landed without the landing gear extended, one of which was doing a simulated engine failure on approach (Other).

### 7.3.6 Asymmetric power loss accidents: manoeuvring

The only accident that occurred when an asymmetric power loss developed while an aircraft was manoeuvring at low level resulted in fatalities. Fuel management led to power loss and it is possible that there was a sudden power increase as fuel flow was restored to one engine. This power surge could have caused the aircraft to yaw and roll, resulting in an in-flight loss of control.

### 7.3.7 Asymmetric power loss accidents: go-around

Two accidents occurred during the go-around phase of flight, one of which was fatal. In the fatal accident, the pilot initiated a go-around and asymmetric power loss developed. The aircraft was being flown at a low height and probably at low speed with minimal opportunity to lower the nose to increase speed and thereby increase aircraft controllability. Consequently, an in-flight loss of control occurred. The non-fatal accident occurred after power was reapplied after a simulated engine failure. During the attempted go-around, the engine appeared to accelerate slowly and the aircraft settled on to the ground. Considering the relative rarity of go-arounds, asymmetric power loss events during this phase are considered risky. However, without information on the frequency of go-arounds, this risk could not be quantified.

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[5] VOR (VHF Omni Ranging) is a navigational instrument that can be used for conducting an instrument approach when descending to land at an airport.

# 8 CONCLUSIONS

- Power loss accident rates in twin-engine aircraft are almost half the rate in single-engine aircraft. However, a power loss accident in a twin-engine aircraft is more likely to be fatal than a power loss accident in a single-engine aircraft.

- Fatal accidents subsequent to a power loss in twin-engine aircraft are overwhelmingly a result of in-flight loss of control events.

- Just over one-third of power loss accidents in twin-engine aircraft occurred during a non-asymmetric power loss. The majority of these were related to fuel management, and no benefit was derived from the presence of a second engine.

- More accidents (46 per cent) occurred following an asymmetric power loss in the take-off phase than in any other phase of flight.

# 9 APPENDIX A: EXTRACTS FROM TWIN-ENGINE AIRCRAFT FATAL ACCIDENT INVESTIGATION REPORTS

The following are extracts from the 11 fatal twin-engine aircraft power loss accident investigation reports. The titles in the boxes refer to the nature of the accident as described in the main text of this report.

**Asymmetric power loss accident: power loss during take-off**

**In-flight loss of control**

**Fatal accident BO/199400698**

When the aircraft was about 300 ft above ground level after takeoff, a witness reported that all engine sounds stopped and that the aircraft attitude changed from a nose-high climb to a more level attitude. A short time later, the noise of engine power surging was heard. The aircraft rolled left and entered a spiral descent. …

The right propeller … was producing considerable power at impact. The right fuel distributor valve contained fuel.

… the left engine had stopped before impact. The left fuel distributor valve contained little fuel. …

If the tip tanks were selected since the previous day, the tip tank fuel contents should have been exhausted at about the time of the final takeoff from Weipa. With a low quantity of fuel in each tip tank, the fuel lines from each tank probably became unported as the aircraft climbed after takeoff, resulting in engines losing power from fuel starvation. When the pilot changed the attitude of the aircraft after the loss of power, some fuel probably became available to the right engine which then regained power. …

**Non-asymmetric power loss accident: power loss during take-off**

**In-flight loss of control**

### Fatal accident BO/199802140

The twin-engine aircraft was of a `centreline thrust' design. This design located one engine and propeller assembly at the front and the other at the rear of the fuselage, immediately behind the passenger cabin. …

VH-YGM arrived at Bundaberg at about 1100 EST on 7 June. At the time, an airshow that had been organised by the local aero club was in progress. …

At about 1339, the pilot reported by radio on the airshow frequency that he was taxiing for departure. …

The aircraft then commenced the takeoff roll with the rear propeller stationary. It became airborne after a ground roll that appeared excessively long and commenced a shallow climb. Witnesses on the other side of the airport beyond the departure end of runway 25 reported that the rear propeller commenced rotating slowly as the aircraft flew low over a line of trees about 300 m beyond the boundary fence. A short time later, the aircraft banked left and descended steeply to the ground. It was destroyed by impact forces and fire. …

There were a number of observations and facts that supported the conclusion that the pilot conducted the takeoff with the rear engine not operating. These included the witness observations that the rear propeller was not rotating at the commencement of the takeoff roll, the recorded video evidence that the rear propeller was not rotating as the aircraft taxied for takeoff, and the takeoff ground roll distance. The already limited (single engine) climb performance of the aircraft would have been reduced further because the rear propeller was not feathered. An additional climb penalty would have arisen as the landing gear doors opened during the retraction cycle. At this stage, the position of the aircraft was probably such that the line of trees beyond the end of the runway precluded the pilot initiating a descent to maintain aircraft speed or conducting an emergency landing straight ahead. The witness observation that the rear propeller commenced rotating at this stage of the flight could indicate that the pilot was attempting to start the rear engine. A possible consequence of such an action was that he was unable to devote his full attention to flying the aircraft at that critical stage of the flight.

The left wing drop and sudden descent of the aircraft evident on the video recording, along with the impact attitude, indicated that the aircraft had aerodynamically stalled. The altitude at which this occurred was too low for the pilot to recover the aircraft to normal flight before ground impact, particularly with only the front engine operating. Had the recommended 1/3 flaps been set for takeoff, the resultant lower stalling speed would have provided a slightly greater safety margin than was available with flaps up. However, it is difficult to assess whether this would have changed the final outcome. …

The following factors were considered relevant to the development of the accident:

1 The pilot conducted the takeoff with the rear engine not operating and the flaps up.

2 The pilot retracted the landing gear.

3 The aircraft aerodynamically stalled at an altitude from which the pilot was unable to recover to normal flight before ground impact.

**Asymmetric power loss accident: power loss during take-off**

**In-flight loss of control**

**Fatal accident BO/200102253**

… As the aircraft accelerated during the takeoff roll, the caps fell from the left wing filler ports, probably as a result of vibration and/or aerodynamic forces. The `smoke' observed by the tower controller and a witness was fuel venting from the open tank filler ports. It was unlikely that any other interpretation of the venting fuel would reasonably have been made in the circumstances, particularly in the deteriorating ambient light conditions, coupled with the position of the filler ports on either side of the engine nacelle.

Other than the tower controller's transmission regarding the `smoke', it could not be determined what other information the pilots of the aircraft used in reaching the decisions to shut down the left engine and attempt a left turnback. However, based on the examination of the left engine and propeller, there would most probably have been no indication from the cockpit instruments that the left engine was malfunctioning in any way. Whether the pilots were able to observe the `smoke', or became aware of the situation regarding the fuel caps, could not be determined. …

At the time the aircraft passed abeam the control tower, there was adequate runway and overrun distance available for the aircraft to land and decelerate significantly before reaching the boundary fence. Whether the pilots considered the option of landing straight ahead after being notified of the `smoke' could not be determined.

The flight path taken by the aircraft (the turn away from the live engine) and the aircraft configuration at impact (left propeller not feathered, landing gear extended) indicated that aspects critical to maintaining single engine performance were not accomplished. The final flight path and impact attitude of the aircraft were typical of what might be expected following loss of control when the airspeed falls below the minimum single engine control speed.

[…Disassembly of the left and right propellers found no evidence of any pre-existing fault or defect. Disassembly of the left propeller confirmed the blades were at fine pitch and not in the feathered position at impact. Disassembly of both engines did not reveal any pre-existing fault or defect that would have affected normal engine operation. …]

**Asymmetric power loss accident: power loss during take-off**

**In-flight loss of control**

**Fatal accident BO/200105618**

At about 0836 Eastern Standard Time on 27 November 2001, a Beech Aircraft Corporation King Air C90 aircraft, registered VH-LQH, took off from runway 29 at Toowoomba aerodrome, Queensland for an Instrument Flight Rules charter flight to Goondiwindi, Queensland. On board were the pilot and three passengers.

Just prior to, or at about the time the aircraft became airborne, the left engine failed. A subsequent examination of the left engine found that it probably lost thrust-producing power almost immediately. Following the engine failure, the take-off manoeuvre continued and the aircraft became airborne prior to crashing.

The aircraft was equipped with an automatic propeller feathering system, but the propeller was not feathered at impact. The reason the propeller was not feathered could not be determined. The landing gear was not retracted during the short flight. The right engine was developing significant power at impact.

The aircraft remained airborne for about 20 seconds. The aircraft's flight path was typical of an asymmetric, low speed flight situation, and it is unlikely that the aircraft's speed was ever significantly above the minimum control speed ($V_{mca}$) of 90 kts. The aircraft manufacturer's specified procedures for responding to an engine failure in LQH stated that the take off should be rejected below the 'take-off speed', specified as 100 kts. After control of the aircraft was lost, and as the aircraft was rolling through about 90 degrees left bank, it struck powerlines about 10 m above ground level and about 560 m beyond the end of the runway. It then continued to roll left and impacted the ground inverted in a steep nose-low attitude. An intense fuel-fed fire erupted upon initial impact with the ground. The aircraft was destroyed and all four occupants sustained fatal injuries. The accident was not considered to be survivable due to the impact forces and post-impact fire.

**Asymmetric power loss accident: power loss en-route**

**In-flight loss of control**

**Fatal accident BO/199302151**

About five minutes after departing Archerfield, the pilot radioed that he was experiencing problems with both engines and that he was in an emergency situation. The pilot of the other aircraft advised him that there were suitable forced landing areas in and around a nearby golf course. However, the aircraft continued and slowly lost altitude …

Ground witnesses reported hearing loud backfiring and fluctuating engine RPM from the aircraft. These sounds were accompanied by erratic rolling and yawing of the aircraft before it rolled to the left and inverted …

Examination of the aircraft engines indicated that the right engine was under power at impact while the left engine was not. The mechanical condition of the engines indicated that they were capable of normal operation.

The PA-31 pilot's operating handbook states that the main fuel tanks must be selected for takeoff. However, the behaviour of the aircraft, the position of the fuel selectors, and the information concerning the contents of the auxiliary tanks suggest that the pilot probably commenced the flight with the auxiliary tanks selected. As the flight progressed and fuel was used, intermittent un-porting of the fuel outlet lines occurred. This caused temporary fuel starvation, resulting in engine surging. These interruptions to engine power would have caused the aircraft to lose altitude, as described by witnesses, and airspeed. The event in which the aircraft rolled to the left and inverted is consistent with the right engine suddenly surging to high power when the aircraft was flying at a low airspeed while the left engine was delivering little or no power.

**Non-asymmetric power loss accident: power loss en route**

**In-flight loss of control**

**Fatal accident BO/200002157**

On the evening of 31 May 2000, Piper Chieftain, VH-MZK, was being operated by Whyalla Airlines as Flight WW904 on a regular public transport service from Adelaide to Whyalla, South Australia. … A significant proportion of the track from Adelaide to Whyalla passed over the waters of Gulf St Vincent and Spencer Gulf. The entire flight was conducted in darkness.

The aircraft reached 6,000 ft and proceeded apparently normally at that altitude on the direct track to Whyalla. At 1856 CST, the pilot reported to Adelaide Flight Information Service (FIS) that the aircraft was 35 NM south-south-east of Whyalla, commencing descent from 6,000 ft. Five minutes later the pilot transmitted a MAYDAY report to FIS. He indicated that both engines of the aircraft had failed, that there were eight persons on board and that he was going to have to ditch the aircraft, but was trying to reach Whyalla.…

On 9 June 2000, the wreckage of the aircraft was recovered for examination. Aside from the engines, no fault was found in the aircraft that might have contributed to the accident. Both engines had malfunctioned due to the failure of components of the engines.

The crankshaft of the left engine fractured at the Number 6 connecting rod journal. … The left propeller was in the feathered position when the aircraft struck the water, confirming that the engine was not operating at that time.

The physical damage sustained by the right engine was restricted to the localised melting of the Number 6 cylinder head and piston. …

Examination of the right propeller indicated that the blades were in a normal operating pitch range (i.e. not feathered) when the aircraft struck the water. It could not be confirmed that the right engine was operating when the aircraft struck the water, although it most probably was operating when radar contact was lost as the aircraft descended through 4,260 ft when 25.8 NM from Whyalla. …

The aircraft speed and propeller RPM information, coupled with the engine failure analysis, was consistent with the following likely sequence of events:

- The power output from the left engine deteriorated during the first third of the cruise segment of the flight after the Number 6 connecting rod big end housing had fractured. The engine ceased operating completely 8-10 minutes later.
- In response to the failure of the left engine, the pilot increased the power setting of the right engine.
- Increased combustion chamber component temperatures via detonation within the right engine led to the Number 6 piston being holed. That resulted in the erratic operation of the right engine with reduced power and controllability and left the pilot with little alternative but to ditch the aircraft.
- The double engine failure was a dependent failure. …

This accident was the first recorded ditching involving a Piper Chieftain aircraft in Australia. Available records world-wide of previous Piper Chieftain engine failure/ditching events illustrate that, in most instances, successful night ditchings occurred in better visibility and weather conditions than those confronting the pilot of MZK. The relatively minor injuries suffered by the occupants of the aircraft indicated that the pilot demonstrated a high level of skill in ditching the aircraft. …

**Asymmetric power loss accident: power loss while manoeuvring**

**In-flight loss of control**

**Fatal accident BO/199403314**

VH-SPP departed Cloncurry on a low level aero-magnetic survey flight at the estimated time of 0730 EST with an endurance of about 7 hours. The aircraft was due to return to Cloncurry by 1230 but failed to arrive….The burnt-out wreckage of the aircraft was found by search aircraft the following morning about 9 km north of the survey area and 30 km south of Cloncurry. …

The factual information obtained from examination of the accident site and the wreckage enabled a number of deductions to be made concerning the accident sequence. Fire damage to the wreckage indicated that there was substantial fuel on board the aircraft at impact. The extreme, unusual attitude of the aircraft at impact indicated that the pilot lost control of the aircraft prior to impact. The respective propeller positions and engine operating conditions at impact imply that, with the right engine operating and the left propeller feathered, such an impact attitude could have resulted from the aircraft developing an uncontrollable roll left as a result of aircraft speed reducing below $V_{mca}$.

No mechanical fault was identified in the left engine which might have been reason for the left propeller to have been feathered. The closed position of both selector valves implied deliberate movement of the fuel selector in the cockpit to the OFF position. …

… after consideration of the factual evidence, the following hypothesis is considered a plausible explanation of the accident sequence.

Background relevant to the hypothesis centres on the accident flight being only the second time the pilot had flown SPP but the first time he had cause to feed fuel from the outboard tanks. Significant differences between SPP and other Aero Commander aircraft the pilot had flown involved the orientation of cockpit fuel tank selector switches and outboard tank fuel transfer time. With respect to the fuel selectors, in the 500 Series aircraft the centre tank selection was at the twelve o'clock position. This compared with SPP where the twelve o'clock position was OFF. Fuel transfer from the outboard tanks took approximately 1 hour in the 500 Series aircraft, while it took some 20 minutes in SPP. Also, the left outboard tank emptied 3–5 minutes more quickly than the right outboard tank. …

If the pilot followed his normal habit of selecting both outboard tanks at about the same time, but forgot that the tanks emptied in about 20 minutes in SPP instead of at least 60 minutes as he was accustomed to from his experience in other Aero Commander aircraft, then at about 1007, the left engine would have ceased operating as the tank ran dry. The expected reaction to such an event would be for the pilot to reselect the centre tank and switch the boost pump on. However, in the stress of the moment, he may have regressed to previously learned behaviour and placed the cockpit selector in the twelve o'clock position, forgetting that this was OFF in SPP, even though this involved passing the centre tank detent and greater angular rotation of the knob than from the OUTBOARD to CENTRE position. When normal left engine operation was not restored, it would have been reasonable for the pilot to have increased power on the right engine, feathered the left propeller, and commenced a climb from survey height. Within a short time, however, the right engine would have begun to run roughly as the right outboard tank became empty. The resultant power loss would have caused the aircraft to lose performance rapidly. Now with similar malfunctions in both engines, the pilot might have realised that he had made an incorrect fuel selection for the left engine, and positioned the right selector correctly at the centretank (half-past one o'clock) position. Given that these events would take time, and could have resulted in air entering the right engine fuel line, the aircraft could have lost both performance and altitude by the time the fuel supply to the engine was restored. The sudden power increase as fuel flow was restored could have been sufficient to yaw and roll the aircraft uncontrollably to the left and result in the impact attitude found at the accident site. …

**Non-asymmetric power loss accident: power loss while manoeuvring**

**In-flight loss of control**

**Fatal accident BO/199600827**

…The [centreline-thrust Cessna 337] aircraft crashed during a low-level inspection of a bay on the coastline to the east of Albany.

The accident occurred after the pilot lost control of the aircraft at low level. Loss of control was precipitated by a loss of power on both engines whilst the aircraft was being flown in a maximum-performance turn.

Loss of power on the rear engine was the result of fuel starvation, probably caused by un-porting of the fuel supply line during prolonged unbalanced flight. The reason for loss of power on the front engine could not be determined although it is possible that the pilot inadvertently selected the front engine to off whilst attempting to change the fuel selection on the rear engine from the main to the auxiliary fuel tank.…

**Asymmetric power loss accident: power loss while on approach**

**In-flight loss of control**

**Fatal accident BO/199601209**

At 1903 the pilot made an "all stations" broadcast 20 NM west of Charleville. He reported inbound on the 270 VOR radial on descent for a practice VOR approach, …

Witnesses at the airport saw the aircraft fly overhead from the west. The aircraft was seen to turn right onto a southerly heading and soon afterwards the sound of the aircraft diminished. A bang was then heard and felt through the ground at about 1915. The aircraft wreckage was located the next day by a search party. The aircraft had struck the ground whilst banked vertically to the right with a 45-degree nose-down attitude, and disintegrated. …

At the time of the accident, there was no moon and the aerodrome pilot activated lighting (PAL) had not been turned on. After passing over the township, which is to the north of the aerodrome, the pilot would have had no visual horizon. The pilot's multi-engine experience at night was 3.9 hours, all of which was in command.

The flight times since the last refuelling at Windorah to arrival overhead at Charleville corresponded to that required to exhaust auxiliary fuel tanks. The pilot was known to have allowed auxiliary tanks to run dry before selecting mains on previous occasions. The fuel supply to the right engine may have been interrupted due to exhaustion of the right auxiliary tank. The operating handbook cautions against using auxiliary tanks in other than level flight due to the possibility of uncovering the tank outlet. Should this occur the engine is likely to lose power, surge and stop. Once the fuel system has ingested air, the engine cannot be restarted until the air is purged and a normal fuel flow restored. The fuel selectors appear to have been selected to the main tanks at impact, but as indicated by the engine tachometer readings, the right engine was not delivering power. This was most likely due to the right engine fuel system having ingested air before the main tank was selected.…

An unexpected power loss while the pilot's attention is concentrated on the flight instruments could be most distracting, even for an experienced pilot. The effect would be for his attention to be immediately diverted to the engine instruments, and then possibly the fuel panel. Cross reference between the attitude and performance instruments is required to perform instrument flight, particularly when there is no visual horizon. This is critical in multi-engine aircraft if an engine fails and asymmetric flight is encountered. Should cross-reference be lost for any reason and the aircraft allowed to get into unbalanced, uncoordinated flight, the aircraft may assume an unusual attitude. The pilot may then become completely disorientated and lose control of the aircraft. The aircraft attitude at impact suggests that this occurred.

**Power loss accident (unknown power condition): power loss while on approach**

**In-flight loss of control**

**Fatal accident BO/200100348**

At about 1930 Western Standard Time1 on 26 January 2001, a Cessna 310R aircraft, VH-HCP, departed Kiwirrkurra, Western Australia (WA), for Newman. The flight was conducted at night under the visual flight rules (VFR), with one pilot and three passengers on board. The aircraft was operated by the Air Support Unit (ASU) of the WA Police Service and had been used to transport police officers from Newman to Kiwirrkurra earlier that day.

The aircraft arrived in the circuit area at Newman at about 2150 for a landing on runway 23. Witnesses at the aerodrome heard the engines start to 'cough and splutter'. Soon after, the aircraft collided with the ground about 3 km to the east of Newman aerodrome. The four occupants sustained fatal injuries. Impact forces destroyed the aircraft.

The investigation determined that both of the aircraft's engines failed due to fuel starvation, prior to impact with the ground. …

Technical examination determined that the left propeller was feathered at the time of impact and this was probably the result of a pilot selection. It could not be determined if that was in response to the failure of the left engine, or the pilot incorrectly identifying which engine had failed.

Irrespective of which engine failed first, it is likely that the fuel supply to the other engine was interrupted as a consequence of the forces acting on the aircraft following the initial engine failure. Those forces, combined with a low quantity of fuel in the main tank, could have resulted in the displacement of the remaining fuel away from the tank's fuel pick-up point and the subsequent failure of the second engine, also due to fuel starvation. …

The pilot was required to make specific control inputs and complete additional actions to correctly identify and respond to the initial engine failure. The second engine probably failed very soon after the first engine, and at a time when the pilot's attention was focussed on responding to the initial event. The investigation could not positively determine at what stage the pilot had lost control of the aircraft. The aircraft should have been controllable following the failure of its engines, but a number of factors significantly increased the difficulty of this task.

Those circumstances included dark night conditions, the limited height available at circuit altitude and the pilot's low level of experience and training to operate a multi-engine aircraft at night.

The investigation concluded that the pilot did not maintain control of the aircraft following the failure of the engines.

**Asymmetric power loss accident: power loss during go-around**

**In-flight loss of control**

**Fatal accident BO/199900220**

The flight apparently proceeded normally until late final approach when the pilot initiated a go-around because of a vehicle on the airstrip. There were clear indications from the wreckage examination that the aircraft was rolling and yawing left at impact. …

[…The right propeller exhibited signs of severe tip curl and leading-edge abrasion, consistent with the engine developing high power at impact. ………]

[…The left propeller showed little evidence of rotational damage. The propeller had not been feathered. …]

… the position of the wing flaps at impact suggested that the pilot had selected full flap, and that the flaps subsequently did not move from this position. This implied that the pilot had been committed to land and that the aircraft speed was at, or less than, 65 kts.

… it is unlikely that the pilot was aware of an asymmetric engine condition until the go-around was initiated. When the asymmetric power condition arose, the pilot's task was complicated by a number of aspects:

- the aircraft was at low level, and probably low speed, when the go-around was initiated. This would have provided minimal opportunity for the pilot to lower the nose of the aircraft to increase airspeed and hence aircraft controllability; …
- the pilot had to deal with the control forces associated with the asymmetric power condition, in addition to those associated with the engine power increase;
- to retract the flaps to the take-off position, feather the left propeller, and adjust the elevator and rudder trims would have required the pilot to fly the aircraft with her left hand while conducting these other tasks with her right hand. Completion of these tasks may have been difficult, if not impossible, in that control of the aircraft may have required the pilot to use two hands on the control yoke to overcome the out-of-trim forces; …
- at a speed of 60 kts, the aircraft would have taken about 7 seconds to travel from overhead the witnesses at the eastern end of the island direct to the impact position. While the actual aircraft track was not established, this timeframe was probably indicative of the period available for the pilot to recognise the situation, evaluate available options, decide what action should be taken, and initiate that action; and
- the north-westerly wind would have exacerbated any tendency for the aircraft to drift left as a result of the asymmetric power situation.

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