Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT

Aviation Research and Analysis AR-2008-079

Third edition

Australian Aviation Safety in Review: 1998 to 2007

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Australian Aviation Safety in Review: 1998 to 2007

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Abstract

In 2009, the Australian Transport Safety Bureau (ATSB) produces its third edition of *Australian Aviation Safety in Review* as part of its role to enhance public awareness of aviation safety. This Review has been developed to provide a readily accessible analysis of the Australian aviation industry, with a major focus on communicating the key safety trends. This publication covers the major aircraft operation categories of passenger transport (regular public transport and charter) and general aviation. Sport and recreational aviation is also discussed, as is the burgeoning trend towards amateur-built and experimental aircraft.

Demographic and activity data on Australian aviation is presented to provide a context within which to examine accident and incident (occurrence) trends. To enable comparison of occurrence trends across different operational categories, data is provided in terms of actual numbers as well as rates per 100,000 hours flown. The latest year for which flying hours are available is 2007.

A new feature of this edition of the Review is a 10-year look at safety trends, focusing on total occurrences (all incidents and accidents), all accidents, and fatal accidents separately. An exploration behind what occurred (occurrence types) and why they occurred (safety factors) is a major focus of this edition.

Executive Director’s foreword

It has been an exciting and progressive year for air safety in Australia. The December 2008 release of the National Aviation Policy Green Paper established the future direction of the aviation industry, asserting the Government’s position on air safety in Australia as the number one priority. This includes the establishment of the Australian Transport Safety Bureau (ATSB) as a statutory agency with a Commission structure to enhance its independence. Legislative amendments to the *Transport Safety Investigation Act 2003* to give effect to the governance changes have been passed by Parliament and the new Commission will come into place on 1 July 2009.

I am delighted to release the third edition of the ATSB’s *Australian Aviation Safety in Review*. The format of this edition departs from that of the first two editions to provide a range of new information not previously presented. The report provides an overview of the aviation industry with a focus on safety data derived from aviation occurrences reported to the ATSB. It covers a 10-year period (1998 to 2007) and describes trends and analysis of both aviation incidents and accidents.

The first chapter deals with the structure and size of Australia’s aviation sector, including the number of aircraft registered and numbers of pilots and engineers licensed, and the amount aviation activity in different sectors. The next two chapters delve into measures of aviation safety. Chapter 2 examines the trends across 10 years for the number of fatal accidents, accidents and incidents, and their rate expressed as a proportion of annual flying hours. Chapter 3 takes a closer look at the nature of aviation occurrences (incidents and accidents) in Australia through an analysis of what occurred. Chapter 4 looks at why they occurred. That is, what human actions and technical failures contributed to the occurrences. Aviation occurrence reporting requirements and procedures are described in Chapter 5, and in Chapter 6, the special topic covered is the issue of birdstrikes in airline operations.

The information in this report is a valuable contribution to the advancement of the aviation safety in Australia. I trust it provides a helpful reference to assist those seeking to understand the big picture about the safety of Australia’s aviation sector. By better understanding the accident and incident trends and analysis in aviation, we can work together to strengthen Australia’s position as a world leader in aviation safety.

I commend the report to you.

Kym Bills
Executive Director
Australian Transport Safety Bureau

The ATSB will become a statutory agency with a Commission structure on 1 July 2009.

Chapter 1:

Aviation activities in Australia

How is air safety governed in Australia?

The present

Aviation safety in Australia is currently administered through a tripartite relationship involving the Australian Transport Safety Bureau (ATSB), Airservices Australia and the Civil Aviation Safety Authority (CASA) (Figure 1).

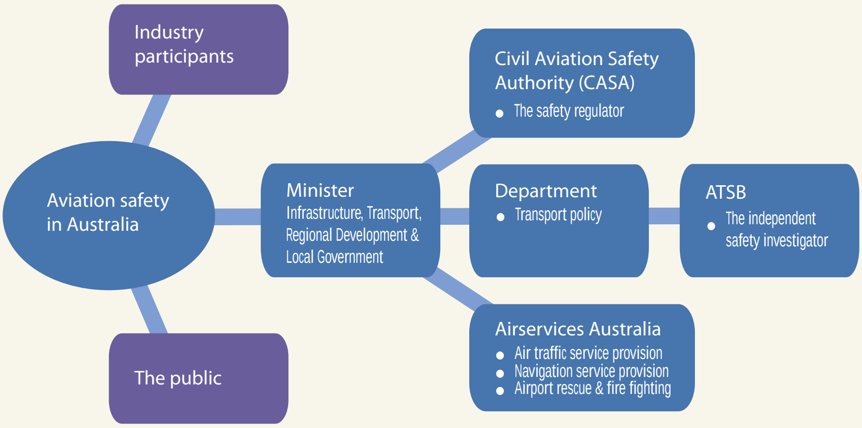
- The ATSB is an operationally independent body within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. The ATSB's core function is to independently investigate, analyse and openly report on aviation incidents and accidents. All ATSB investigations are no blame, with an emphasis on learning to improve future safety. In addition to its investigative role, the ATSB conducts safety data recording, analysis and research; and fosters safety awareness, knowledge and action.

- CASA is the primary agency responsible for the safety regulation of civil air operations in Australia, airspace regulation, and the operation of Australian aircraft overseas. CASA also provides a comprehensive safety education and training program including a range of informative materials on a broad range of subjects such as safety management systems, pilot guides, and the publication of the *Flight Safety Australia* magazine.

- Airservices Australia provides air traffic control management over an area that covers 11 per cent of the earth's surface. This not only covers the Australian flight information region, but also international airspace over the Pacific and Indian Oceans. Airservices Australia also provides the industry with aeronautical data, and telecommunications and navigation services; and aviation rescue and fire fighting services at 19 of Australia's busiest airports.

While each organisation has a distinct function, they share a common goal: *safe aviation*.

Figure 1: Aviation safety in Australia



The future for the Australian Transport Safety Bureau

The Australian Government's release of the *National Aviation Policy Green Paper* in December 2008 established the future directions of the Australian aviation industry, and was designed to improve the effectiveness of Government policy to ensure Australian aviation remains safe, efficient and competitive.

The Green Paper discusses a number of important reforms that aim to improve the investigation and regulation of aviation safety. Most notably, the Government announced that the ATSB is to become a statutory agency with a Commission structure to enhance its independence. A Commission will help to facilitate interaction with industry and other agencies, and improve quality control. It will oversee and approve ATSB reports and ensure investigation reports are communicated effectively to industry and the safety regulator, CASA, and acted upon as a key part of Australia's aviation safety system.

Legislative amendments to the *Transport Safety Investigation Act 2003* to give effect to the governance changes were passed by Parliament in March 2009, with the new ATSB Commission to be in place on 1 July 2009.

The National Aviation Policy Green Paper is available online at <http://www.infrastructure.gov.au/aviation/nap>.

How is Australia's aviation industry organised?

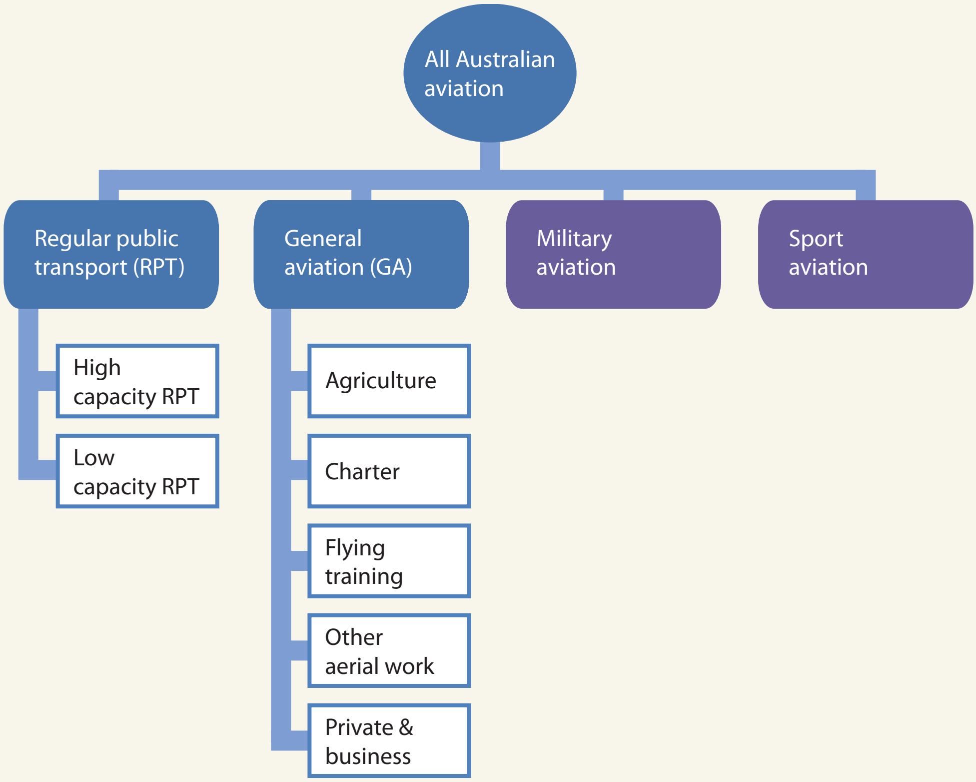
Past and present

Traditionally, the Australian aviation industry has generally been divided into four categories (Figure 2). The two main categories are regular public transport (RPT) and general aviation (GA).

The RPT services are airline operations that fly according to a fixed schedule, providing carriage for fare-paying passengers and/or cargo services. These services are further divided into high capacity and low capacity RPT, determined by the number of passengers that can be carried or the amount of cargo that can be loaded. High capacity RPT aircraft carry more than 38 passenger seats or a payload of greater than 4,200 kg. Low capacity RPT operations are conducted in aircraft other than high capacity RPT aircraft.

The other main sector of the aviation industry, GA, covers a diverse set of activities including charter, aerial agriculture, flying training and private flying. The two other categories of flying operations are military aviation (not covered by this report) and sport aviation, which includes gliders, private ballooning and ultralight aircraft. The definitions for each category are set out in the Glossary.

Figure 2: The current composition of the Australian aviation industry



Fare-paying passengers should be able to fly with any air operator, including charter operators, in the knowledge that the aircraft is maintained and its crew trained to the same standard that CASA requires of any other comparable operator, even if the company only provides aircraft for passenger services occasionally.

The Hon John Anderson, MP, November 1999.

New classification of operations

Improvements to Australian air transport regulations are necessary for a number of reasons. Since the introduction of the *Civil Aviation Act 1988*, civil aviation regulations (CARs) have become more complex. Over the years, the current regulations have been progressively altered to keep pace with international trends in aviation safety regulation, but do not necessarily follow international best practice.

Generally, some regulations have been seen by CASA and the industry as being overly prescriptive and an unnecessary burden on some types of aviation operations; ambiguous, disjointed and difficult to interpret. In some cases, the regulations have been difficult to enforce and comply with, and have relied on exemptions for their effect.

The current CARs are not harmonised with the United States, European and New Zealand aviation rules, which limits the ability of CASA to incorporate international changes to aviation safety related practices. There are also a number of differences between the current regulations and international standards and recommended practices set by the International Civil Aviation Organization (ICAO). For example, ICAO standards do not differentiate between charter and RPT operations.

Civil Aviation Safety Regulation (CASR) 121 intends to correct these shortcomings and align Australian air safety regulations with international best practice. Part 121 is to be based on the European *Joint Aviation Regulations – Operations* (JAR-OPS 1), adapted for the Australian aviation industry and legal framework.

An important aspect of the Part 121 changes will be the reclassification of passenger charter operations away from GA and into the same category as RPT passenger operations. The purpose of this change is to minimise the distinction in safety standards between RPT and charter operations, and reduce the accident rate in Australian charter operations. Under the current rules, charter flights may be operated to a lower level of safety than is applied to RPT flights.[1]

Part 121 changes

With the introduction of Part 121, aviation activities in Australia will be split into three categories[2] (Figure 3):

- **Passenger transport** (including RPT and charter passenger operations);
- **Aerial work** (specialised activities that present elevated safety risks or consequences, such as flying training and agriculture); and
- **General and freight-only activities** (such as private and business, RPT and charter dedicated mail and freight operations, and crew-only activities such as test, ferry, and positioning flights).

---

1 Civil Aviation Safety Authority. (2002). Notice of Proposed Rule Making, Air Transport Operations – Large Aeroplanes, Proposed Part 121A of the Civil Aviation Safety Regulations (CASRs) (NPRM 0211OS). Canberra: CASA.

2 Civil Aviation Safety Authority. (2009). *CASA's Industry Sector Priorities and Classification of Civil Aviation Activities* (Regulatory Policy – CEO-PN001-2004). Canberra: CASA.

CASA will continue to regulate VH- registered sport and recreational aircraft separately.

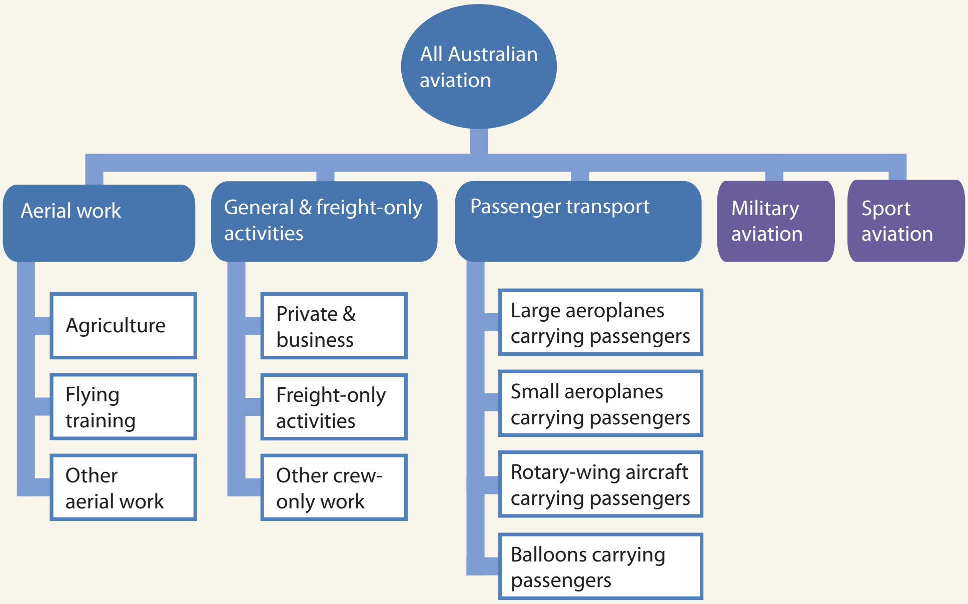
Within passenger transport, the current division between low capacity and high capacity will be replaced by:

- **Large aeroplanes** – aeroplanes having a maximum takeoff weight (MTOW) greater than 5,700 kg; and
- **Small aeroplanes** – aeroplanes having a MTOW less than 5,700 kg.
- Rotary-powered aircraft and balloons that carry passengers will also fall under the passenger transport category.

Small aeroplanes generally include small aircraft used in charter and low capacity RPT operations such as the Piper PA-31 Navajo and the Cessna 410. Large aeroplanes include turboprop and turbofan aircraft found in corporate aviation, the airlines and some charter operations.

Some aircraft that were previously in the low capacity RPT category will be in the large aeroplane category. Aircraft such as the Fairchild SA227 Metro, Beechcraft 1900D, Bombardier DHC-8-100 and -200 series aircraft, Learjet, and Saab 340 series aeroplanes, which may previously have operated as low capacity aircraft, will be designated under Part 121 as large aeroplanes.

Figure 3: Future composition of the Australian aviation industry under CASR Part 121



For further information on Part 121 and the changes to aviation operation classification in Australia, go to www.casa.gov.au.

In this Review, an adapted version of this hierarchy has been used to provide data continuity with previous editions.

- **Passenger transport** – high capacity RPT, low capacity RPT and charter[3] operations (both fixed and rotary-wing aircraft).
- **General aviation** – agriculture, flying training, other aerial work and private/business operations (both fixed and rotary-wing aircraft).

3 Charter has not been separated into passenger and freight operations. For the data presented in this report, the vast majority of charter incidents and accidents involved passenger carrying operations. Only about 10 per cent of incidents and accidents involving charter operations were identified as specifically involving freight, test and ferry, or check and training operations.

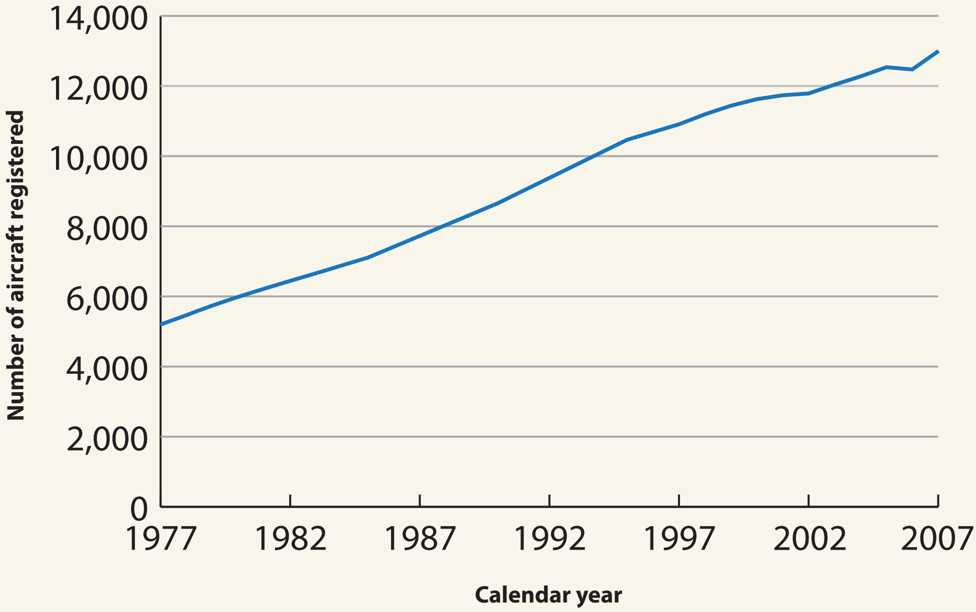
The number of aircraft on the register has more than doubled over the last 30 years.

How many aircraft are registered in Australia?

Both commercial and non-commercial aircraft in Australia are registered with CASA.[4] Aircraft on the CASA civil aircraft register are assigned a registration, which is also known as the 'tail' number. Every registration is unique and is identified by the prefix 'VH' followed by three letters (e.g. VH-AUS).

The number of aircraft on the register has increased steadily over the last 30 years, more than doubling from approximately 5,200 aircraft in 1977 to 11,194 in January 1998, and 12,990 aircraft in December 2007 (Figure 4). The 2007 figure was a 4.15 per cent increase from 2006, where a small drop in registrations occurred for the first time since 1940. This figure increased slightly in 2008 to 13,460 aircraft.

Figure 4: Aircraft on the Australian civil register, 1998 to 2007

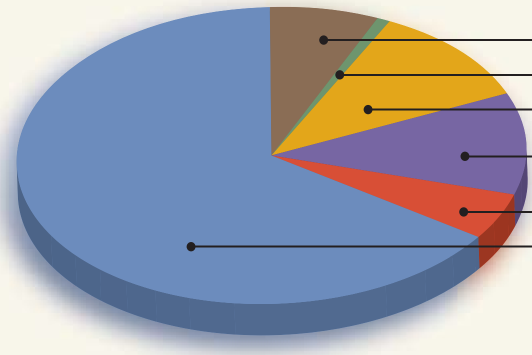


Source: CASA

The vast majority of aircraft on the register operate within the GA sector of the industry: small aeroplanes (those with a MTOW less than 5,700 kg) were most popular, accounting for 9,393 aircraft or 65 per cent of aircraft on the register. Large aeroplanes (those with an MTOW greater than 5,700 kg) account for five per cent or 680 aircraft, while sport aircraft (such as gliders and balloons) accounted for 1,429 aircraft (Figure 5).

4 Some sport, recreational, amateur-built and experimental aircraft are registered with Recreational Aviation Australia (RA-Aus), the organisation responsible for the administration of non-VH registered recreational aircraft in Australia. RA-Aus issues aircraft registrations that contain numbers (e.g. 24-1234).

Figure 5: Proportion of aircraft by category, 2007



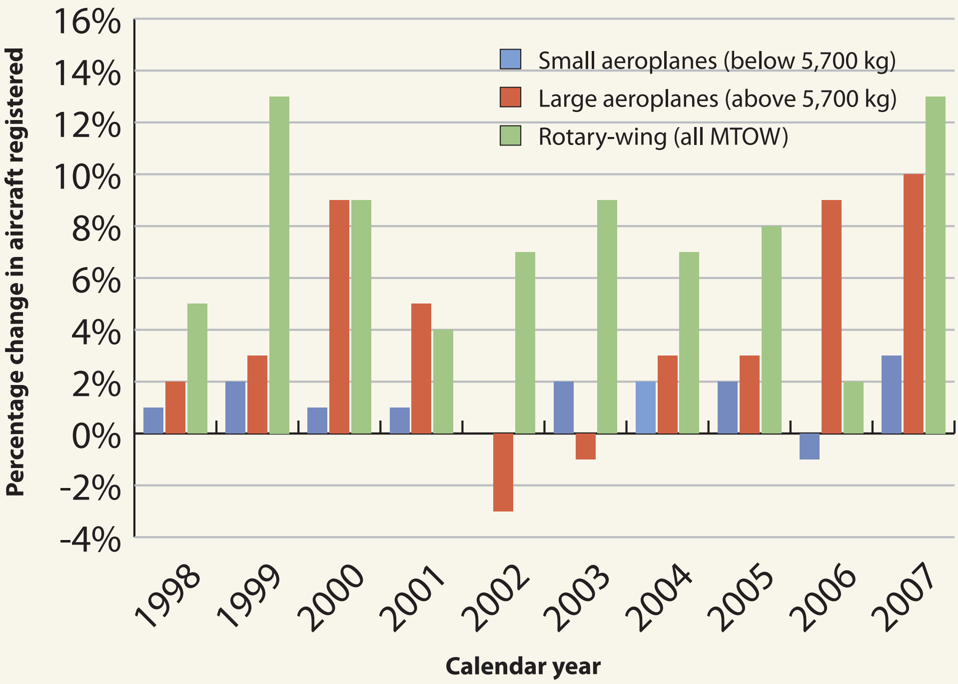
Source: CASA

In 2006, the number of aircraft on the register decreased for the first time since 1940. This may have been due to the introduction of new CASA regulations relating to aircraft registrations. About 300 aircraft were removed from the register due to the aircraft owner not providing CASA with the required documentation for transition to new registration rules. While this was a temporary state (most aircraft were subsequently re-registered), there was a net reduction in small aeroplane registrations of 66 aircraft. Over the entire 10-year period, growth in the number of small aeroplanes on the register was generally static (Figure 6).

In comparison, large aeroplane growth was much more variable due to airline fleet renewal, the acquisition of new aircraft types, and low capacity RPT operators expanding into high capacity services. The negative growth in large aeroplane registrations in 2002 and 2003 may be attributed to the de-registration of Ansett Australia's fleet following the airline's collapse in September 2001, with aircraft being withdrawn from service or exported overseas. However, this was short lived with the introduction of Virgin Blue and Jetstar into the Australian domestic aviation market.

Rotary-wing aircraft (helicopters) have shown consistently strong growth compared with other aircraft types, increasing from 751 in 1998 to 1,489 in 2007.

Figure 6: **Percentage change in fixed-wing and rotary-wing aircraft registrations, 1998 to 2007**[5]



Source: CASA

5 CASA records fixed-wing aeroplane registrations according to the aircraft's maximum take-off weight (MTOW) of 5,700 kg. The net reduction in aircraft registrations in 2006 was one per cent.

What was the first Australian-built aircraft?

When powered, controlled flight began in the early twentieth century, many of the most important steps in aviation were taken by amateur aircraft builders designing and building their own aircraft. Prominent names in the formative years of aviation, such as Curtiss, Wright, Roe, Bleriot, Santos-Dumont, Farman, Martin, Hargreaves, and Duigan, were all amateur builders. Before the First World War (1914-1918), there were very few factory-built aircraft. It was not until the aeroplane as a machine was improved in terms of capability, safety and efficiency through further research and development in the immediate pre-war years, that it developed into a viable means of transport and a valuable military asset. This process ushered commercial production aeroplanes into use in the 1920s.

The first attempts at powered, controlled flight in Australia were by Banks, Wittber and Custance, and Weiss in 1910. John Duigan conducted the first powered, controlled flight of an Australian-built aircraft on 7 October 1910 at Mia Mia, Victoria, flying a distance of 196 yards in front of six witnesses. This aircraft was followed by two others which Duigan built with his brother at the Ivanhoe family home in Melbourne. The third aircraft crashed at Keilor on 18 February 1913, which represents one of the first aircraft accidents on record in Australia.

Today, amateur-built aircraft represent a popular and progressive area of the aviation scene in Australia, and currently make up almost 10 per cent of all VH-registered aircraft.

John Duigan flying his amateur-built aircraft at Mia Mia, Victoria, 1910

At a glance: VH- aircraft registrations

Number of aircraft registered	2007
Small aeroplanes (below 5,700 kg MTOW)[6]	9,392
Large aeroplanes (above 5,700 kg MTOW)	680
Rotary-wing aircraft[6]	1,489
Sport	1,429
Total	**12,990**

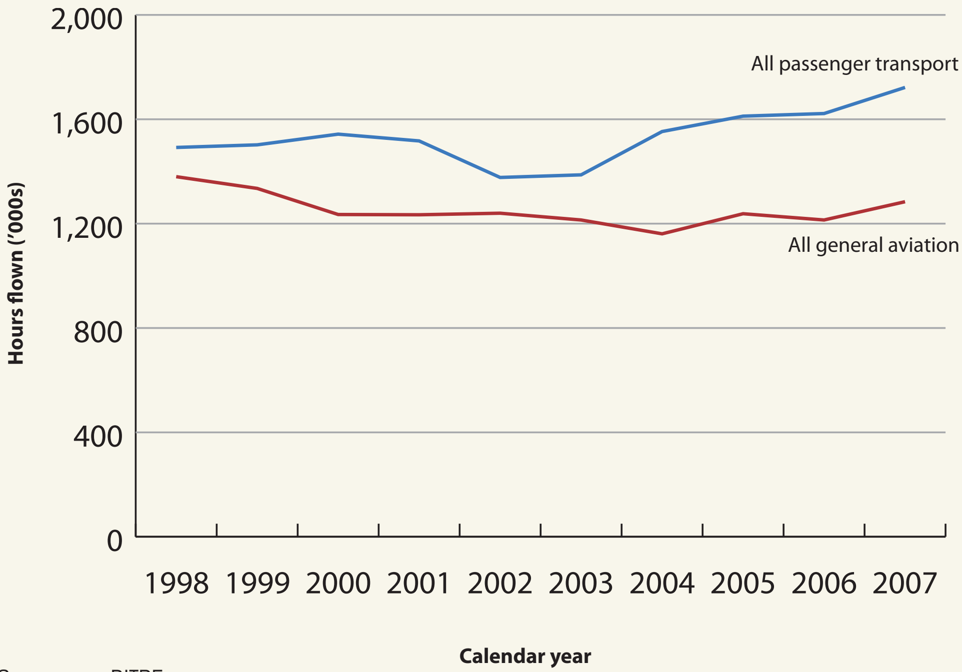
Source: CASA

6 Totals include amateur-built aircraft.

Annual flight hours

In Australia, over the last 10 years most flying activity (in terms of hours flown) has been in passenger transport. The total number of hours flown by passenger transport aircraft annually has grown from 1.49 million in 1998 to 1.72 million in 2007. Flying activity in GA has decreased slightly, with the total number of hours flown falling from 1.38 million in 1998 to 1.28 million in 2007 (Figure 7).

Figure 7: Total flying activity in Australia (by hours flown), 1998 to 2007



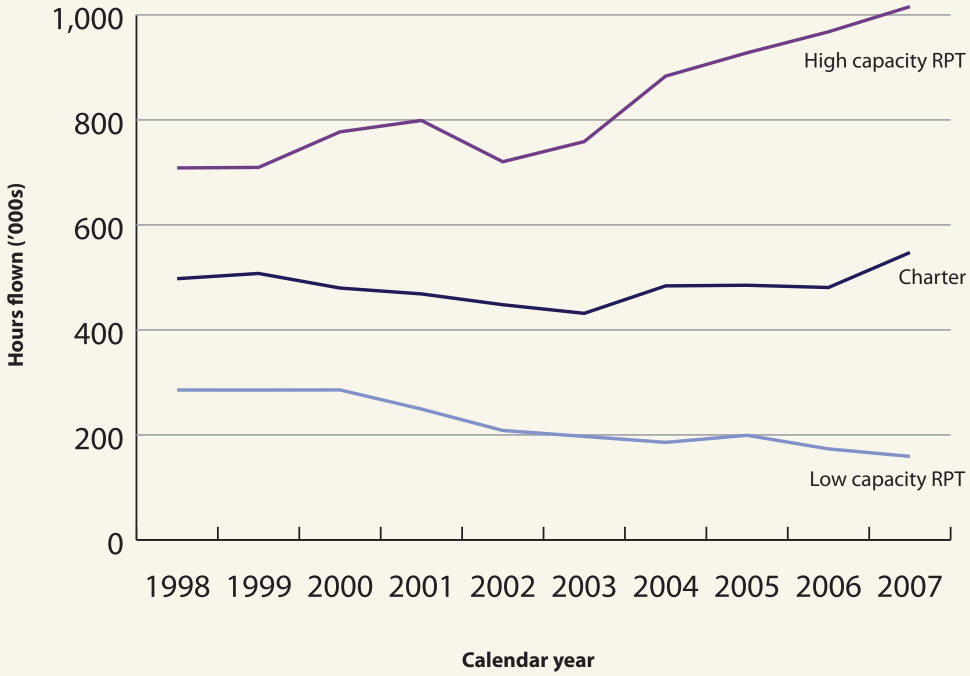
Source: BITRE

Flying activity in passenger transport has grown since 1998, but GA has decreased.

Passenger transport

Most flying activity in passenger transport was in high capacity RPT operations, making up 59 per cent of the total passenger transport hours flown (Figure 8).

Figure 8: Passenger transport hours flown, 1998 to 2007



Source: BITRE

- **High capacity RPT:** Between 1998 and 2007, high capacity RPT flying activity grew very strongly from 708,511 hours in 1998 to 1,015,730 hours in 2007. A slight decrease in growth occurred in 2001 due to the demise of Ansett Australia, however, the growth in Qantas domestic operations and the entrance of new operators such as Virgin Blue and Jetstar allowed a quick return to positive growth. This growth is expected to continue following the introduction and expansion of Tiger Airways Australia and V Australia.
- **Low capacity RPT:** Flying activity in low capacity RPT has remained relatively stable, with the highest number of hours flown recorded in 2000 (285,667 hours). Since this time the trend has been downwards. In 2007, there were 159,089 hours flown in low capacity RPT operations, a decrease of eight per cent from 2006. This trend is set to continue following the recent cessation of services by Queensland regional airline Macair and global economic pressures reducing the financial viability of some lower capacity routes.
- **Charter:** Non-scheduled transport operations[7] have experienced variable activity over the past decade. Prior to 1999, charter activity was on the rise. Between 2000 and 2003, this trend changed, with activity falling to its lowest point in 2003 at 431,552 hours flown. Since 2003, charter activity has increased, reaching 480,756 hours flown in 2006 (Figure 8). A notable increase in charter hours was recorded in 2007, with 547,353 hours flown. This represents a 14 per cent increase from the previous year, and may be partly due to the resources boom in Queensland and Western Australia, where charter aircraft are used for transporting personnel and equipment to and from remote mining operations.

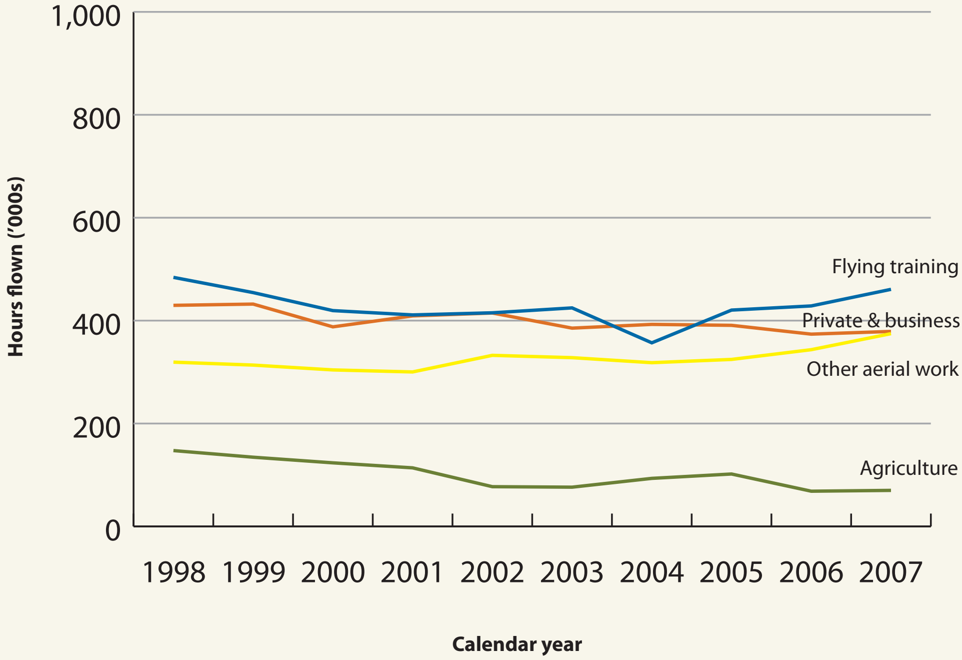
7 Flight hours for charter collected by the Bureau of Infrastructure, Transport and Regional Economics are not separated into passenger and freight operations. Hence, charter hours referenced in this report include both types of activities.

General aviation

In 2007, GA aircraft flew a total of 1,284,489 hours, which is about 450,000 hours less than passenger transport. This is significantly less than GA figures published in previous editions of the Review as charter (which generally made up most GA flying hours) has been included in passenger transport for this report.

General aviation hours flown have generally decreased since 1998, from a peak of 1.38 million in that year, to a minimum of 1.16 million in 2004. Since 2004, GA hours have grown by 11 per cent (Figure 9).

Figure 9: General aviation (GA) hours flown, 1998 to 2007



Source: BITRE

The majority of activity in the GA sector is split relatively evenly between flying training (36 per cent), private and business operations (30 per cent), and aerial work operations (29 per cent).

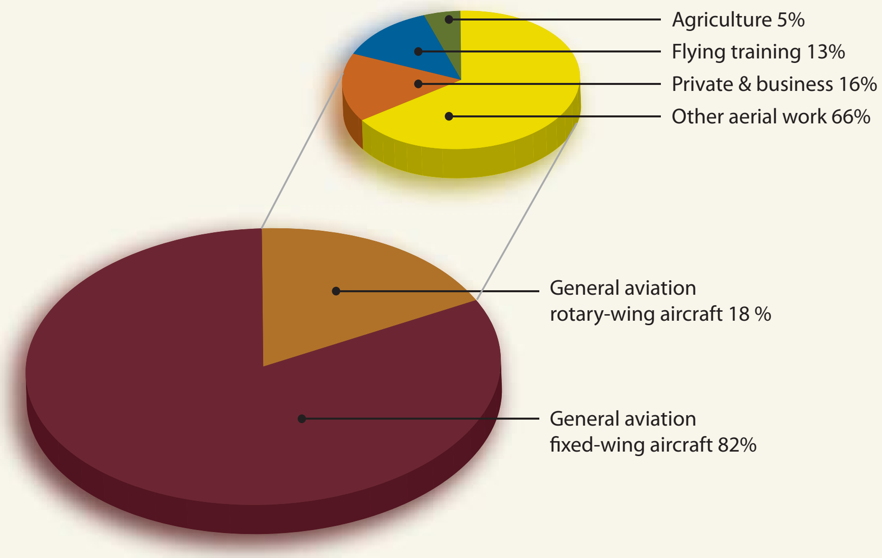
- **Flying training:** There has been variable activity in flying training over the last 10 years, peaking in 1998 at 484,049 hours, but dropping markedly in 2004 to 356,835 hours flown. Since 2004, flying training activity has grown consistently to reach 460,770 hours in 2007 (Figure 9).
- **Private and business:** The overall trend for private and business flying has been downward since 1998, decreasing to a low of 373,693 hours in 2006. This may be due to the increasing number of private pilots switching to non-VH registered sports and amateur-built aircraft. However, private and business hours increased slightly in 2007 to 378,975 hours (Figure 9).
- **Other aerial work:** This portion of the GA sector includes aircraft involved in activities such as aerial fire fighting, aerial ambulance, and search and rescue. Aerial work activity has grown since 2001, increasing from 300,253 to 374,681 hours flown in 2007 (Figure 9).
- **Agriculture:** Accounts for the smallest proportion of GA activities, however, continues to make a significant contribution to Australia’s agricultural industry through seeding, spraying and fertilising crops. Since 1998, hours flown in aerial agriculture have generally declined from a peak of 147,404 in that year to 70,063 hours in 2007. This is less than half as many hours as flown in 1998 (Figure 9). The decrease in aerial agriculture may be a consequence of higher fuel prices and decreased activity due to the prolonged drought in rural Australia.

Rotary-wing aircraft

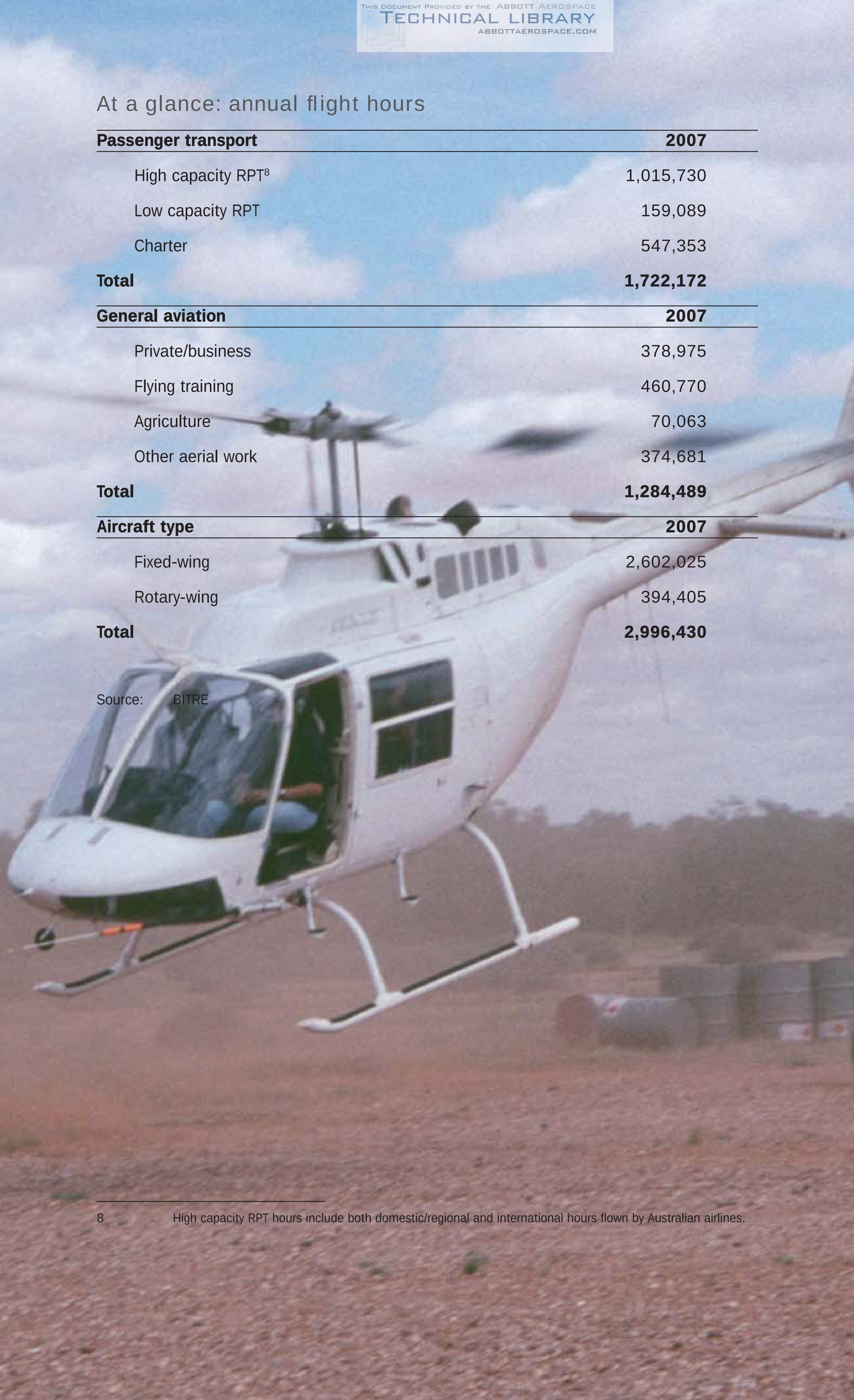
Fixed-wing aircraft (aeroplanes) and rotary-wing aircraft (helicopters) have different operational capabilities that lend themselves to different, but equally important functions in Australian aviation. For example, fixed-wing aircraft are typically used for carrying passengers, transporting cargo, and travelling long distances. Rotary-wing aircraft are optimised for use over shorter distances, for activities into confined spaces or that require significant manoeuvring, and for operations close to the ground such as surveying and photography, spotting, medical evacuation, search and rescue, and aerial mustering.

Rotary-wing aircraft make up approximately one-fifth of GA activity and five per cent of passenger transport activity in Australia. These proportions have been rising over the last 10 years – total rotary-wing flying activity between 2006 and 2007 grew 16 per cent to 394,405 hours. In passenger transport, all rotary-wing aircraft are currently involved in charter operations only. In GA, two-thirds of rotary-wing activity is in aerial work (Figure 10).

Figure 10: Rotary-wing hours flown in GA, 1998 to 2007



Source: BITRE



At a glance: annual flight hours

Passenger transport	2007
High capacity RPT[8]	1,015,730
Low capacity RPT	159,089
Charter	547,353
Total	**1,722,172**
General aviation	**2007**
Private/business	378,975
Flying training	460,770
Agriculture	70,063
Other aerial work	374,681
Total	**1,284,489**
Aircraft type	**2007**
Fixed-wing	2,602,025
Rotary-wing	394,405
Total	**2,996,430**

Source: BITRE

8 High capacity RPT hours include both domestic/regional and international hours flown by Australian airlines.

Aircraft movements

The number of takeoffs, landings and circuits undertaken at certain airports are collected by Airservices Australia. Commonly referred to as aircraft movements, this information provides a useful indicator of the density of traffic at Australia's major airports.

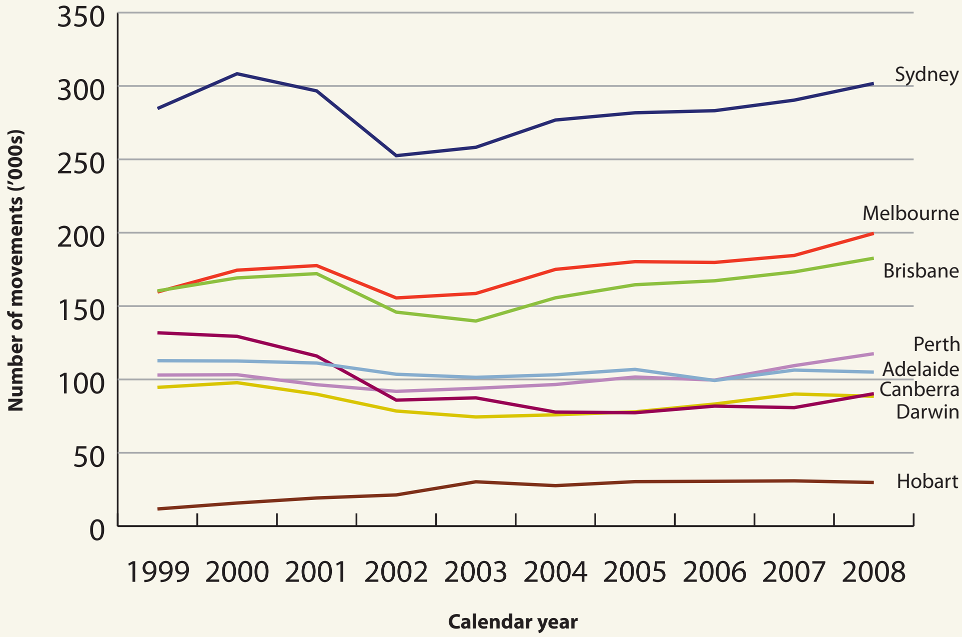
Of all the major and secondary capital city airports in Australia, Bankstown Airport in Sydney recorded the highest number of aircraft movements in 2007.

Australia's major capital city airports mostly cater for RPT operations. However, airports such as Perth also have a significant number of non-scheduled charter movements, particularly for transporting personnel to and from remote mines.

Of the major capital city airports, Sydney, Melbourne, and Brisbane have the greatest number of aircraft movements, collectively accounting for 61 per cent of all major capital city airport movements. Sydney remains the busiest airport, recording just over 300,000 movements in 2008. In 2007, Perth overtook Adelaide as the fourth busiest airport in Australia (Figure 11).

Movement figures have been generally stable or have increased slightly over the last 10 years at most major capital city airports, except for a dip in 2001 and 2002 that can be attributed to the cessation of Ansett Australia's domestic and international operations.

Figure 11: Australia's major capital city airports, aircraft movements, 1999 to 2007[9]



Source: Airservices Australia

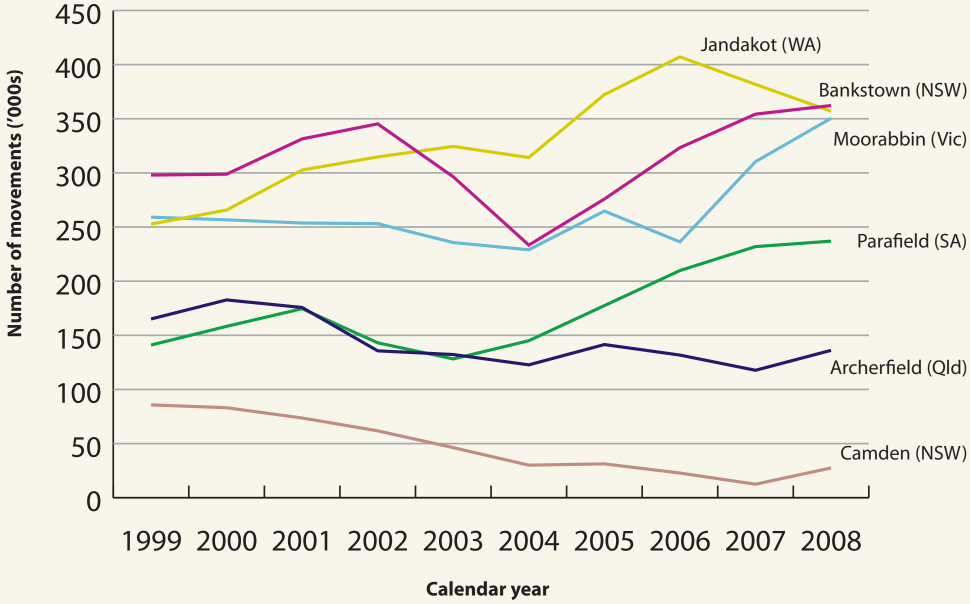
9 The number of aircraft movements may be underestimated as data is only recorded during hours of air traffic control tower operation.

Secondary capital city airports (also known as General Aviation Airport Procedures or GAAP airports) generally cater for some charter operations and high volumes of GA aircraft covering a broad range of flying activities.

In 2008, Bankstown once again overtook Jandakot as the busiest GAAP airport, and the busiest airport in Australia in terms of aircraft movements, recording 362,206 movements (Figure 12). This was followed by Jandakot, which recorded 356,920 movements and Moorabbin with 350,426 movements.

While the number of aircraft movements at most GAAP airports has increased markedly since 2004, some airports have shown slowed growth or a decrease in movements since 2007. In particular, activity at Jandakot has dropped considerably, with a 12 per cent decrease in movements since its peak of 407,148 in 2006. Activity at Archerfield and Camden airports was lower in 2008 than it was 10 years previously.

Figure 12: Secondary capital city (GAAP) airports, aircraft movements, 1999 to 2008



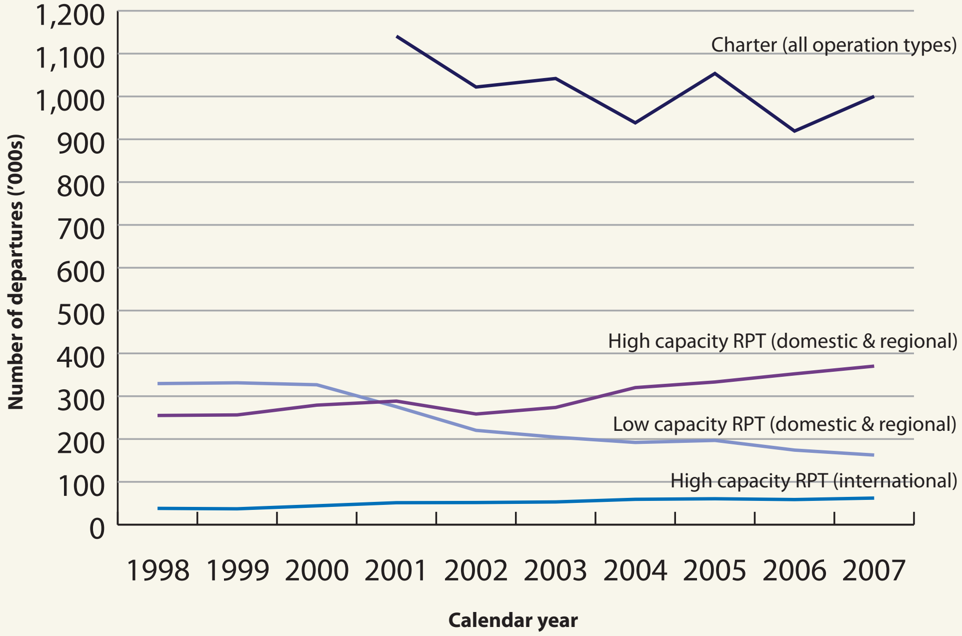
Source: Airservices Australia

Passenger transport departures

Charter operations have recorded substantially more departures than other forms of passenger transport in Australia since 2001.[10] This is to be somewhat expected, as charter is characterised by more flights of shorter distances. In 2007 for example, the average sector length in charter operations was 30 minutes, compared with one hour in low capacity RPT, and 2 hours 20 minutes in high capacity RPT operations.

International RPT services from Australia (including both Australian and overseas operators) have shown strong growth since 1999, rising from 38,042 departures in that year to 62,117 in 2008 (Figure 13). Since 2001, high capacity RPT services have replaced low capacity RPT services as the primary form of domestic scheduled passenger transport. This could be attributed to major and regional airlines employing larger aircraft on regional routes, such as the Bombardier Q400, as well as the growth in domestic air travel caused by the expansion of Jetstar and Virgin Blue.

Figure 13: Passenger transport aircraft departures by operation type, 1998 to 2007



Source: BITRE

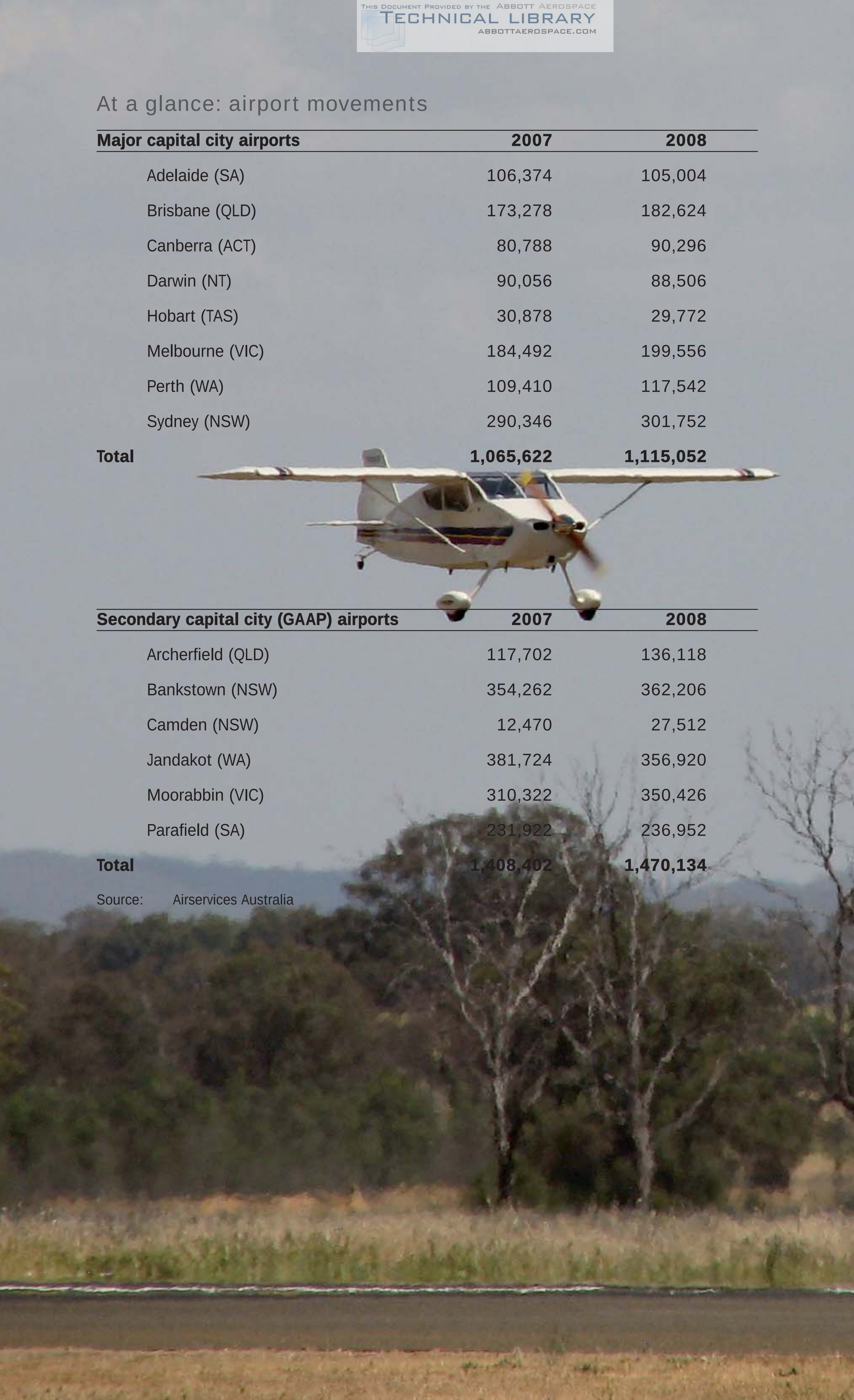
10 Departure data for charter operations is not available prior to 2001.

At a glance: airport movements

Major capital city airports	2007	2008
Adelaide (SA)	106,374	105,004
Brisbane (QLD)	173,278	182,624
Canberra (ACT)	80,788	90,296
Darwin (NT)	90,056	88,506
Hobart (TAS)	30,878	29,772
Melbourne (VIC)	184,492	199,556
Perth (WA)	109,410	117,542
Sydney (NSW)	290,346	301,752
Total	**1,065,622**	**1,115,052**

Secondary capital city (GAAP) airports	2007	2008
Archerfield (QLD)	117,702	136,118
Bankstown (NSW)	354,262	362,206
Camden (NSW)	12,470	27,512
Jandakot (WA)	381,724	356,920
Moorabbin (VIC)	310,322	350,426
Parafield (SA)	231,922	236,952
Total	**1,408,402**	**1,470,134**

Source: Airservices Australia



Aircraft age

The average age of aircraft on the Australian civil register varies considerably between the major airlines (domestic and international), and the GA/regional fleet.

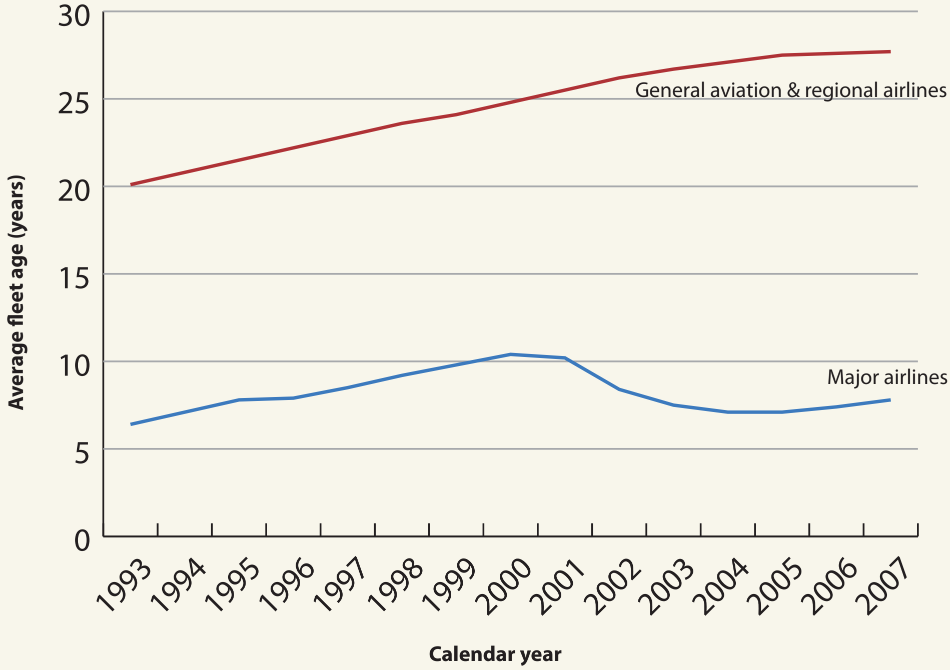
Major Australian airlines

Looking at the last 15 years (1993 to 2007), the average age of aircraft operating with major Australian airlines rose steadily from six to 10 years until the collapse of Ansett Australia in 2001. This event led to the forced retirement of the Ansett fleet, which included many older aircraft types such as the Boeing 767 200 and the BAe 146. After this period, Qantas and new entrants Virgin Blue and Jetstar and were introducing more modern aircraft types such as the Boeing 737 800 and Airbus A320. As of 2007, aircraft operating with major Australian airlines were 7.8 years old on average (Figure 14). The recent introduction of Embraer E-Jets, Boeing 777 and Airbus A380 aircraft onto the Australian register is likely to cause further decreases to the average aircraft age, as will any future deliveries of new-generation aircraft such as the Boeing 787 and Airbus A350 to Australian airlines.

General aviation and regional airlines

Compared with the major Australian airlines, the average age of GA and regional airline aircraft in Australia has steadily risen over the last 15 years, from 20 years in 1993 to 28 years in 2007 (Figure 14). This reflects the combined age of turboprop aircraft operating with regional airlines, and piston-engined aircraft, which make up the majority of the GA sector.

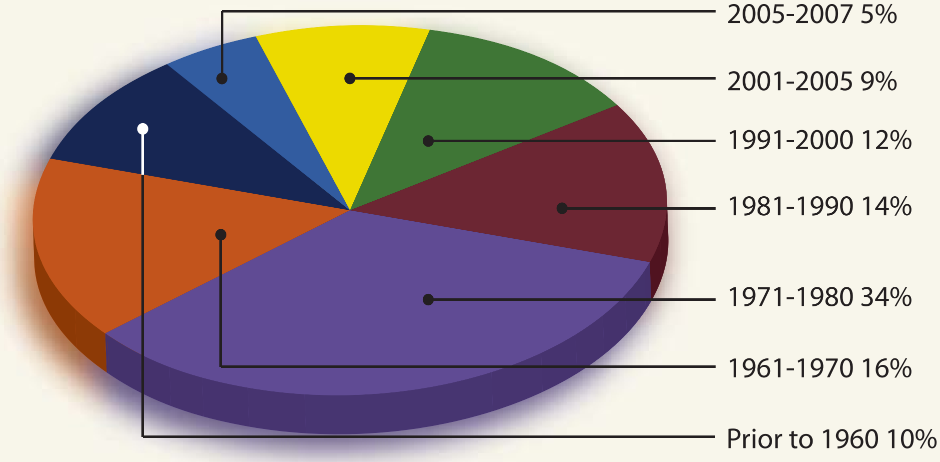
Figure 14: Average age of aircraft on the Australian civil register, 1993 to 2007



Source: BITRE

Approximately three-quarters of all aircraft on the register at December 2007 were built prior to 1990 (Figure 15). As average aircraft age trends show that a majority of large aeroplanes are less than 10 years old, the remaining aircraft on the register (mostly GA aircraft) are likely to have been built prior to 1990 and are at least 20 years old.

Figure 15: Proportion of aircraft on the Australian civil register by year of manufacture, at 31 December 2007



Source: CASA

Regional aircraft ages are also on the rise, particularly in the 10 to 19-seat category. In this category, demand for used aircraft remains strong as airlines find it difficult to source replacement aircraft with few new types being produced. However, the average age of the GA/regional fleet has been static since 2005. For regional aviation, this may be due to a reduction in operating aircraft as some routes are discontinued by airlines, or the result of new regional jets supplementing turboprop aircraft on some higher-traffic regional routes. For GA, this may reflect the growth of amateur-built experimental aircraft and the shift from private operations to sport aviation, as well as increased imports of newer production Cessna and Piper aircraft since the recovery of the GA aircraft manufacturing industry in the United States (following the introduction of the General Aviation Revitalization Act in 1994).


1
2
3

How many licensed pilots and engineers are in Australia?

Pilot licences

The Civil Aviation Safety Authority is responsible for issuing flight crew licences to pilots intending to fly VH-registered powered aircraft. The issuing of a private, commercial or airline transport licence to a pilot indicates that the holder has achieved a required level of training, skill and knowledge. The following are the varying types of licences that can be obtained by pilots wanting to operate fixed-wing or rotary-wing aircraft[11].

- **Student pilot licence (SPL):** The student licence is a permit to learn to fly. Student pilots can fly with a qualified instructor, or can conduct limited solo flights within their local training area to consolidate their learning. After completing further training and passing the general flying progress test (GFPT) theoretical exam, a student pilot is allowed to act as pilot in command carrying passengers within the local training area, but not for hire or reward. This licence is known as a SPLPAX/SPLPAXH[12].
- **Private pilot licence (PPL/PP(H)L):** Private pilots may fly themselves or passengers anywhere in Australia for recreational purposes. A special category of private licence, SPECPL, allows foreign pilots who hold a current overseas private or higher class of licence to undertake private operations in Australia on a short-term basis.
- **Commercial pilot licence (CPL/CP(H)L):** Commercial pilots are authorised to fly as pilot in command of a single pilot aircraft engaged in any operation and of a multi-crew aircraft engaged in private or aerial work, or as a co-pilot of a multi-crew aircraft in any operation.
- **Air transport pilot licence (ATPL/ATP(H)L):** Air transport pilots may fly an aircraft as pilot in command or co-pilot in any operation, including a large airline type aircraft.

In December 2007, there were 33,626 people in Australia holding a current pilot's licence, including student pilots. The most common licence type was the PPL, accounting for almost half of all licences. Airline transport and commercial licences were the next most common, accounting for around 8,000 licences each.[13]

Collectively, 49 per cent of licence holders are allowed to fly in a commercial capacity for hire or reward (ATPL, ATP(H)L, CPL, CP(H)L), while the remaining 51 per cent fly for recreational purposes (PPL, SPECPL, PP(H)L, SPECPLH) or are learning to fly (SPLPAX, SPLPAXH).

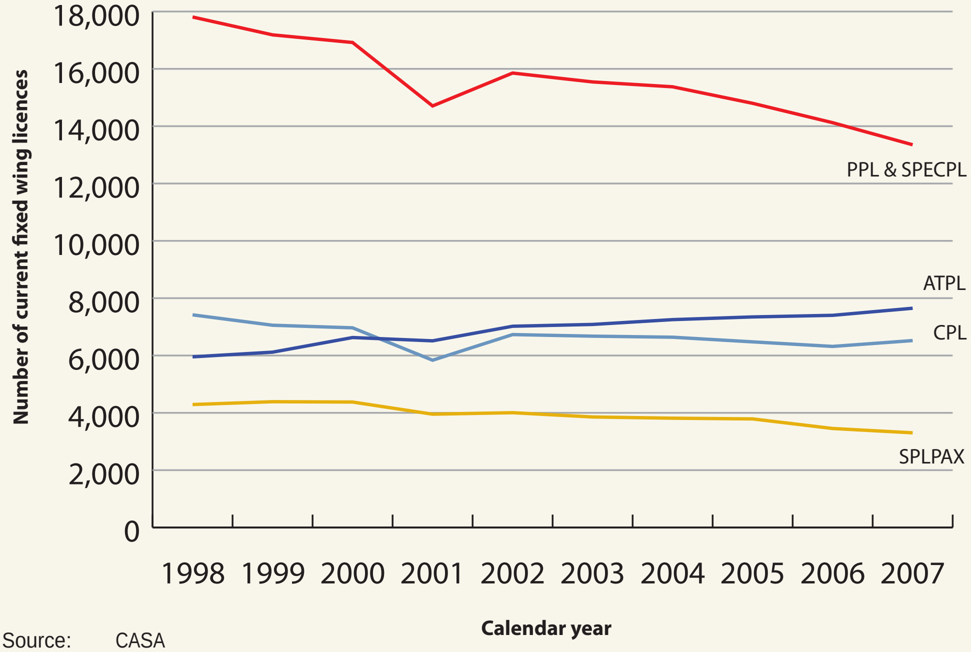
Over the last 10 years, with the exception of the ATPL, there has been a decline in the number of fixed-wing pilot licences held, particularly PPL and SPLPAX licences. Since 1998, total fixed-wing licences have fallen from 35,472 to 30,825 in 2007 (Figure 16). On the other hand, there has been growth in the number of pilots flying rotary-wing aircraft. Commercial helicopter licences, CP(H)Ls, have risen from 1,236 in 1998 to almost 1,600 in 2007 (Figure 17).

11 Helicopter pilot licences are annotated by the letter 'H', e.g. CP(H)L.

12 SPLPAX are the only student licences included in this report, as CASA does not hold reliable data for SPL licence numbers prior to 2004.

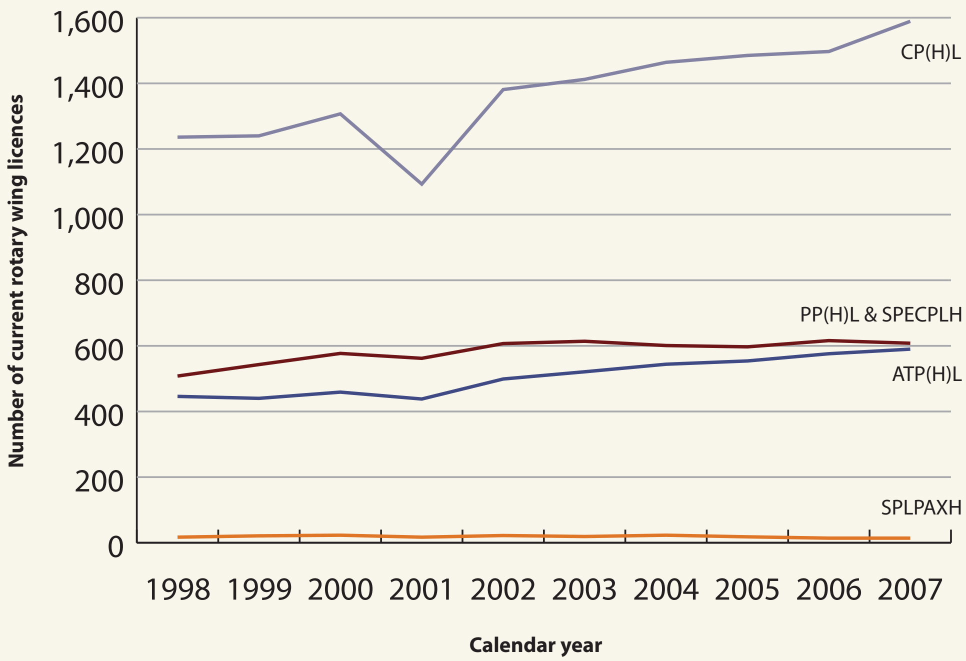
13 This data refers only to the highest category of licence held.

Figure 16: **Current fixed-wing pilot licences, 1998 to 2007**



Source: CASA

Figure 17: **Current rotary-wing pilot licences, 1998 to 2007**

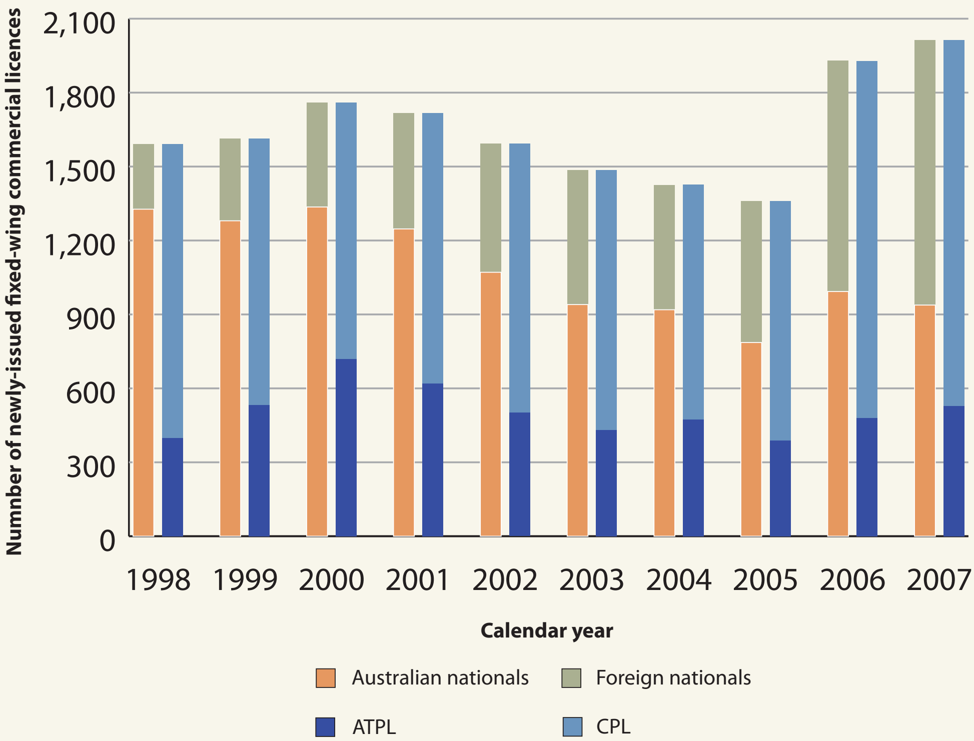


Source: CASA

From 2000 to 2005, Australia experienced a decline in the number of new pilots across all licence types except ATPL. However, since 2005, growth has occurred in the number of newly issued pilot licenses in both fixed-wing and rotary-wing aircraft (Figure 16 and Figure 17). The number of newly issued CPLs reached a peak for the 10-year period of 1,484 in 2007, an increase of 56 per cent on its low of 952 licences in 2004.

The increase in newly issued CPLs may be partly attributed to the growth of training schemes and centres in Australia for training foreign pilots, either to PPL or CPL status (Figure 18 and Figure 19). The increase may also foreshadow the recent introduction of cadet pilot schemes in a number of airlines, which seek to address the shortage of trained pilots available for passenger transport services. In recent times, some airlines have been suspending flights as a consequence of flight crew shortages. Cadet pilot schemes train people to become commercial pilots who then fly for that airline. It is expected that over the next couple of years, the number of CPLs issued will continue to increase as a result of these initiatives.

Figure 18: Commercial fixed-wing licences: proportion of newly-issued ATPL/CPL licences by type and holder nationality, 1998 to 2007



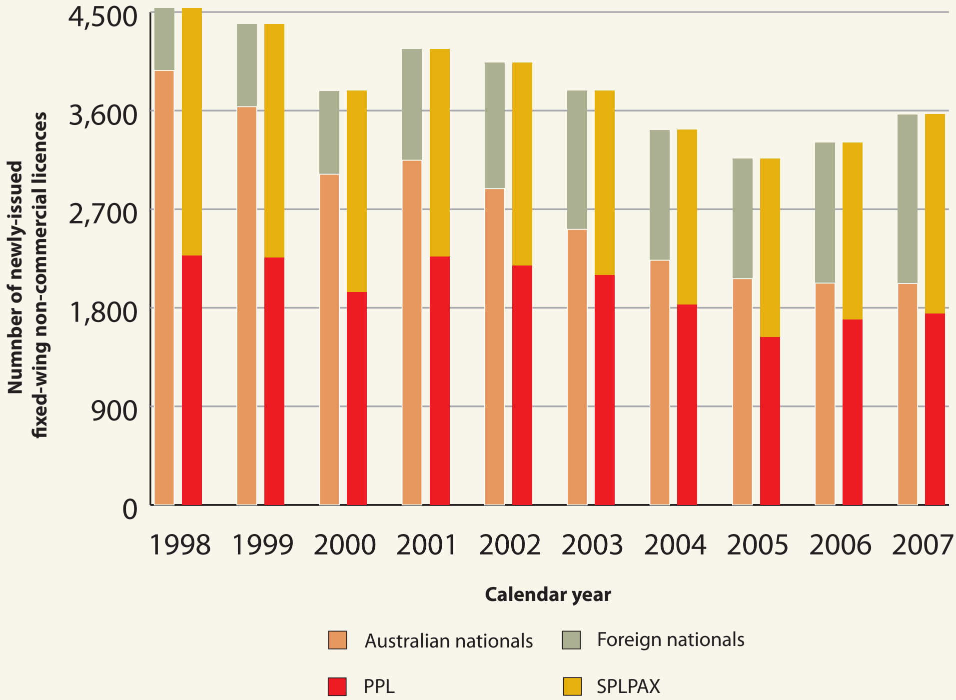
Source: CASA

Aircraft maintenance engineer licences and ratings

Aircraft maintenance personnel maintain a whole range of aircraft and their components, from simple piston engines to complex, state of the art microprocessor controlled jet aircraft; from classic wood and fabric structures to those made from advanced composites and complex metal alloys. Aircraft electrical systems also range from basic technologies like those found in cars through to large scale generation and distribution systems with enough capacity to power a small town. Aircraft flight management systems, navigation and communication systems embrace advanced microprocessor, satellite and laser technology and a career in maintaining these systems can offer far more challenge and diversity than the servicing of ground based devices.

Source: CASA. (2007). Engineer careers: Aircraft maintenance licences & ratings. Canberra: Civil Aviation Safety Authority, p. 8.

Figure 19: **Non-commercial fixed-wing licences: proportion of newly-issued PPL/SPLPAX licences by type and holder nationality, 1998 to 2007**



Source: CASA

At a glance: pilot licences

By licence type	2007
Air transport	8,239
Commercial	8,110
Private	13,960
Student	3,317
Total	**33,626**

By aircraft type	2007
Fixed-wing	30,825
Rotary-wing	2,801

Less LAME licences are being issued today than 10 years ago.

Aircraft maintenance engineer licences

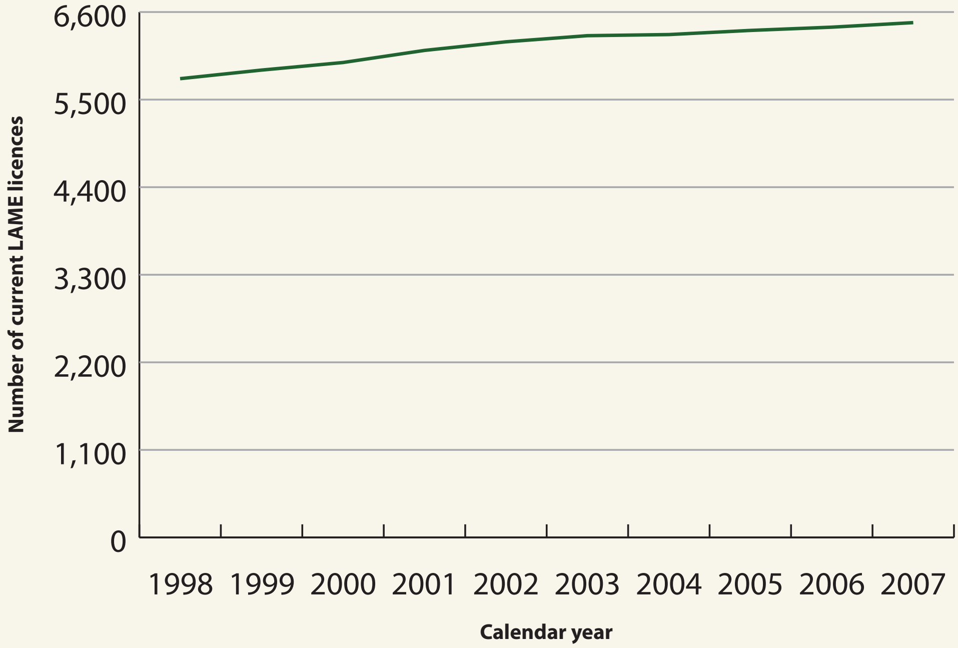
Aircraft maintenance engineers (AMEs) are responsible for maintaining and servicing the aircraft as well as its engines and systems. Certification of AMEs is a responsibility of CASA, who allow engineers to be licensed to conduct maintenance on one or more of five areas of the aircraft:

- airframe
- engines
- electrical
- instruments
- radio.

After an AME has accumulated four years experience and passed the theoretical exams administered by CASA, he or she can apply to become a licensed aircraft maintenance engineer (LAME).

The number of current LAME licences has increased slowly since 1998, from 5,763 in that year to 6,467 in 2007 (Figure 20). Since 2006, the number of LAMEs has grown by less than one per cent.

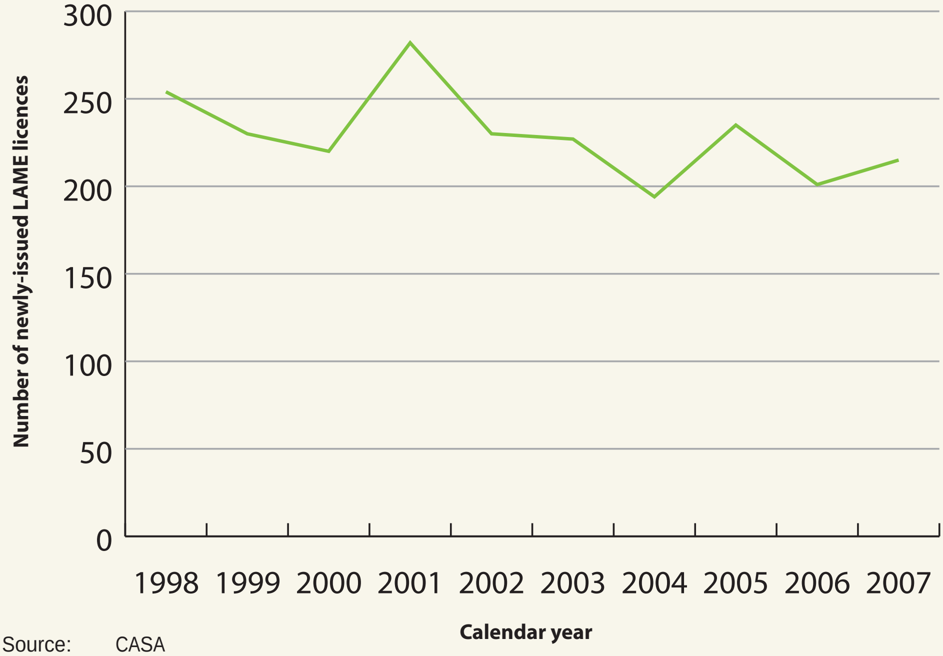
Figure 20: Current LAME licences, 1998 to 2007



Source: CASA

Less LAME licences are being issued today than 10 years ago. In 1998, 254 new LAME licences were issued. This peaked in 2001 at 282, but has decreased to 215 licences issued in 2007 (Figure 21).

Figure 21: Newly issued LAME licences, 1998 to 2007



Source: CASA

The skills shortage in the aviation industry is not limited to pilots. For a number of years there has also been a shortage of qualified AMEs. The shortfall in LAMEs is expected to continue as aircraft fleet sizes increase in response to the demand for air transport services, and as the average aircraft age rises, in particular, for the GA aircraft fleet.

In an effort to encourage people to take up a career as a LAME, CASA offers a scholarship program that provides financial support for the payment of tools, textbooks, travel and accommodation to attend full-time theory training. Details of the CASA LAME scholarship program can be found at <www.casa.gov.au/ame/engschol.htm>.

Furthermore, since July 2007, both the AME (avionics) and AME (mechanical) trades have been on the National Skills Needs List. This means that apprentices in these trades are eligible for a range of Australian Government incentives, including a $2,000 apprentice wage top-up, an $800 tool kit, and a $13,000 wage subsidy for apprentices aged over 30 years. Details of this Australian Government program can be found at <www.toolsforyourtrade.com.au>.

At a glance: Aircraft maintenance engineer licences

Number issued

	2007
Current	6,467
Newly issued	215
Ratings	

Ratings

Licence type	**2007**
Mechanical	
Airframes	4,915
Engines	4,525
Total LAMEs holding Mechanical licences	*5,079*
Avionics	
Electrical	1,669
Instruments	1,614
Radio	1,185
Total LAMEs holding Avionics licences	*1,814*
Total LAMEs holding both Mechanical and Avionics licences	*1,789*
Total LAMEs	**6,467**

Source: CASA

Since 1998, the number of ultralight and light sport aircraft registered with RA-Aus has almost doubled.

Sport aviation

Sport aircraft types

The Civil Aviation Safety Authority is responsible for the regulation of sports aviation; however, the administration of many sport and recreational flying activities has been delegated to aircraft associations, many of which issue their own pilot certificates and ratings. Sport aircraft may be registered either on the Australian civil VH- register, or on the register of recreational aircraft maintained by Recreational Aviation Australia (RA-Aus).

While there are several different types of sport aircraft, this report examines just a few types: ultralight and light sport aircraft, gliders, gyroplanes, hang gliders and balloons. These types of sport aircraft usually tend to have more readily available statistical data.

- **Ultralights and light sport aircraft:** Ultralights and light sport aircraft are small fixed-wing aircraft that may be registered with RA-Aus. The authority for pilot and maintenance licensing of ultralight and light sport aircraft is also delegated to RA-Aus. Aircraft registered with RA-Aus are not permitted to have a MTOW greater than 544 kg (or 614 kg for seaplanes). Ultralight and light sport aircraft are emerging as a viable alternative to VH-registered GA aircraft, which has led to a thriving aircraft manufacturing industry in Australia.

- **Gliders:** Gliders use air currents and thermal energy in the atmosphere to stay aloft. While most gliders must be launched with the assistance of other devices such as being towed by other aircraft or launched by a winch, some types of glider are capable of self-launching using small engines. Gliders are regulated by the Gliding Federation of Australia (GFA).

- **Gyroplanes:** Gyroplanes are aircraft that use a freely turning rotary wing to provide lift, and an engine-driven propeller to provide thrust. Most modern gyroplanes use a pusher propeller and are light and manoeuvrable. The Australian Sport Rotorcraft Association (ASRA) is responsible for administering gyroplane registrations and licensing.

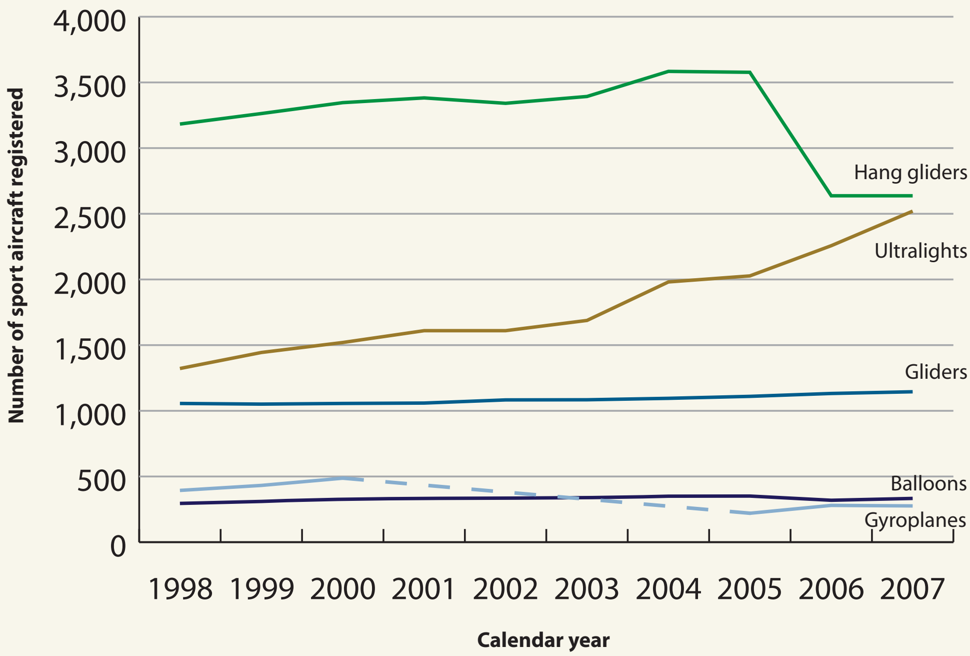
- **Hang gliders:** Hang gliders consist mainly of a fabric-covered aluminium wing-frame with the pilot attached below by a harness, with directional control provided by the pilot shifting his or her weight. The Hang Gliding Federation of Australia (HGFA) is responsible for maintaining aircraft registrations as well as pilot licences. Some hang gliders are also equipped with a light-weight engine, and are known as microlights or trikes.

- **Balloons:** Balloons rely on either gas or hot air to produce lift and maintain altitude and are subject to prevailing wind for travel. Ballooning for recreational or training purposes is administered by the Australian Ballooning Federation (ABF), while ballooning for commercial purposes is administered by CASA.

Sport aircraft registrations, 1998 to 2007

Hang gliders (including paragliders and microlights) are the most common sporting aircraft. However, there was a sudden decline in hang glider registrations from 3,577 in 2005 to 2,637 in 2007. Since 1998, the number of ultralight and light sport aircraft registered with RA-Aus has almost doubled from 1,322 in that year to 2,520 in 2007. As a result, ultralight and light sport aircraft (36 per cent) now make up a similar proportion of all sport aircraft registrations as hang gliders (38 per cent). This change may reflect a possible shift from people flying hang gliders, paragliders and microlights towards ultralights and light sport aircraft (Figure 22).

Figure 22: Registered sport aircraft by type, 1998 to 2007[14]



Source: CASA

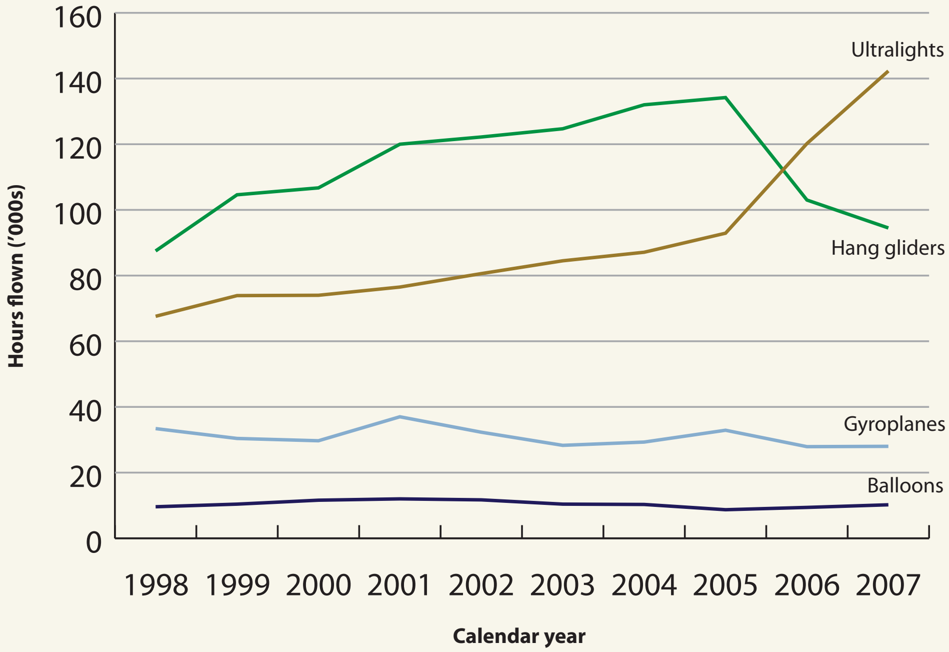
14 Registration data for gyroplanes was not available between 2000 and 2005.

Sport aircraft hours flown, 1998 to 2007

From 1998 to 2005, hang gliders recorded the most activity in terms of annual hours flown. Since 2006, ultralights and light sport aircraft have overtaken hang gliders to have the largest number of flying hours (Figure 23). This is likely due to the growth in the number of ultralight and light sport aircraft on the register over the last few years, and the subsequent decrease in the number of registered hang gliders.

Hours flown data for balloons and gyroplanes indicate that activity in these aircraft types was generally steady over the last 10 years.

Figure 23: Hours flown by registered sport aircraft by type, 1998 to 2007[15]



Source: BITRE

15 Reliable activity data for gliders was not available over the 1998 to 2007 period.

Amateur-built aircraft

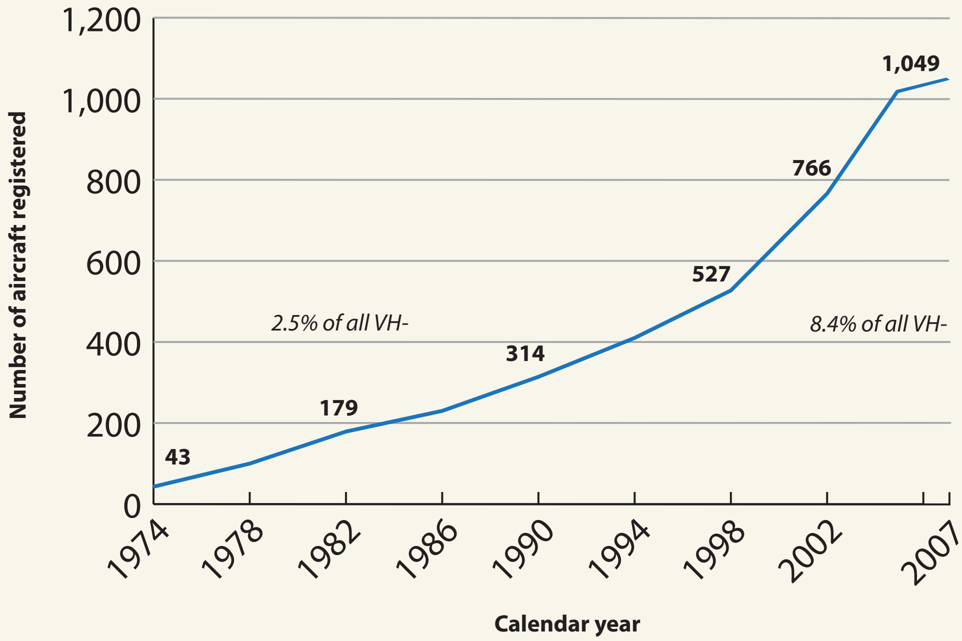
Amateur-built aircraft can be referred to in many different ways: home-built aircraft, kit planes, amateur, experimental, plans-built, ultralight, and non factory-built aircraft.

An amateur-built aircraft is defined to be an aircraft of which the majority (at least 51 per cent) has been constructed by an individual builder. An amateur-built experimental aircraft is not limited by the normal requirements of a certified aircraft, and has been appropriately certified by CASA with a special certificate of airworthiness and an experimental certificate.

In Australia, amateur-built and amateur-built experimental aircraft can either be VH-registered aircraft or registered as recreational aircraft through RA-Aus. Data here is only provided for VH-registered amateur and experimental aircraft.

Amateur-built aircraft are rapidly growing in popularity as private pilots look towards cheaper, but equally reliable and high-quality alternatives to traditional GA aircraft (Figure 24).

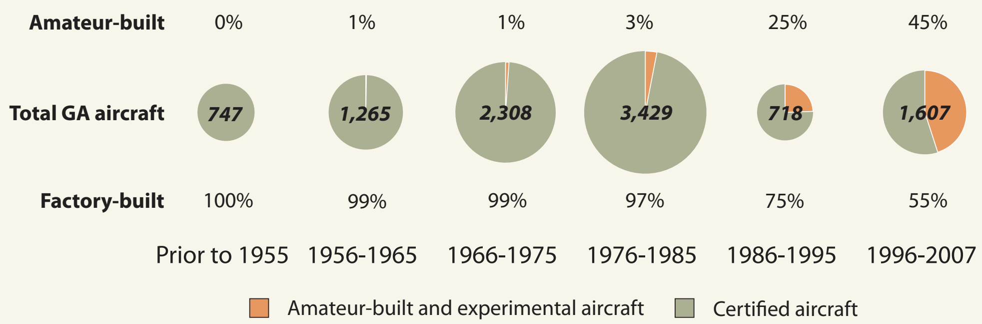
Figure 24: Growth of VH- registered amateur-built aircraft



While most GA aircraft on the register are over 20 years old, most amateur-built and experimental aircraft were constructed after 1995 (Figure 25). At 31 December 2007, amateur-built and experimental aircraft on the Australian civil register numbered 1,044 (almost 10 per cent of all VH-registered aircraft[16]).

16 Excludes VH-registered sport aircraft, such as balloons and gliders.

Figure 25: **Certified and amateur-built/experimental GA aircraft on the Australian civil register at 31 December 2007, by year of manufacture**



Source: CASA

At a glance: Common amateur-built and experimental aircraft on the Australian civil register, by kit or plans manufacturer, as at October 2008

Type	Number registered
Vans	322
Jabiru	63
Glasair	62
Rotorway	56
Neico/Lancair	48

Source: CASA

The ATSB's highest priority in investigating occurrences is commercial passenger-carrying operations.

Chapter 2

Aviation accidents, incidents, fatal accidents and fatalities

The ATSB accident and incident database

The Australian Transport Safety Bureau (ATSB) is Australia's prime agency for the independent investigation of civil aviation accidents, incidents and safety issues. It does so in accordance with Annex 13 to the Convention on International Civil Aviation, commonly known as the Chicago Convention 1944. Annex 13 has legal force in Australia through the *Transport Safety Investigation Act 2003* (the TSI Act), which applies to all investigations commenced on or after 1 July 2003. Annex 13 was also incorporated into the now repealed Part 2A of the *Air Navigation Act 1920*, which applied to all investigations commenced on and before 30 June 2003.

The TSI Act contains provisions for the mandatory reporting of occurrences that are classified as either Immediately Reportable Matters (accidents and serious incidents) or Routine Reportable Matters (incidents). It is from these reports that the ATSB makes a decision on whether or not to investigate. The decision is based on factors such as safety value to be obtained from the investigation and where resources may best be targeted. In accordance with the Australian Government's aviation safety priority, the ATSB's highest priority in investigating occurrences is commercial passenger-carrying operations.

All reported occurrences that meet defined criteria are entered into the ATSB database. The reliability of the database is therefore dependent on the industry's compliance with the mandatory reporting requirements.

General accident and incident trends

This section sets out the number of accidents and incidents (the total number of occurrences), fatal accidents, and fatalities for the 10-year period 1998 to 2007 involving VH-registered aircraft, and foreign registered aircraft operating within Australia. Data is drawn from the ATSB's aviation safety occurrence database. However, the number of accidents and incidents alone does not represent a complete picture of trends in aviation safety. In order for the data to be properly interpreted and for meaningful comparisons to


COCKPIT
VOICE
RECORDER
FLIGHT

be made, it is necessary to calculate occurrence rates. This is calculated as the number of accidents and incidents in a given period divided by the number of hours flown in that category of operation. The accident, incident, fatal accident and fatality rates are normally calculated per 100,000 hours flown.

Of the 7,701 aviation safety occurrences recorded in the ATSB's database in 2007, the vast majority were classified as incidents (98 per cent).

Since 1998, there has been a general upwards trend in the number of safety incidents recorded (Figure 26). When taking into account the amount of flying activity in each operation type (hours flown), an increase in the rate of safety incidents was also visible. For example, the rate of incidents reported across all operation types increased from 159 per 100,000 hours flown in 1998 to 283 in 2007. It is unlikely that this increase in reports represents a decrease in aviation safety. This is supported by the consistently declining accident rate in both passenger transport and GA operations over the last 10 years (Figure 27). The large increase in the number of reported incidents is likely to be due to improved awareness of aviation safety issues, clearer guidelines and legislation on what constitutes a reportable matter (with the introduction of the *Transport Safety Investigation Regulations 2003*), and a greater willingness by the aviation industry to report safety incidents.

Figure 26: Incidents by operation type, 1998 to 2007

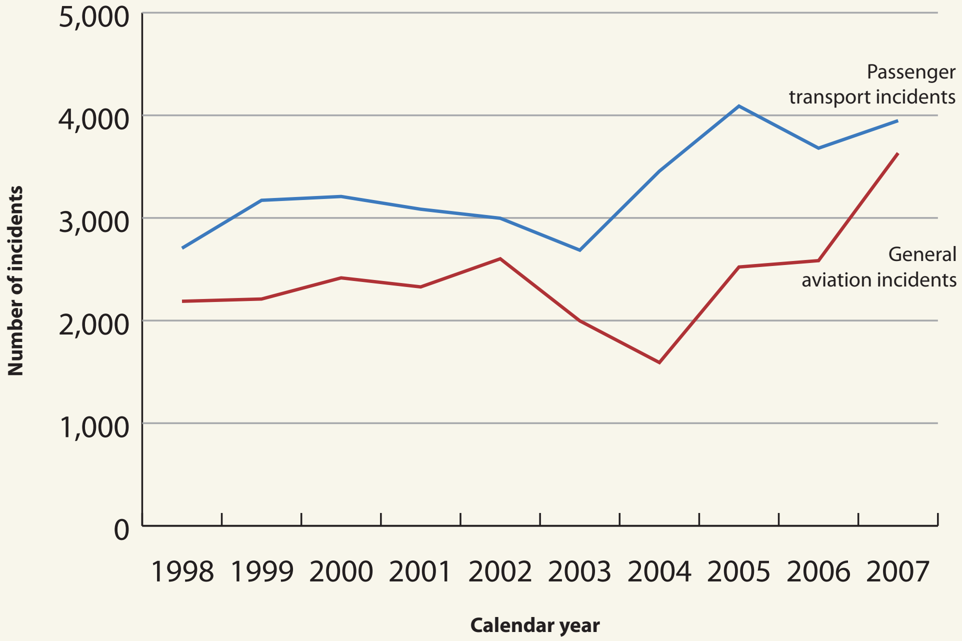
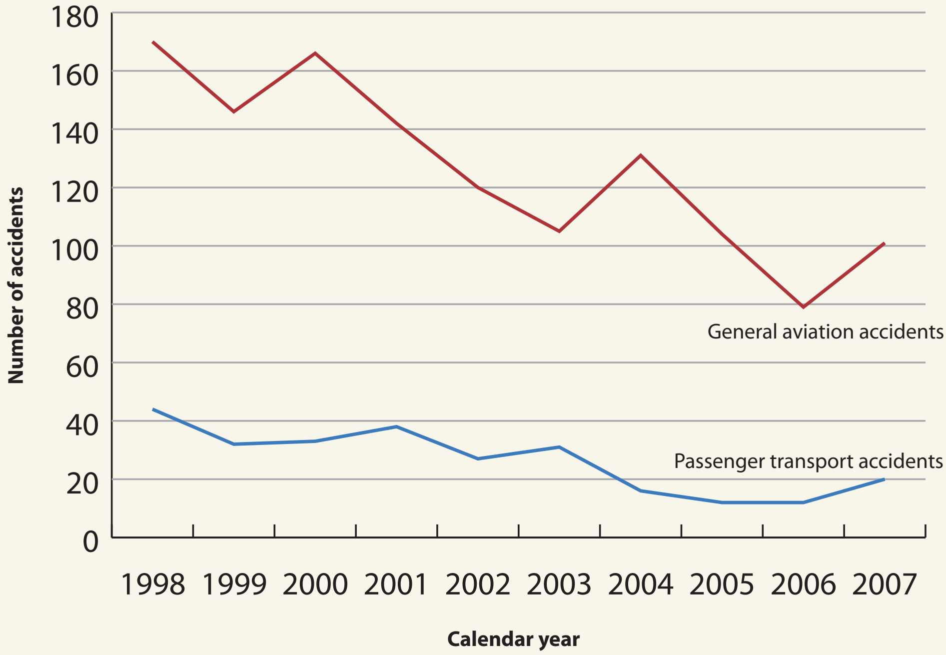


Figure 27: Accidents by operation type, 1998 to 2007



Safety occurrences are classified as accidents when aircraft occupants receive serious or fatal injuries and/or the aircraft incurs substantial damage or is destroyed. This means that an accident may not always involve an aircraft 'crashing' or the people on board being injured. For example, if a passenger accidentally falls from an open door of an aircraft and breaks a leg, it is classified as an accident. Similarly, if a catering truck runs into an aircraft while a pilot is on board and the aircraft suffers substantial damage, it is also classified as an accident, even if no-one is injured. For a complete definition of 'accident', please refer to the Glossary.

Accident statistics

Passenger transport accidents, 1998 to 2007

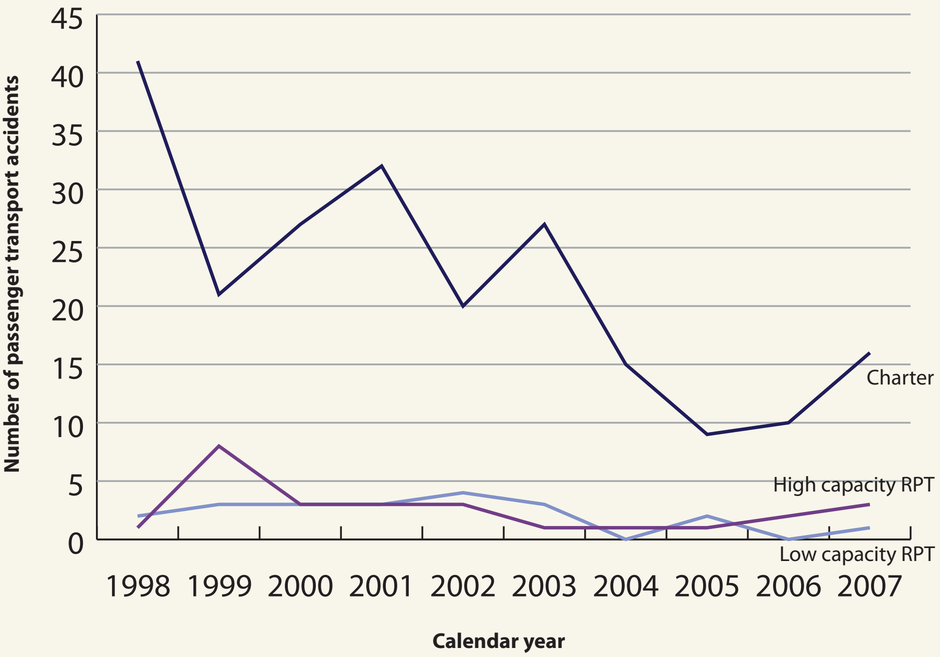
Passenger transport accident, fatal accident and serious injury statistics, 1998 to 2007

Between 1998 and 2007, there were 265 accidents in passenger transport operations (Figure 28 and Figure 29). Of these:

- 26 occurred in high capacity regular public transport (RPT) operations (0.8 accidents per 100,000 sectors flown);
- 21 occurred in low capacity RPT operations (0.8 accidents per 100,000 sectors flown); and
- 218 occurred in charter operations (1.8 accidents per 100,000 sectors flown).

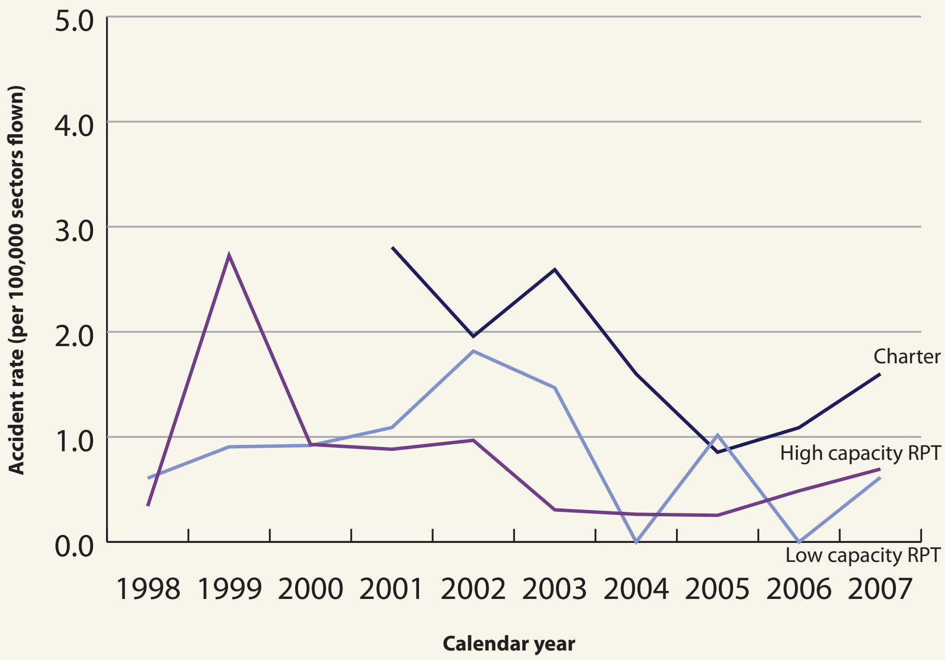
A short summary of a number of the accidents is provided below.

Figure 28: Passenger transport accidents, 1998 to 2007



While the number of accidents in charter operations is higher than for regular public transport operations, sector times for charter flights are significantly shorter (30 minutes, compared to 60 minutes for low capacity RPT and 140 minutes for high capacity RPT) and hence there are a lot more movements involving charter aircraft. A rate comparison based on accidents per sector flown provides a more real picture of the number of accidents in passenger transport operations (Figure 29).

Figure 29: **Passenger transport accident rate per 100,000 sectors flown, 1998 to 2007[17]**

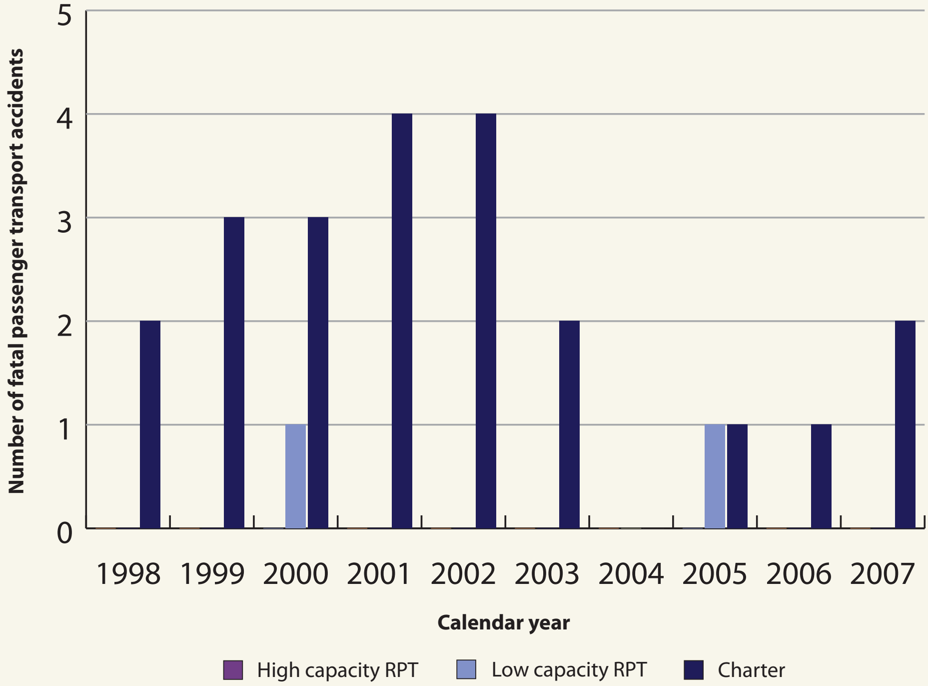


Between 1998 and 2007, charter operations recorded the highest number of fatal passenger transport accidents, with 22 fatal charter accidents resulting in 65 fatalities. Over the same period, there have only been two fatal RPT accidents, both involving low-capacity aircraft. Unfortunately, these two accidents resulted in 23 fatalities (Figure 30).

In May 2005, a Fairchild Metroliner aircraft impacted terrain during an approach to Lockhart River aerodrome in far north Queensland. This accident claimed the lives of all 13 passengers and two crew. This was Australia's worst civil air accident since the loss of a Vickers Viscount in 1968, which claimed 26 lives. In 2000, eight people were fatally injured when a Piper Chieftain aircraft ditched off the South Australian coast after both engines failed over water at night.

17 Sector data for charter operations was not available prior to 2001.

Figure 30: Fatal passenger transport accidents, 1998 to 2007



Serious injuries to crew members and passengers in passenger transport operations remained low in both high capacity RPT (average of one serious injury per year) and charter (average of two serious injuries per year) over the 10 year period. Most serious injuries occurred as the result of an aircraft impact with terrain or during evacuations. No serious injuries occurred in accidents involving low capacity RPT operations between 1998 and 2007.

High capacity RPT accidents

The high capacity RPT accidents included:

- The mechanical failure of nose landing gear actuator and linkage components (a Boeing 737-300 in 1999, and a Fokker F100 in 1999).
- Hail damage to a Boeing 767-200 just prior to takeoff, causing substantial damage to the wing surfaces and engine cowlings (1999).
- A Boeing 747-200B aircraft engine striking the ground during the landing flare in crosswinds (1999).
- A runway overrun of a Boeing 747-400 aircraft on landing in poor weather conditions (1999).
- Collision with ground equipment during pushback and taxiing, causing substantial aircraft damage (a Boeing 737-300 collided with a catering truck in 1999; a Boeing 737-400 in 1999 collided with airstairs; a Boeing 727 in 1999 collided with airstairs; a BAe 146 in 2001 collided with airstairs; a towmotor vehicle collided with a Boeing 737-400 nose landing gear in 2001; and a disabled persons lift collided with the winglet of a Boeing 737-800 in 2004).
- Failure of the right wing landing gear on a Boeing 747-300 just prior to takeoff (2000).
- Passengers sustaining a broken ankle when the aircraft encountered turbulence during the cruise (a Boeing 747-400 in 2000 resulting in two injuries, and a Boeing 747-400 in 2007 resulting in one injury).
- A passenger falling and breaking a hip while disembarking from a Boeing 717 aircraft (2001).
- A flight attendant falling and breaking a leg when a Boeing 767-200 aircraft encountered windshear (2002).
- Passengers and crew members receiving serious injuries as the result of an evacuation from the aircraft (a Boeing 747-400 in 2003 following a wheel brake fire, and an Airbus A330 in 2005 following smoke in the forward cargo hold).
- The left wing tip of a Boeing 747-400 aircraft colliding with the right horizontal stabiliser of a Boeing 767-300 aircraft while taxiing for departure, causing substantial damage (2006).
- Significant airframe vibrations and control difficulties with a Boeing 737-200 aircraft during a missed approach (2007).
- The partial loss of the right elevator on a Boeing 747-400 aircraft during climb (2007).

Low capacity RPT accidents

The low capacity RPT accidents included:

- The collapse of the nose landing gear due to a mechanical fault, resulting in substantial damage to the propellers and landing gear of an Embraer EMB-820 aircraft (1998), a Cessna 402 aircraft (2000), and a Cessna 404 Titan aircraft (2000).
- A Cessna 402 aircraft landing short of the runway during a forced landing due to an unlocked nose landing gear (1999).
- A Beech 1900D aircraft experienced smoke in the cockpit and a right engine fire following landing (1999).
- A Piper PA-31 Chieftain aircraft impacting the sea following the failure of both engines in-flight, fatally injuring all people on board (2000).
- A Piper PA-31 Chieftain aircraft striking the runway during the landing flare, causing damage to the fuselage, propellers and radio aerials (2001).
- A Piper PA-31 Chieftain aircraft running off the end of the runway and down an embankment (2002).
- Animal and bird strikes resulting in substantial damage to the engine and propellers of a Beech 1900D aircraft (1998), the collapse of an Embraer EMB-820 nose landing gear (1999), a Beech 1900D aircraft (2001), the propellers of a Saab SF-340A aircraft (2001), and the horizontal stabiliser of a Fairchild SA227-DC Metro aircraft (2002).
- The nose wheel tyre of a Cessna 404 Titan aircraft deflating during the landing resulting in the nose landing gear collapsing (2002).
- Ground collisions with the aircraft wing hitting a pole (a Cessna 402 in 2002) and a stationary fuel tanker (a Cessna 402 in 2003).
- A Piper PA-31 Chieftain aircraft inadvertently landing with the landing gear in the retracted position (2003).
- The landing gear retracting while a Piper PA-31 Chieftain aircraft was on the ground (2003).
- A Fairchild SA227-DC Metro aircraft impacting terrain while on approach to land, fatally injuring all people on board (2005).
- An intentional wheels-up landing of a Piper PA-31 Chieftain aircraft due to the undercarriage failing to extend, causing substantial aircraft damage (2005).
- The collision of an Embraer EMB-120 aircraft with runway lights during landing (2007).

Fatal charter accidents

The fatal charter accidents included:

- A Partenavia P.68 aircraft impacting terrain while on approach to land (1998).
- A Bell 206L LongRanger helicopter that collided with the sea due to a loss of visual contact in heavy rain (1999).
- Hypobaric incapacitation of the pilot and passengers of a Beech Super King Air 200 following a failure of the aircraft's pressurisation and supplemental oxygen system (2000).
- In-flight structural failure and breakup of a Piper Aerostar 600A aircraft during attempted recovery from a spiral manoeuvre (2000).
- Fuel starvation or interruption to the engine of a Cessna 210 Centurion aircraft (2001).
- A Beech C90 King Air aircraft that suffered a loss of control and impacted power lines following an uncontained engine failure (2001).
- A Piper PA-32 Seminole aircraft that suffered abnormal engine performance shortly after takeoff, and subsequently impacted with terrain (2002).
- A Robinson R44 helicopter that was operating with a maximum takeoff weight and centre of gravity outside limits, leading to an in-flight loss of control and collision with terrain (2003).
- In-flight loss of control accidents including a Britten Norman BN-2A Islander aircraft that crashed on final approach due to an engine failure (1999), a Cessna 206 Stationair aircraft conducting manoeuvres in darkness with a lack of visual cues (2000), a Cessna 210 Centurion aircraft conducting aerial manoeuvres (2001), a Cessna 206 flying at low level over water in severe weather conditions (2002), a Cessna 172 Skyhawk aircraft that suffered carburettor icing (2003), and a Beech 58 Baron aircraft that lost control for unknown reasons (2006).
- Collision with terrain accidents (Cessna 185 Skywagon in 1998, Aero Commander 500-S in 2001, Cessna 210 Centurion in 2002, Piper PA-31 Navajo in 2005, Cessna 210 in 2007, Robinson R44 in 2007).

General aviation accidents, 1998 to 2007

The general aviation (GA) sector of the industry covers a diverse set of flying activities, ranging from aerial mustering to flying training to medical evacuation and aerial fire fighting. By far, the majority of accidents recorded by the ATSB each year involve GA operations. However, within GA, the number of accidents and fatal accidents varies greatly across the different operational groups (see the Glossary for definitions).

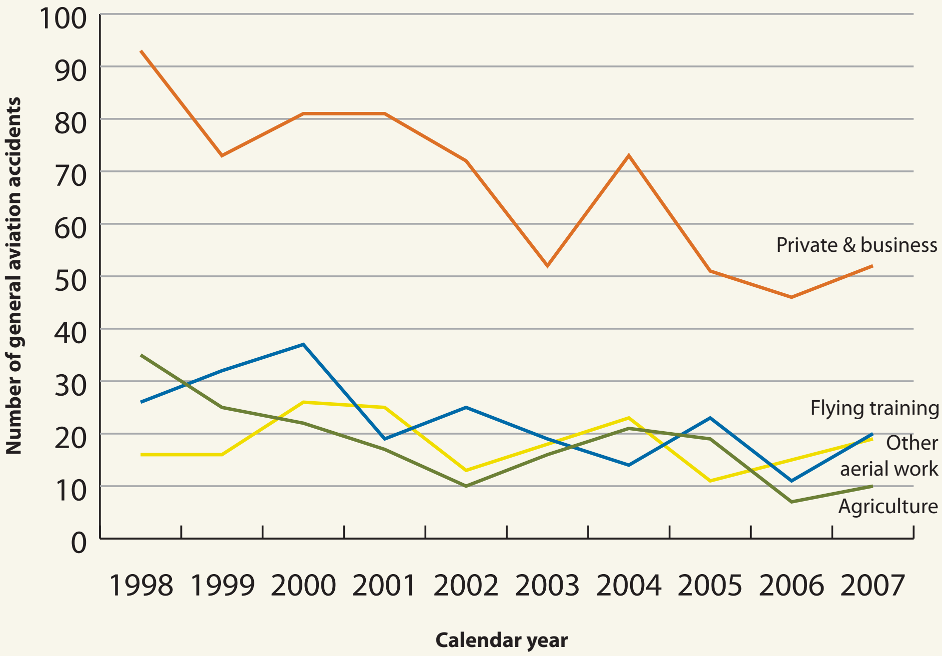
General aviation accident, fatality and serious injury statistics, 1998 to 2007

There were 1,264 accidents in GA operations recorded between 1998 and 2007 (Figure 31 and Figure 32). Of these:

- 182 occurred in aerial agriculture operations (18.1 accidents per 100,000 hours flown);
- 226 occurred in flying training operations (5.3 accidents per 100,000 hours flown);
- 182 occurred in other aerial work operations (5.6 accidents per 100,000 hours flown); and
- 674 occurred in private and business operations (16.9 accidents per 100,000 hours flown).

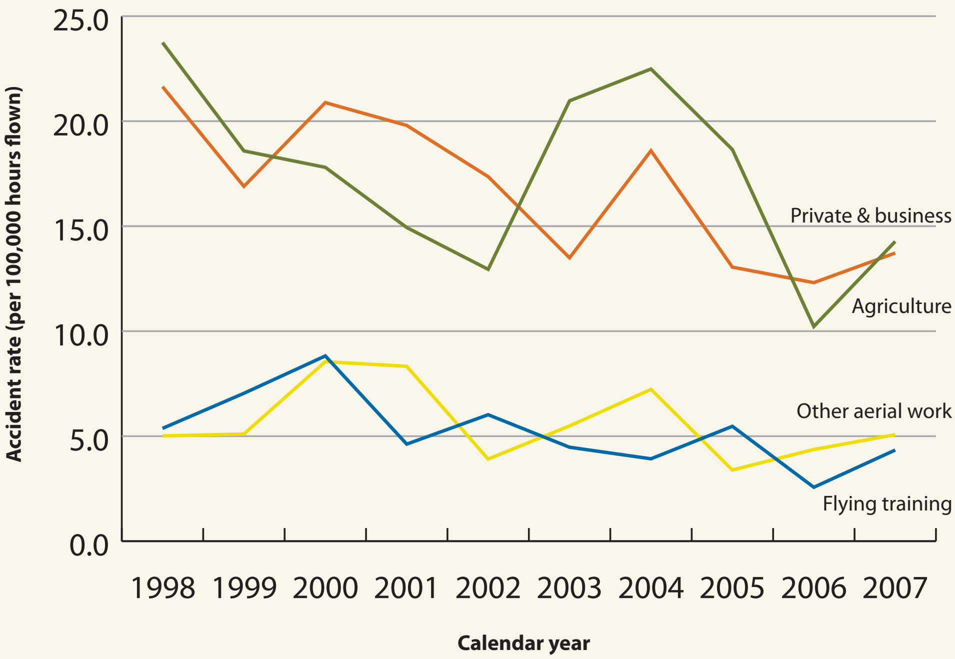
While accidents in private/business operations were most prevalent, they have decreased from 93 accidents in 1998 to 52 accidents in 2007 (a decrease of 44 per cent). The number and rate of accidents in aerial agriculture and flying training have also decreased over the last 10 years.

Figure 31: **General aviation accidents, 1998 to 2007**



The accident rate in agricultural operations remains relatively high compared with the number of hours flown, underscoring the inherently more demanding environment of aerial agriculture operations. Accident rates in other aerial work activities generally remained stable between 1998 and 2007 (Figure 32).

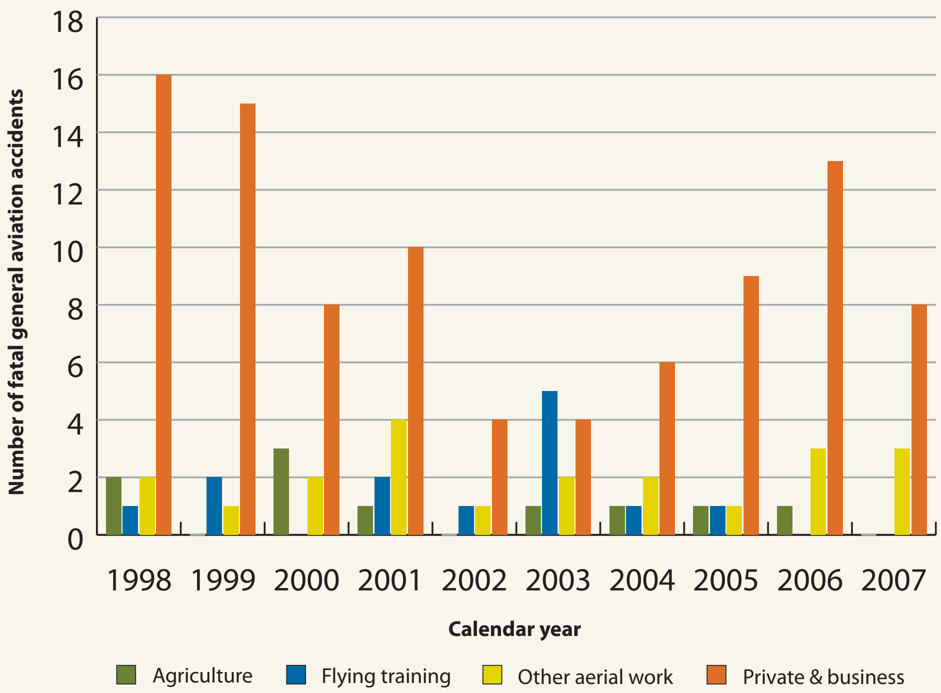
Figure 32: **General aviation accident rate per 100,000 hours flown, 1998 to 2007**



The number of fatal GA accidents has remained very low across other aerial work, agriculture and flying training operations (less than three per year), with the exception of 2003 where five fatal flying training accidents were recorded. In comparison, the number of fatal accidents and fatalities involving private operations increased from 2003 to 2006, despite the fact the number of all accidents having decreased. The lowest number of fatal accidents occurred in 2003, with three fatal accidents recorded. This increased four-fold to 13 accidents in 2006, however decreased to seven in 2007 (Figure 33).

While the number of GA accidents in 2007 was higher than in 2006, serious injuries and fatalities remained relatively steady, with 20 fatalities and nine serious injuries.

Figure 33: Fatal accidents in general aviation, 1998 to 2007



Fatal general aviation accidents

The following are brief summaries of the fatal accidents involving GA aircraft in 2007:

- The pilot of an Air Tractor AT-802 aircraft was fatally injured when the aircraft flew into the surface of Lake Liddell, Victoria.
- A Cessna 172 Skyhawk collided with an ultralight aircraft over Latrobe Valley Aerodrome, Vic. The ultralight collided with the ground, fatally injuring the pilot. The Cessna landed safely.
- After takeoff from Uaroo Station, the pilot of a Cessna 172 Skyhawk lost control of the aircraft and impacted the side of a hill. It is possible that the aircraft encountered adverse meteorological conditions such as strong wind gusts and willy-willies (124 km south-south-east of Onslow Aerodrome, NT).
- The four occupants of a Cessna 337 Skymaster aircraft were fatally injured after the pilot became spatially disoriented while manoeuvring over water at low level in conditions of reduced visibility (between Venus Bay and Cape Liptrap, Vic.).
- A Cessna 172 Skyhawk aircraft collided with powerlines alongside the Stuart Highway whilst flying at low level between Katherine and Tennant Creek, NT. The three occupants were fatally injured (37 km north of Elliot, NT).
- The pilot of a Robinson R22 helicopter was fatally injured when the helicopter impacted terrain during aerial survey operations near Doongan, WA.
- A Pacific Aerospace Corporation 08-600 Cresco aircraft impacted a mountain in a state forest whilst undertaking a ferry flight from Ingham to Tully, Qld. The pilot was fatally injured in the accident, which was consistent with controlled flight into terrain (CFIT) (24 km south of Tully, Qld.).
- During manoeuvring after takeoff and while still below tree height, the main rotor of a Robinson R22 helicopter struck and fatally injured a bystander. It was probable that the helicopter was impacted by a gust of wind requiring a recovery manoeuvre by the pilot (Maryfield Station, NT).
- On final approach to Esperance Aerodrome, WA at night and in marginal weather conditions, the Piper PA-28RT-201 Turbo Dakota aircraft collided with terrain. All three occupants received fatal injuries.
- An amateur-built Van's RV-4 aircraft collided with terrain in the Moorabbin aerobatic area after entering an unstable spiral dive. The two occupants were fatally injured (Clyde North, Vic.).
- A Piper PA-30 Twin Comanche aircraft impacted the sea whilst attempting an emergency landing on a beach following engine problems. The pilot, the sole occupant, was fatally injured (15 km south-east of Gold Coast Aerodrome, Qld.).

At a glance: accidents by operation type

Number of accidents

	Accidents 2007	Fatal accidents 2007	Fatalities 2007
Passenger transport			
High capacity RPT	3	0	0
Low capacity RPT	1	0	0
Charter	16	2	2
Total	*20*	*2*	*2*
General aviation			
Agriculture	10	0	0
Flying training	20	0	0
Other aerial work	19	3	3
Private/business	52	8	17
Total	*101*	*11*	*20*
Total	**121**	**13**	**22**

Incident statistics

The analysis of accidents is useful for looking at the level of safety in the aviation industry and identifying trends over a period of time. However, another helpful tool for reviewing aviation safety is the use of incident data.

Passenger transport incidents, 1998 to 2007

There were 3,948 passenger transport incidents reported to the ATSB in 2007 (Figure 34). Most incidents occurred in high capacity RPT operations. A large increase in incidents was recorded from 2003 to 2006. This increase may be partly attributed to the entrance and rapid growth of Virgin Blue and Jetstar, and clearer guidelines and legislation on what constitutes a reportable matter (with the introduction of the *Transport Safety Investigation Regulations 2003*). While the number of low capacity RPT incidents remained steady, the rate as a proportion of flying activity increased from 209 incidents per 100,000 hours flown in 1998 to 387 in 2007. Charter incident reporting rates also increased slightly relative to flying activity in 2007. This may be due to improved reporting cultures among low capacity RPT and charter operators (Figure 35).

Figure 34: Passenger transport incidents, 1998 to 2007

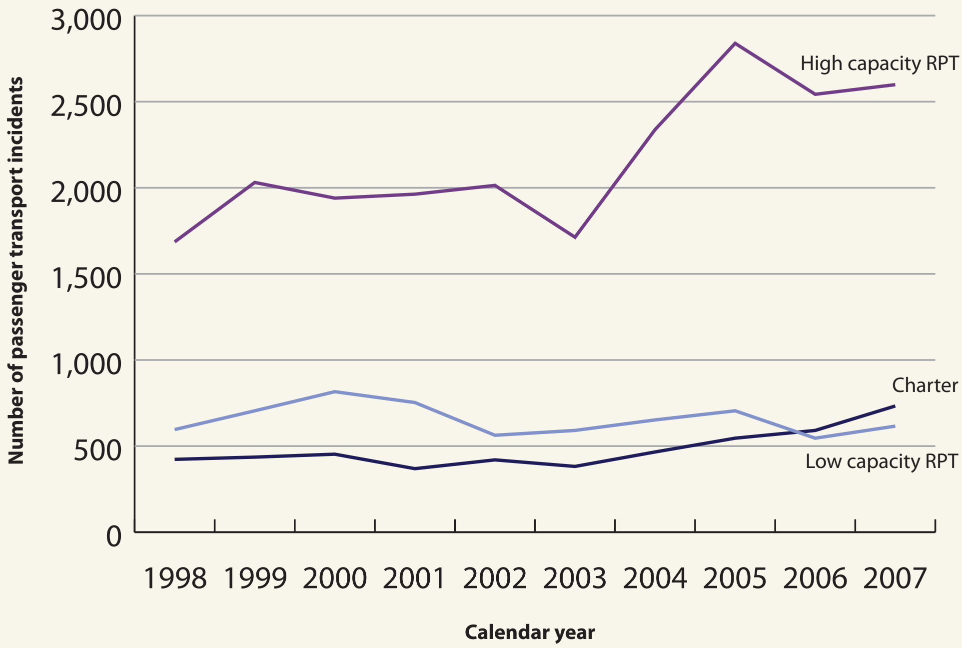
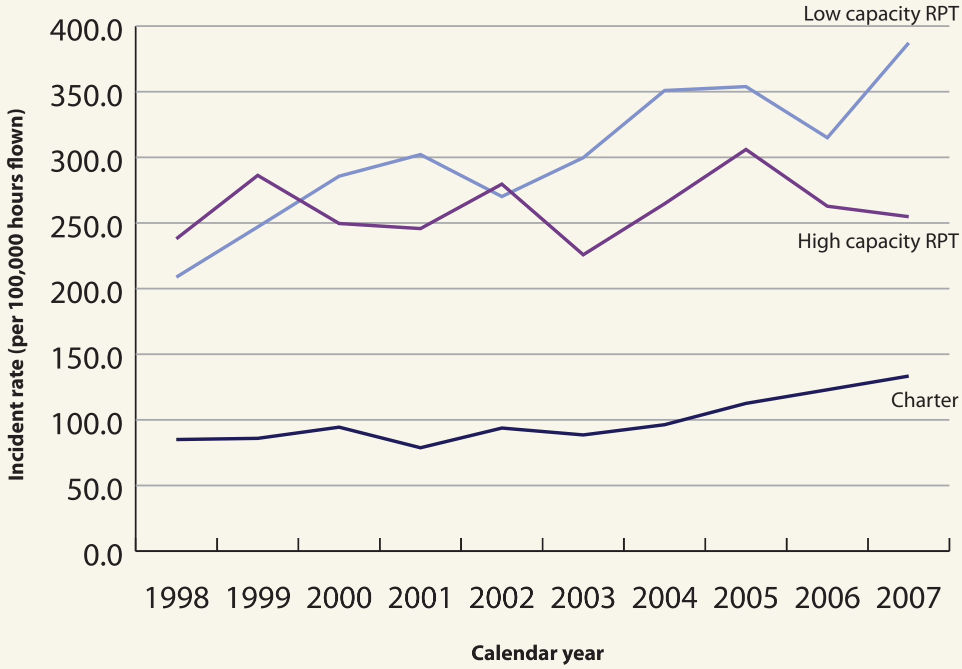


Figure 35: **Passenger transport incident rate per 100,000 hours flown, 1998 to 2007**



Since 2007, the ATSB has published two reports that reviewed immediately reportable matters in passenger transport operations: one covering RPT, and one specific to charter operations. These and other aviation safety research reports are available online at <www.atsb.gov.au>.

General aviation incidents, 1998 to 2007

There were 3,632 incidents involving GA operations reported to the ATSB in 2007 (Figure 36). Unlike passenger transport incidents, a significant proportion of GA incidents (75 per cent) are not categorised into a specific operation type (private/business, flying training, agriculture, or other aerial work) due to a lack of reported information.

Of the 893 GA incidents reported in 2007 that did have an operation type associated, flying training recorded the highest number and rate of incidents (Figure 36 and Figure 37). Fluctuations in incident numbers across all operation types may partly reflect changes in how incidents have been recorded by the ATSB over time and, since mid 2003, clearer guidelines and legislation on what constitutes a reportable matter (with the introduction of the *Transport Safety Investigation Regulations 2003*).

Figure 36: General aviation incidents, 1998 to 2007

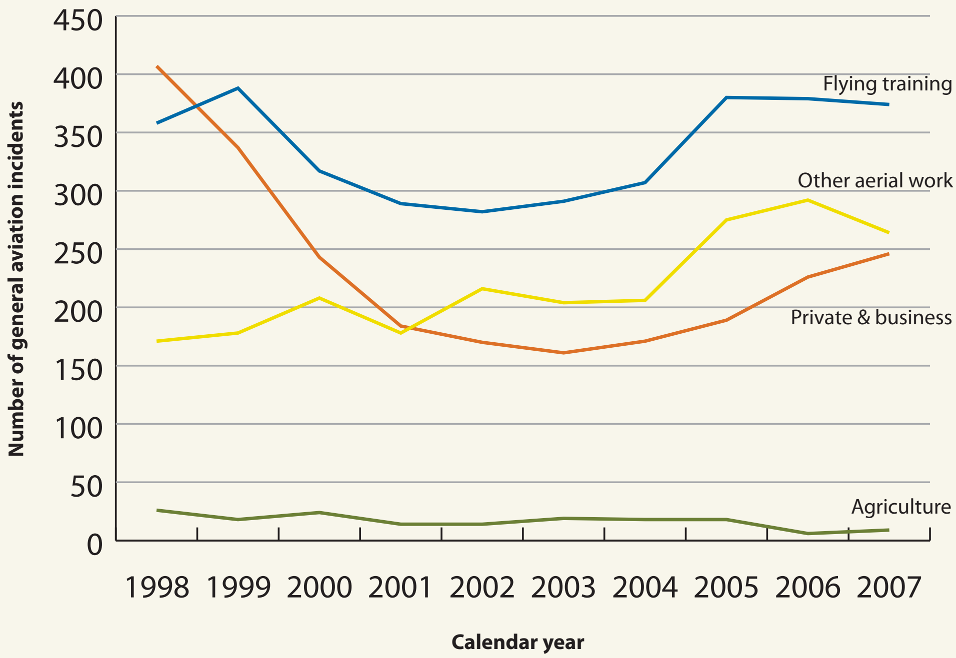
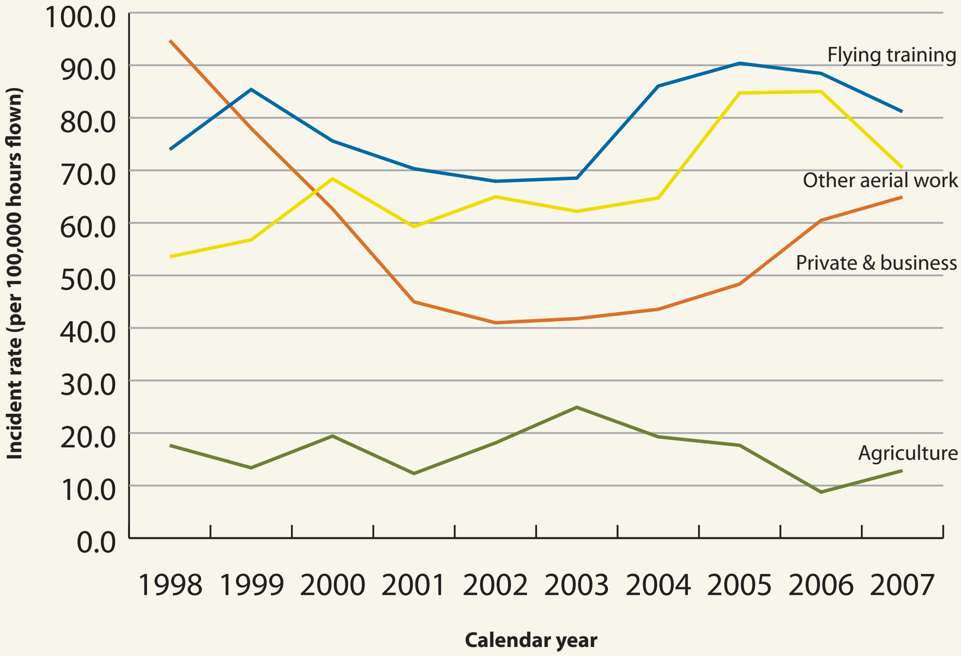


Figure 37: General aviation incident rate per 100,000 hours flown, 1998 to 2007



At a glance: Incidents by operation type

Number of incidents

	Incidents 2007
Passenger transport	
High capacity RPT	2,599
Low capacity RPT	616
Charter	733
Total	*3,948*
General aviation	
Agriculture	9
Flying training	374
Other aerial work	264
Private/business	246
Uncategorised	2,739
Total	*3,632*
Total	**7,580**

Accidents and incidents are complex occurrences often involving a chain or sequence of events.

Chapter 3

Classifying accidents and incidents: occurrence types

The preceding chapters set out some basic measures of aviation activity, and occurrence rates in Australia between 1998 and 2007. This chapter takes a closer look at the nature of occurrences (accidents, serious incidents and incidents) in Australia over this period, in terms of what occurred and what phase of the flight they occurred in. Chapter 4 will look at what safety factors contributed to these occurrences.

The majority of accidents in Australia occur in general aviation (GA), particularly within the private/business flying category. Only a small proportion of accidents result in fatal injuries. However, the number of reported incidents from both passenger transport and GA operations is similar. To gain insights into the safety implications of occurrences, it is informative to take a closer look at the kinds of occurrences that occur, and which part of the flight they occur in.

Accidents and incidents are complex occurrences, often involving a chain or sequence of events. The challenge is to classify an accident or incident meaningfully, and in doing so, capture its main character to identify what contributed to the occurrence. The aim of this classification method, known as occurrence types, is to ensure consistency in accident and incident classification and allow for useful comparisons to be made. There are four different occurrence categories used by the ATSB: mechanical, operational, aerodrome and airways facility, and airspace.

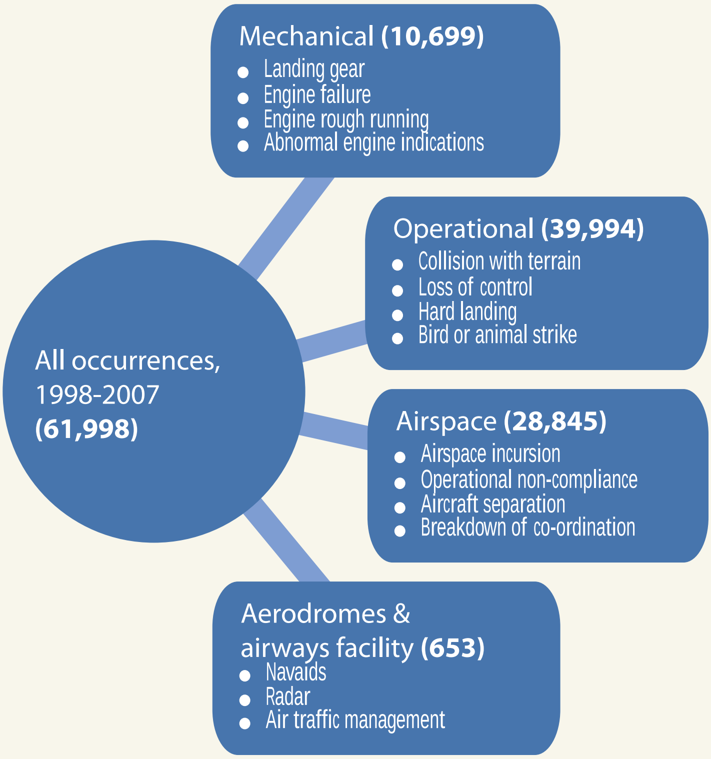
The data analysed in this chapter covers aircraft involved in passenger transport and GA operations, excluding sport aircraft such as gliders and balloons. Data in this edition of the Review may differ slightly to previous editions as the ATSB's database has undergone a quality assurance process.

It is important to note that the reporting requirements under the TSI Act for GA operations differ to those required for passenger transport. Reporting requirements for passenger transport operations are more extensive than for GA operations. For example, runway incursions are required to be reported by passenger transport operators, but not by GA operators. Despite this, many GA operators do report these events to the ATSB. This may lead to smaller numbers of reports from GA operators for some types of events, which should be considered when interpreting comparisons with passenger transport.

Classifying accidents and incidents: occurrence types

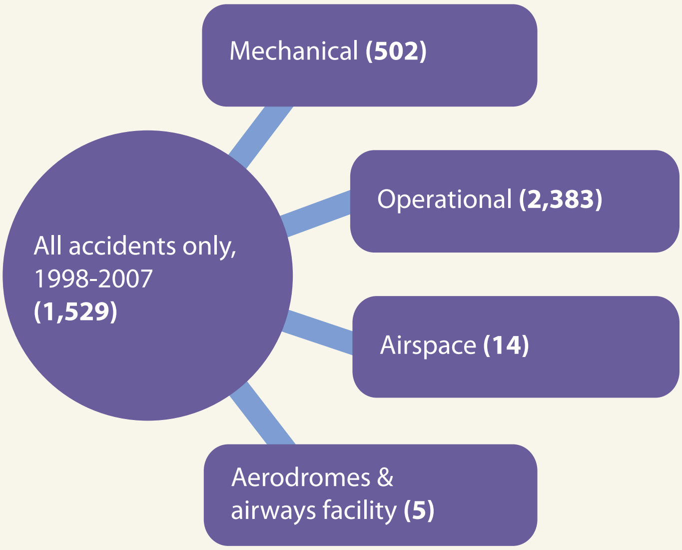
For every accident or incident, the ATSB associates one or more occurrence types to each aircraft involved. The four broad-level occurrence types used are: mechanical, operational, aerodromes and airways, and airspace. For the 61,998 occurrences and 1,529 accidents between 1998 and 2007, the number of occurrence types can be seen in Figure 38. The occurrence type data for accidents and incidents still under investigation was obtained from the preliminary investigation report, however, throughout the course of the investigation process, further information may be obtained and may require re-classification.

Figure 38: Occurrences by occurrence type, 1998 to 2007[18]



18 Note: One or more occurrence type for an accident or incident is assigned to each aircraft involved. As a result, the sum of the occurrence types will be greater than the number of incidents and accidents.

Figure 39: **Accidents (both fatal and non-fatal) by occurrence type, 1998 to 2007**[18]



It is important to understand that the occurrence classification discussed in this chapter describes the type of event (i.e. something that happened at a specific point in time, such as an engine failure). In essence, the occurrence type describes what happened. The occurrence type does not take into account why the event occurred (in this example, why the engine failed). Where possible, this is discussed in Chapter 4.

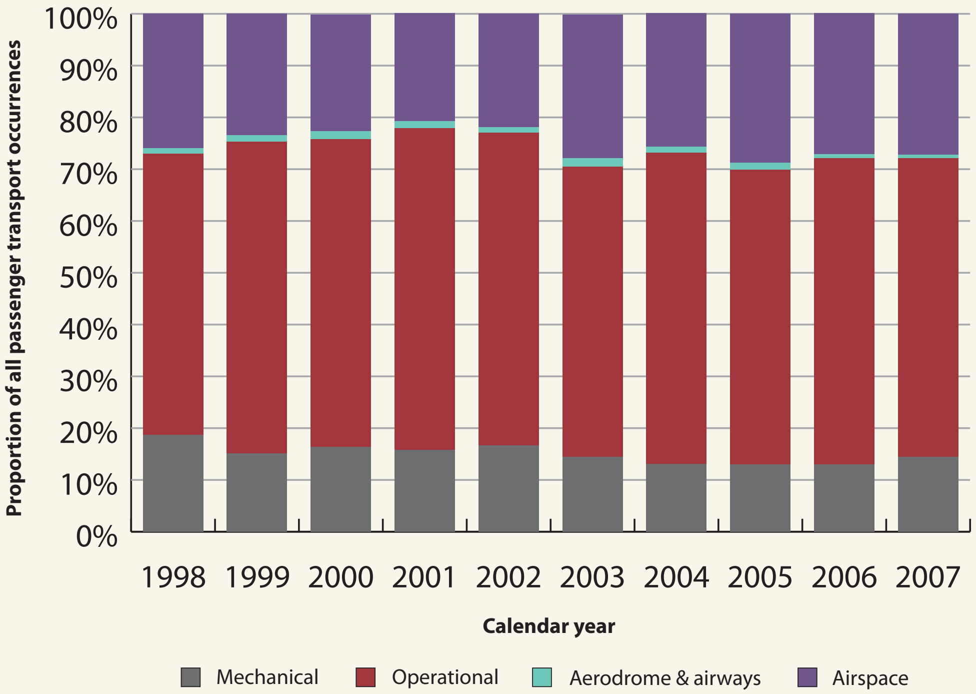
Operational and airspace related events
are most common in passenger transport occurrences.

All occurrences

Passenger transport occurrences

In air transport, operational-related events consistently accounted for the greatest proportion of occurrences, with 58 per cent in 2007 (Figure 40). Airspace-related occurrences were the next most frequent, accounting for 27 per cent of passenger transport incidents and accidents.

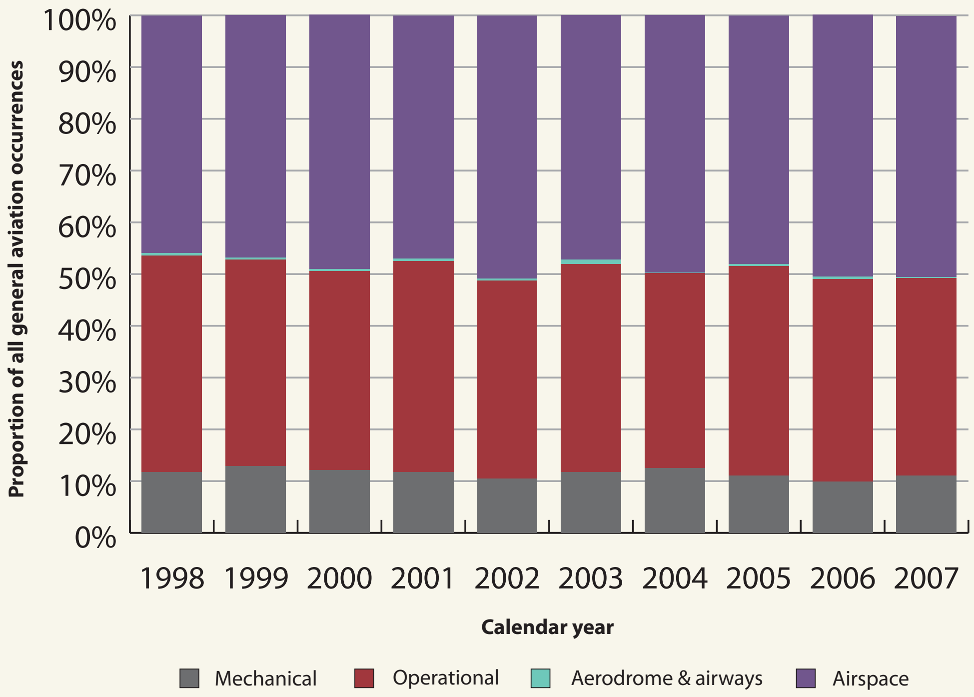
Figure 40: Passenger transport occurrences by occurrence type, 1998 to 2007



General aviation occurrences

In GA, airspace-related events accounted for the greatest proportion of occurrences throughout the 10-year reporting period, with 51 per cent in 2007 involving an airspace event. Operational events were the next most frequent, involved in 38 per cent of occurrences (Figure 41).

Figure 41: General aviation occurrences by occurrence type, 1998 to 2007



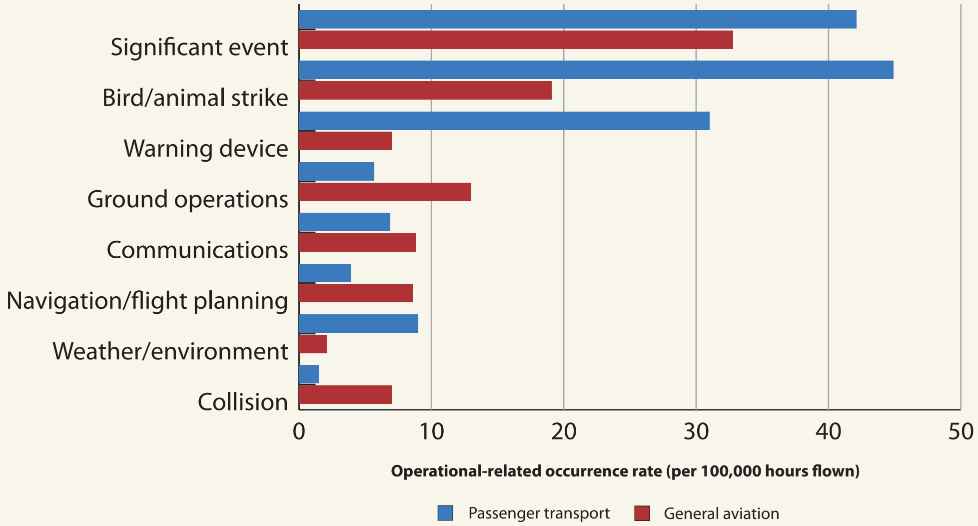
Operational-related occurrences

All occurrences

Half of all occurrences, and over three-quarters of all accidents (82 per cent) recorded between 1998 and 2007 were operational-related events.

Significant events and bird/animal strikes were the leading types of accidents and incidents in both passenger transport and GA operations. For passenger transport, this was followed by warning device-related occurrences. These include advisory and action alerts by the traffic alert and collision avoidance system (TCAS) and ground proximity warning systems (GPWS) fitted to many larger aircraft. Other prevalent operational-related occurrence types in GA included ground operations (e.g. foreign object damage, ground handling, incursions and excursions), navigation/flight planning (e.g. landing on the wrong runway, being lost or unsure of position), communications (e.g. callsign confusion), and collisions (on the ground, with terrain and wires, or with other aircraft) (Figure 42).

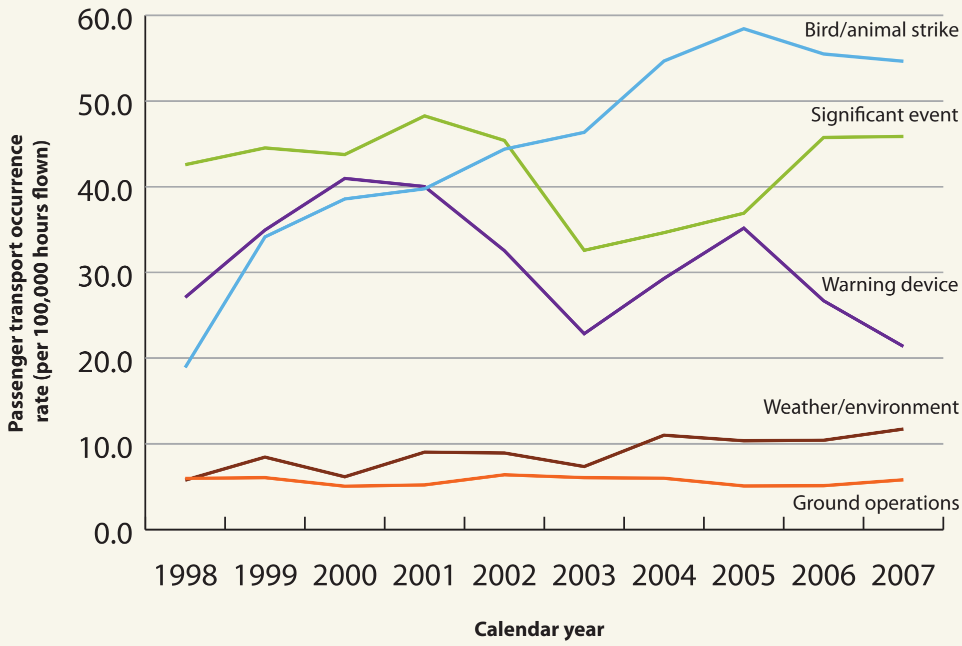
Figure 42: All occurrences that were operational-related, rate (per 100,000 hours flown) by operation type, 1998 to 2007



Significant event rates in both passenger transport and GA operations remained generally consistent between 1998 and 2007. In passenger transport operations, the most common significant events were diversions and returns, rejected takeoffs, missed approaches/go-arounds, and smoke and fumes. These were often the result of other operational events occurring, such as configuration warnings and powerplant problems. Similarly, the most common significant events in GA operations (diversions and returns, forced landings) were often interrelated to other types of operational events.

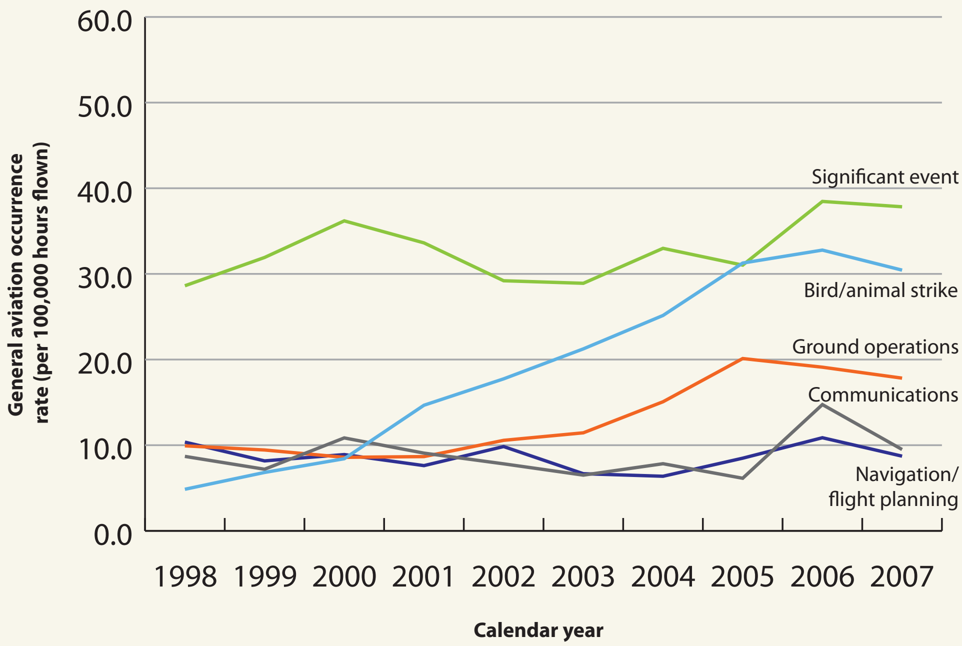
On the other hand, bird and animal strikes have increased steadily since 1998 across both passenger transport and GA operations, due primarily to improved reporting by pilots and ground crews. Fluctuations in some of the other occurrence types may be partly attributed to changes in the ATSB's data classification policy over the reporting period (Figure 43 and Figure 44).

Figure 43: Passenger transport operational-related occurrence rate (per 100,000 hours flown), Top 5 event types, 1998 to 2007



For GA, ground operation occurrences remained relatively stable for the first half of the reporting period, with an average of 10 per 100,000 hours flown. This increased from about 2003 onwards to 20 in 2005, and 18 per 100,000 hours flown by 2007. The rise in the ground operations rate appears to coincide with the introduction of the Transport Safety Investigation Regulations in 2003, which also saw an increase in the number of runway incursion occurrences reported (Figure 44).

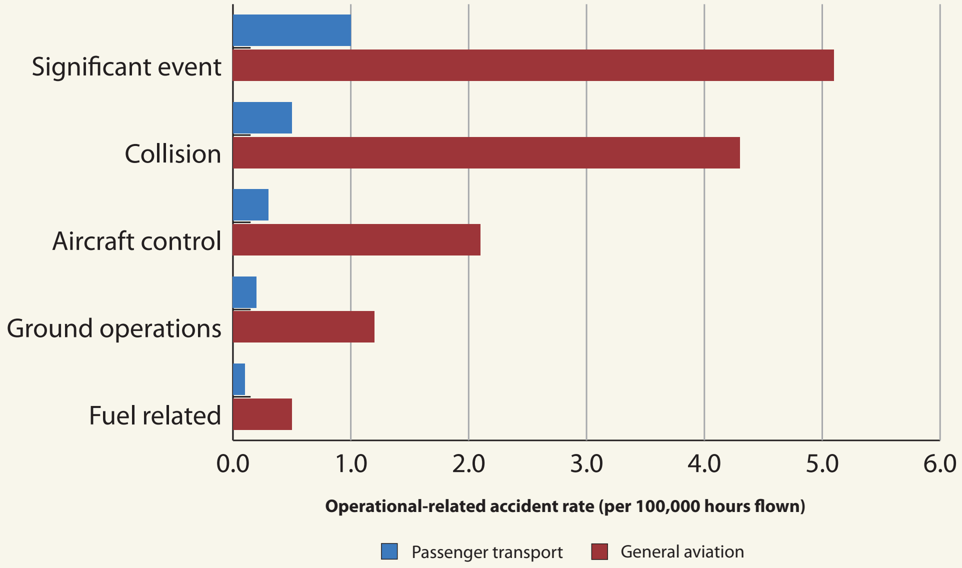
Figure 44: General aviation operational-related occurrence rate per 100,000 hours flown), Top 5 event types, 1998 to 2007



All accidents

Most accidents in both passenger transport and GA operations had more than one operational-related event associated with them. Between 1998 and 2007, there were 2,383 operational-related events recorded for the aircraft involved in the 1,529 accidents. The most common involved significant events, or were collisions and aircraft control-related accidents (Figure 45).

Figure 45: Accidents that were operational-related, rate (per 100,000 hours flown) by operation type, Top 5 event types, 1998 to 2007



In passenger transport, most rates remained close to zero across the 10-year period, with the exception of significant events, which decreased from 1.5 accidents per 100,000 hours flown in 1998 to less than 0.5 per 100,000 hours flown in 2007.

In GA operations, collision and aircraft control-related accident rates generally remained steady between 1998 and 2007. The exception was significant events, which decreased from about six accidents per 100,000 hours flown in 1998 to three per 100,000 hours flown in 2007.

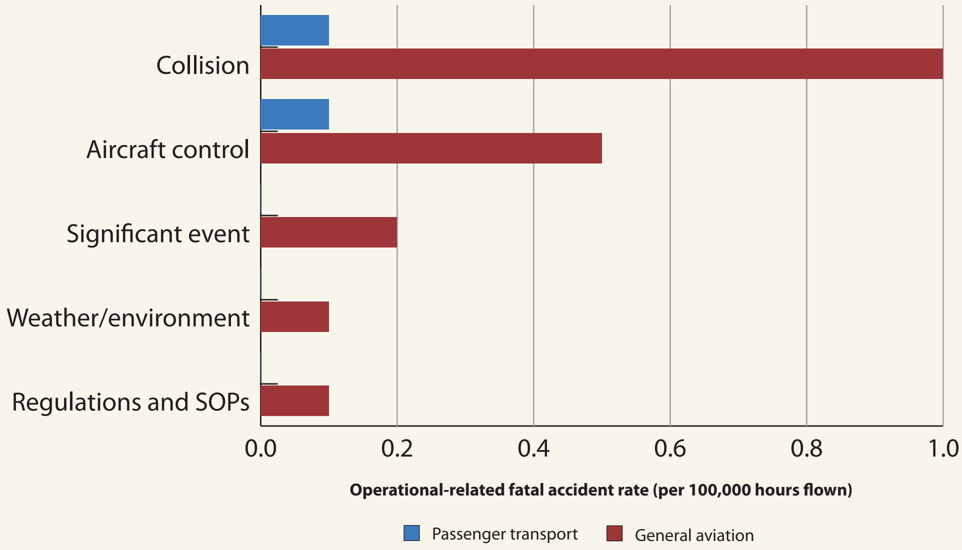
Fatal accidents

Operational-related fatal accidents occurred more frequently in GA operations than in passenger transport, accounting for 86 per cent.

More specifically, collisions were the most dominant type of operational-related events in fatal GA accidents, with one fatal accident per 100,000 hours flown. In passenger transport, there were very few fatal accidents, with collisions and aircraft control issues most commonly involved. No fatal accidents related to significant events, regulations, or standard operating procedures (SOPs) occurred in passenger transport between 1998 and 2007 (Figure 46).

In GA, collisions were the most common type of operational-related fatal accident.

Figure 46: Fatal accidents that were operational-related, rate (per 100,000 hours flown) by operation type, top 5 event types, 1998 to 2007



At a glance: operational-related accidents and incidents

	Accidents 2007	Incidents 2007
Aircraft control	28	107
Aircraft loading	1	116
Bird/animal strike	4	1,328
Cabin safety	3	55
Collision	69	78
Communications	0	208
Fuel related	2	75
Ground operations	17	312
Miscellaneous	0	31
Navigation/flight planning	1	165
Regulations and SOPs	2	39
Significant event	53	1,223
Warning device	1	453
Weather/environment	13	237

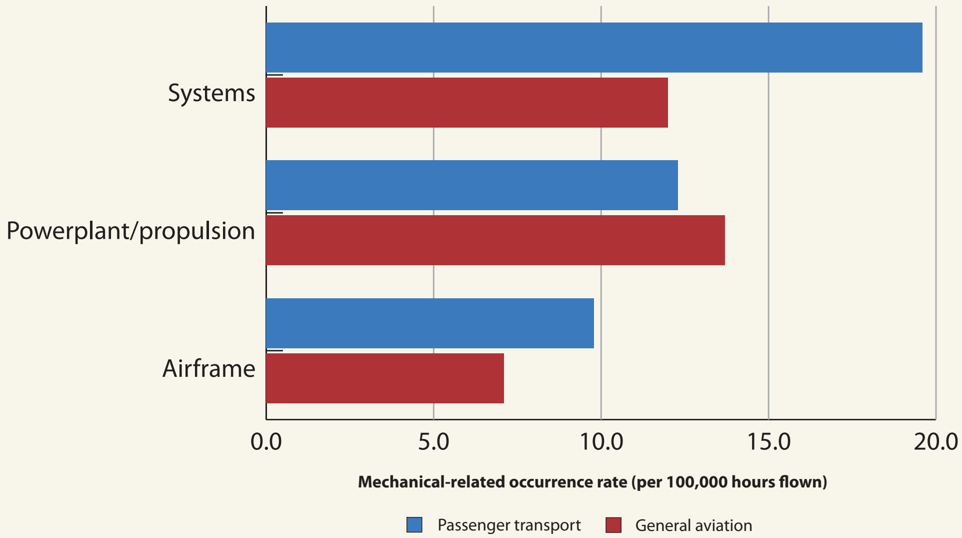
Mechanical-related occurrences

All occurrences

Of the 61,998 occurrences involving aircraft operating in the passenger transport and GA sectors of the aviation industry between 1998 and 2007, 14 per cent (10,105 aircraft involved in the occurrences) involved some sort of mechanical event.

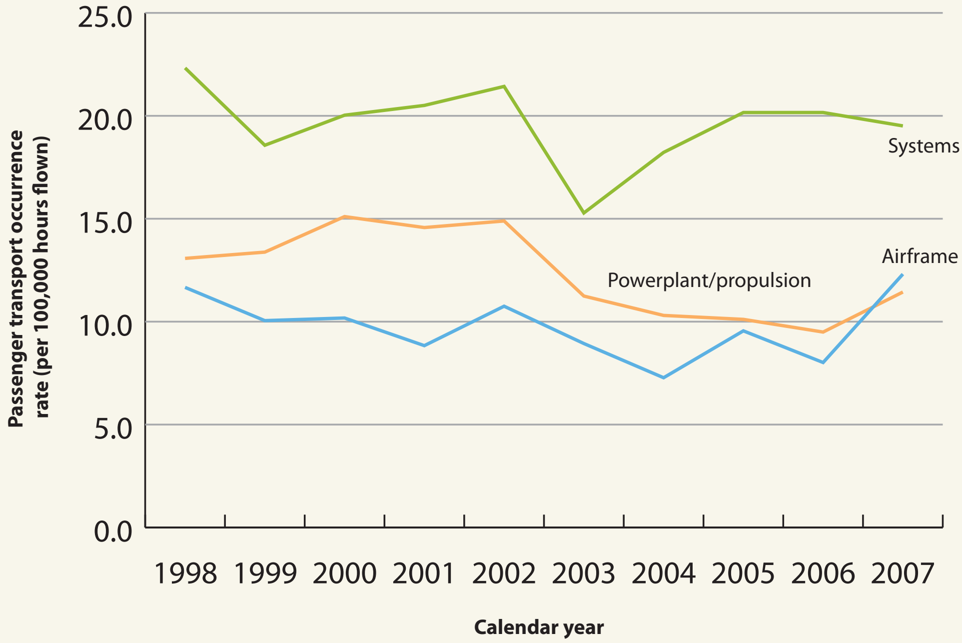
In passenger transport, systems failures were the leading contributor to mechanical-related occurrences. These failures relate to individual aircraft systems, such as the fuel, hydraulics, avionics, oil, or flight control system. Powerplant and propulsion-related events occurred most frequently in GA. Partial engine power loss (rough running) or total power loss (engine failure) are common events. Powerplant and propulsion events can also involve abnormal engine indications, auxiliary power unit performance, and problems with propellers, gearboxes or transmissions. Issues with the airframe and its components (e.g. doors, windows, nacelles, panels) were less common, but still notable (Figure 47).

Figure 47: All occurrences that were mechanical-related, rate (per 100,000 hours flown) by operation type, 1998 to 2007



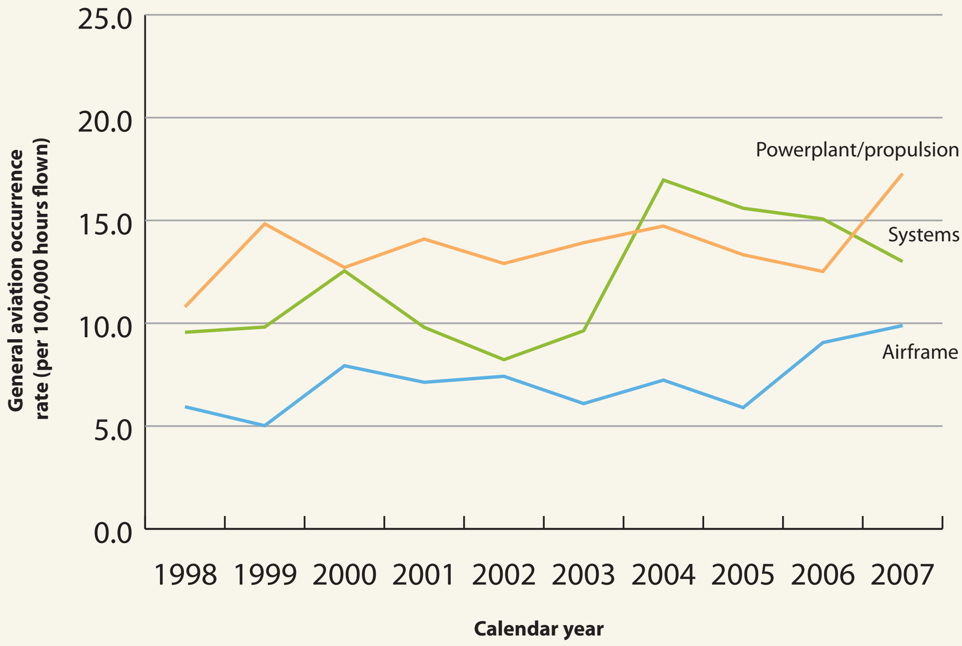
In passenger transport operations, systems and airframe events remained relatively steady over the 10-year period. The average powerplant and propulsion-related occurrence rate reduced in 2002 from 15 occurrences per 100,000 to 10, and remained steady until 2007. The decrease in the powerplant and propulsion-related occurrence rate since 2002 may be partly attributed to a reduction in the number of abnormal engine indications occurrences reported to the ATSB. A slight rise in engine-related occurrences occurred in 2007, most likely attributable to increased reporting (Figure 48).

Figure 48: **Passenger transport mechanical-related occurrence rate (per 100,000 hours flown), 1998 to 2007**



In GA operations, powerplant and propulsion events remained relatively steady between 1999 and 2007, with a jump in 2007. The airframe-related rate doubled from about five to 10 occurrences per 100,000 hours flown over the 10 years. The system-related occurrence rate in GA remained relatively stable for the first half of the reporting period, but then rose from a long-term average of 10 per 100,000 hours flown to 15 in 2003. Since 2003, it has declined slightly towards the long-term average (Figure 49).

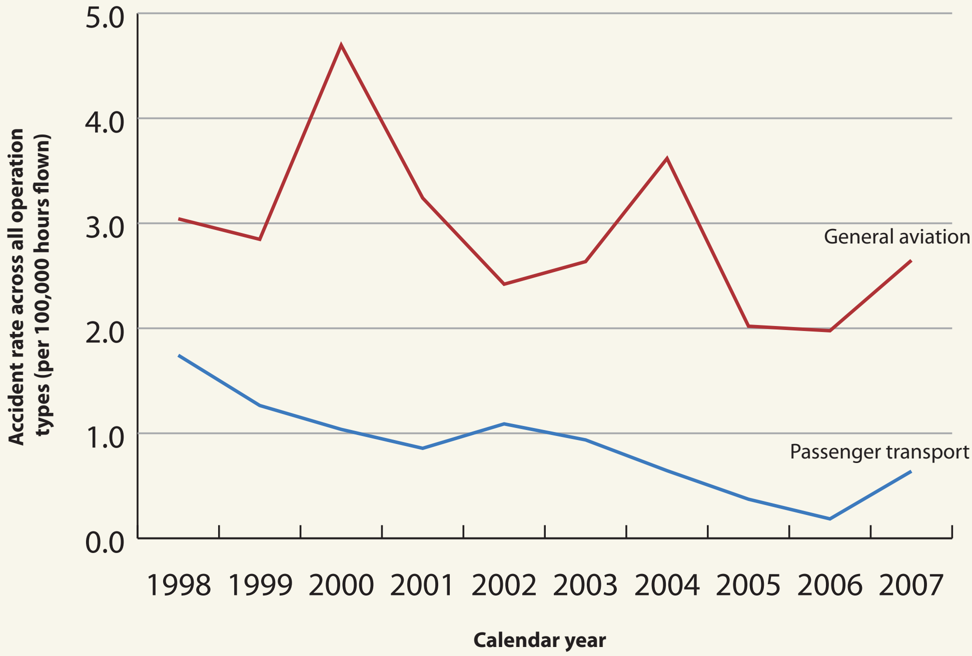
Figure 49: **General aviation mechanical-related occurrence rate (per 100,000 hours flown), 1998 to 2007**



All accidents

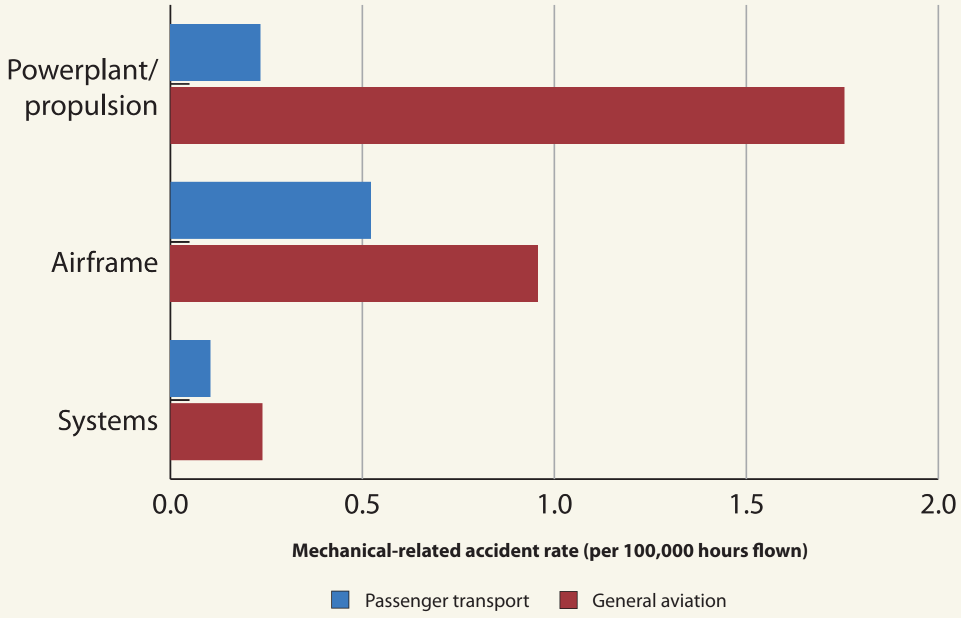
Of the 1,529 accidents that occurred in passenger transport and GA between 1998 and 2007, 301 (20 per cent) involved a mechanical failure. The majority of these occurred in GA (Figure 50).

Figure 50: **Mechanical-related accident rate by year by operation type (per 100,000 hours flown), 1998 to 2007**



Powerplant and propulsion events were the most common form of mechanical failure in GA aircraft, remaining relatively steady across the 10-year period despite some fluctuations. In passenger transport operations, airframe-related events occurred more frequently (Figure 51).

Figure 51: Accidents that were mechanical-related, rate (per 100,000 hours flown) by operation type, 1998-2007



Airframe events were the most common type of mechanical-related occurrences in passenger transport accidents, with a steady decline recorded since 1998, from 1.2 to 0.4 accidents per 100,000 hours flown in 2007. Almost all airframe events in passenger transport were landing gear related, and the majority occurred in charter operations.

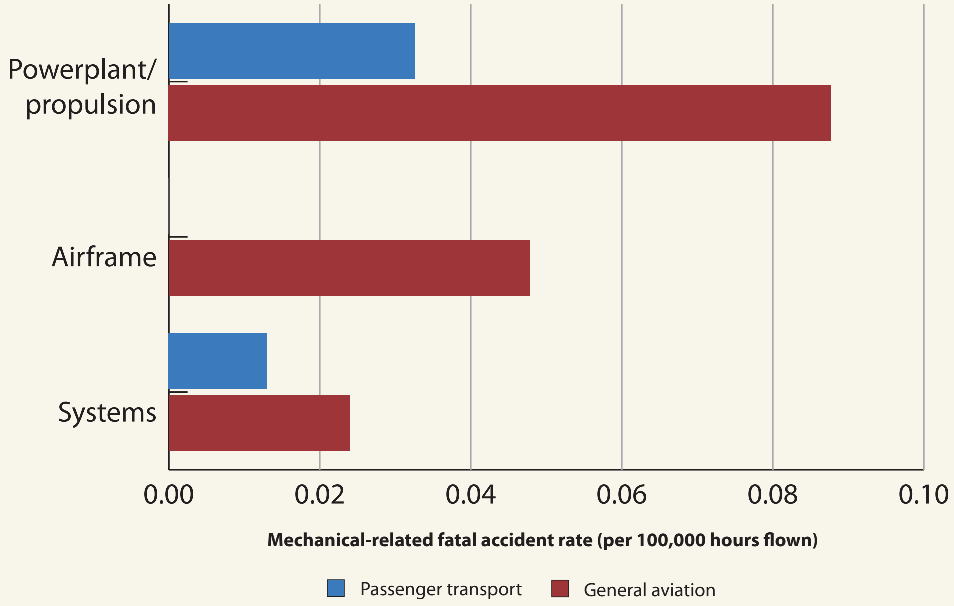
General aviation accidents that involved mechanical failures also showed airframe events as an important factor from 1998 to 2005. Landing gear events, such as wheels-up landings, were the major type of airframe-related accident. Like passenger transport, airframe events in GA showed a steady decline over the decade.

Fatal accidents

There were a total of 25 mechanical-related accidents resulting in fatalities between 1998 and 2007 in both passenger transport and GA operations. Most of these (74 per cent) involved GA aircraft.

Powerplant and propulsion accidents were more likely to be fatal in both GA and passenger transport operations than other types of mechanical-related events. No airframe-related fatal accidents occurred in passenger transport over the 10-year period (Figure 52).

Figure 52: Fatal accidents that were mechanical-related, rate (per 100,000 hours flown) by operation type, 1998 to 2007



At a glance: mechanical-related accidents and incidents

	Accidents 2007	Incidents 2007
Airframe	14	325
Powerplant/propulsion	31	388
Systems	0	503

Passenger transport flights are predominantly conducted within controlled airspace, while GA aircraft operate mainly outside controlled airspace.

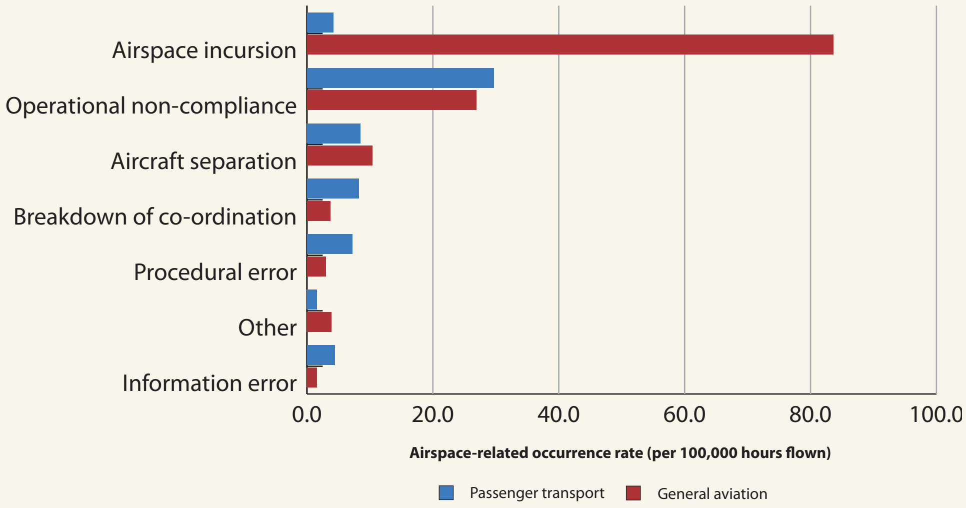
Airspace-related occurrences

All occurrences

Airspace-related events were involved in a large proportion of occurrences, with 28,845 airspace events associated with aircraft involved in the 61,998 aviation safety occurrences between 1998 and 2007.

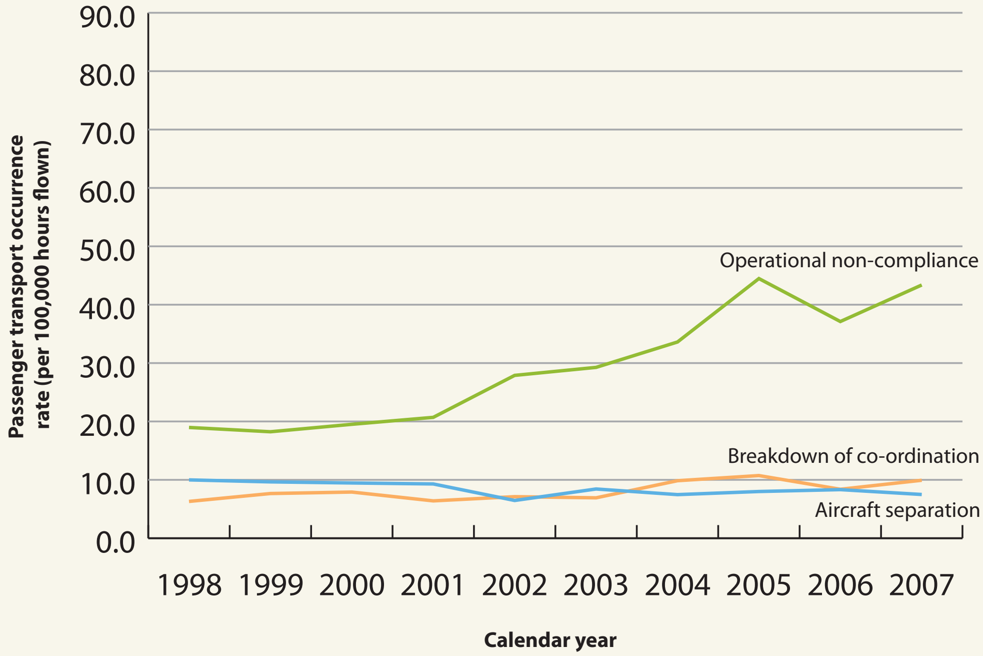
In GA operations, the most common airspace events were airspace incursions, with 84 occurrences per 100,000 hours flown on average over the 10 years. In passenger transport operations, operational non-compliance was the most common airspace-related event, with almost 30 occurrences per 100,000 hours flown. General aviation also recorded a similar operational non-compliance rate (Figure 53). These rates somewhat reflect the differing operating environments that passenger transport and GA aircraft function in and to some degree the different reporting requirements for each sector. Passenger transport flights are predominately conducted within controlled airspace, while GA aircraft operate mainly outside controlled airspace.

Figure 53: All occurrences that were airspace-related, rate (per 100,000 hours flown) by operation type, 1998 to 2007



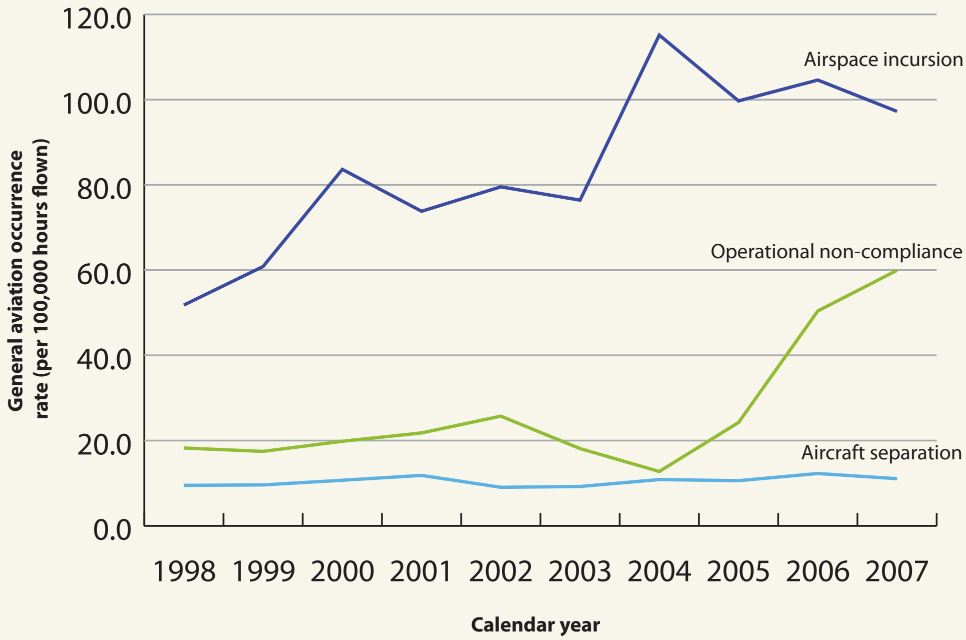
Operational non-compliance events in passenger transport operations increased steadily from about 20 events per 100,000 hours flown in 2000 to over 40 in 2005 and 2007 (Figure 54). This was due to a steady increase in both published information and verbal instruction non-compliance events. This can be partially attributed to increased reporting by Airservices Australia.

Figure 54: **Passenger transport airspace-related occurrence rate (per 100,000 hours flown), 1998 to 2007**



Operational non-compliance events also rose substantially from 2004 to 2007 in GA operations, from an average of approximately 20 occurrences per 100,000 hours flown to almost 60. This increase occurred across both published information and verbal instruction-related non-compliance events.

Figure 55: **General aviation airspace-related occurrence rate (per 100,000 hours flown), 1998 to 2007**



Fatal accidents

Between 1998 and 2007, there were 10 accidents (involving 11 aircraft) where airspace-related factors were part of the accident sequence. However, in all cases, these factors were not considered the primary occurrence type, that is, the single event that best describes what happened in the occurrence. The primary occurrence types in those cases included controlled flight into terrain (CFIT), collision with terrain, midair collision, wirestrike and loss of control.

At a glance: airspace-related accidents and incidents

	Accidents 2007	Incidents 2007
Aircraft separation	0	271
Airspace incursion	0	1,338
Breakdown of co-ordination	0	232
Information error	0	95
Operational non-compliance	1	1,516
Other	0	5
Procedural error	0	154

Aerodrome and airways facility-related occurrences

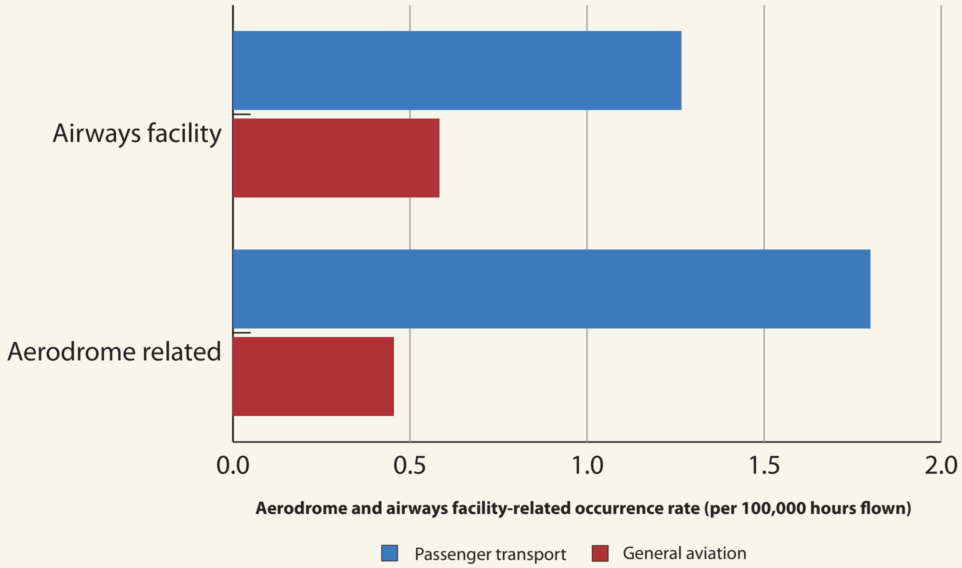
All occurrences

Of all the four occurrence categories, aerodrome and airways facilities were the least common. Only 653 events were recorded across the 61,998 occurrences between 1998 and 2007 (less than one per cent).

Aerodrome-related events might involve airport or approach lighting, markings or signs. Airways facility-related events can involve air traffic management systems, navaids, or radar operation.

Events related to aerodrome and airways facilities occurred more often in passenger transport operations than in GA. Across both operation types, the rate of airways facility-related events was generally the same as the rate of aerodrome related events (Figure 56).

Figure 56: All occurrences that were aerodrome and airways facility-related, rate (per 100,000 hours flown) by operation type, 1998 to 2007



Over the 10 years, there were no aerodrome and airways facility-related passenger transport accidents recorded. Airways facility incidents displayed bimodal characteristics with a peak recorded in 2000 and 2005 of about three events per 100,000 hours flown. Between these years, there was an average of two events per 100,000 hours flown. This pattern was largely driven by air traffic management (ATM) hardware-related occurrences (i.e. occurrences involving faults or deficiencies in the ATM system).

Compared with passenger transport, GA operations showed a relatively steady rate for occurrences where aerodrome and airways facilities were involved.

All accidents

Five accidents occurred between 1998 and 2007 in which aerodrome or airways facility-related events were involved, all involving GA operations. In all cases, the aircraft sustained serious damage from landing on an area with poor surface conditions or from impacting unmarked hazards such as a concrete drain or ditch. None of those accidents were fatal.

There were no accidents related to airways facilities.

At a glance: aerodrome and airways facility-related accidents and incidents

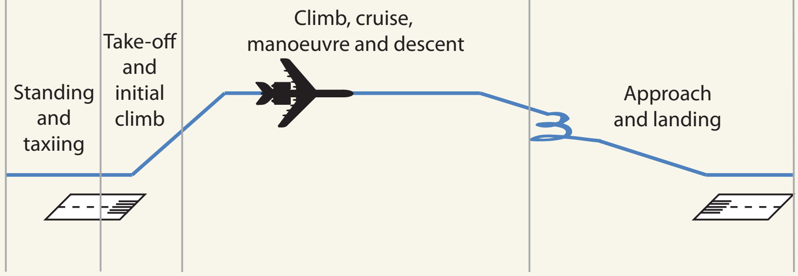
	Accidents 2007	**Incidents 2007**
Aerodrome related	0	29
Airways facility	0	11

Occurrences by phase of flight

Almost half of all occurrences (49 per cent) occurred during the climb, cruise, manoeuvre and descent phases of flight. The most common phases of flight for accidents were the takeoff/initial climb and approach/landing phases, phases where the aircraft is flying near to or on the ground. Together, these phases accounted for 61 per cent of the total number of accidents between 1998 and 2007 (Figure 57).

From this, it could also be assumed that these phases make up a similar proportion of the fatal accidents. However, this is not the case. These phases accounted for only two-fifths of the fatal accidents over the 10-year period. The climb, cruise, manoeuvre and descent phases accounted for 48 per cent of the fatal accidents, even though these phases made up only a third of the total number of accidents. Aircraft travelling at normal cruise speeds involve greater levels of kinetic energy compared with the take-off and landing phases of flight, and hence have a greater potential for more serious or fatal injuries to the aircraft occupants. However, for example, when operating closer to the ground during the initial climb phase there may be insufficient altitude or height to recover if control of the aircraft is lost. This may result in the aircraft being destroyed and the occupants receiving serious or fatal injuries.

Figure 57: Occurrences, accidents and fatal accidents by phase of flight, 1998 to 2007[19]



	Standing and taxiing	Take-off and initial climb	Climb, cruise, manoeuvre and descent	Approach and landing
Percent of flight time (average)	< 1%	2%	82%	16%
All occurrences	8% (7,031)	21% (17,974)	49% (42,568)	20% (17,953)
Accidents	6% (181)	35% (1,027)	32% (936)	26% (741)
Fatal accidents	1% (4)	25% (100)	48% (191)	19% (78)

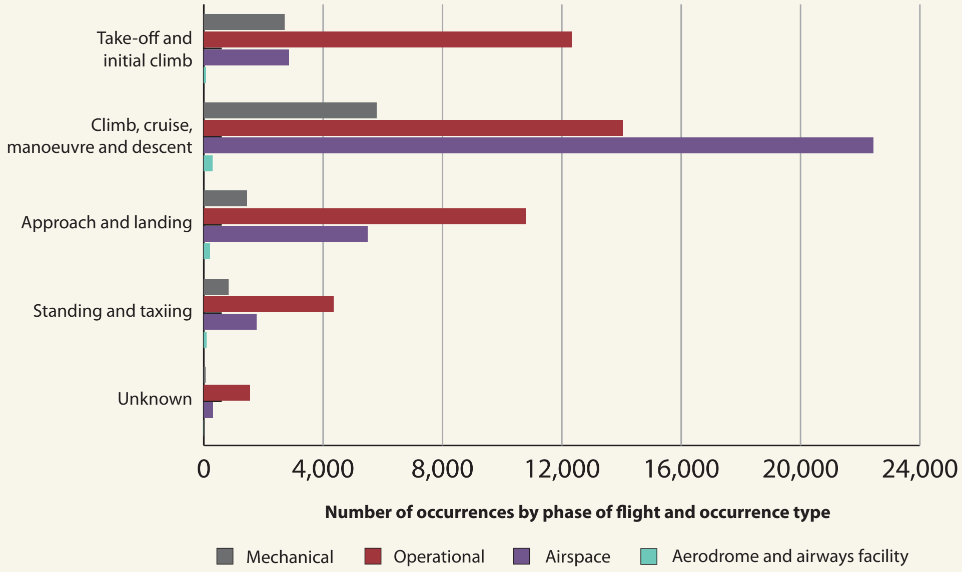
Of the 171 fatal accidents that occurred between 1998 and 2007, the phase of flight for one or more of the aircraft involved could not be determined in 27 cases. In most of those accidents, all of the aircraft occupants received fatal injuries. Along with no witness information regarding the accident, there were insufficient details to determine the phase of flight.

By occurrence type

For accidents and incidents in all of the four occurrence categories (mechanical, operational, aerodromes and airways facilities, and airspace), most occurred while the aircraft was in the climb, cruise, manoeuvre and descent phases of flight (generally 30 to 50 per cent). Airspace-related events made up a significantly larger proportion of occurrences in these phases than in others (68 per cent). Operational-related events were most common in the other phases of flight (Figure 58).

19 Percent of flight time (average) data is provided by Boeing, and is based on worldwide commercial jet aircraft flights. Data may differ slightly for GA operations. Boeing. (2008). Statistical Summary of Commercial Jet Airplane Accidents, Worldwide Operations, 1959-2007. Seattle, WA: Boeing Commercial Airplanes.

Figure 58: Occurrences by phase of flight and occurrence type, 1998 to 2007



At a glance: phase of flight

Number of aircraft involved

	All occurrences 2007	Accidents 2007	Fatal accidents 2007
Standing	367	8	0
Taxiing	797	2	0
Takeoff	1,072	29	4
Initial climb	904	41	0
Climb	1,139	6	4
Cruise	2,882	48	10
Manoeuvring/airwork	210	38	3
Descent	582	9	0
Approach	1,467	13	2
Landing	1,011	59	0
Unknown	467	7	7
Total[20]	**10,898**	**260**	**30**

20 The total number of incidents and accidents by phase of flight shown here is greater than the number of accidents and incidents shown in Chapter 2, as an accident or incident can involve two or more aircraft that are in different phases of flight.

The identification and analysis of safety factors is the key to understanding why an accident or incident occurred.

Chapter 4

Explaining why accidents and incidents happen: contributing safety factors

The analysis of occurrences by type and phase of flight tells us something about when, and under what circumstances an accident or incident occurs, but not why it occurred. The identification and analysis of safety factors is the key to understanding why an accident or incident occurred, and the events or circumstances that contributed to its occurrence. They are at the heart of the Australian Transport Safety Bureau's (ATSB) investigation process.

This third edition of Australian Aviation Safety in Review introduces an analysis of the safety factors that contribute to aviation accidents and incidents.

What is a safety factor?

Safety factors[21] are events or conditions that increase the risk to safe flight operations. A safety factor is something that, if it occurred in the future, would increase the likelihood of an occurrence and/or the severity of the adverse consequences associated with an occurrence.

A contributing safety factor is something that, if it had not occurred or existed at the time, would have probably stopped the occurrence from happening, reduced the adverse consequences of an occurrence, or would have prevented another contributing safety factor from existing.

An accident or incident typically involves a number of different contributing safety factors. The manner in which the different factors combine and relate to each other during the events leading up to an accident is often complex and dynamic. The ATSB has classified safety factors associated with all occurrences in its database where sufficient information was available. The ATSB uses an occurrence analysis model based on the Reason[22] model of accident investigation. This model states that accidents rarely occur entirely from the actions of operational personnel (such as flight crew, cabin crew, air traffic controllers, maintenance engineers, and ground handlers), but rather from a combination of problems originating at all levels of an organisation.

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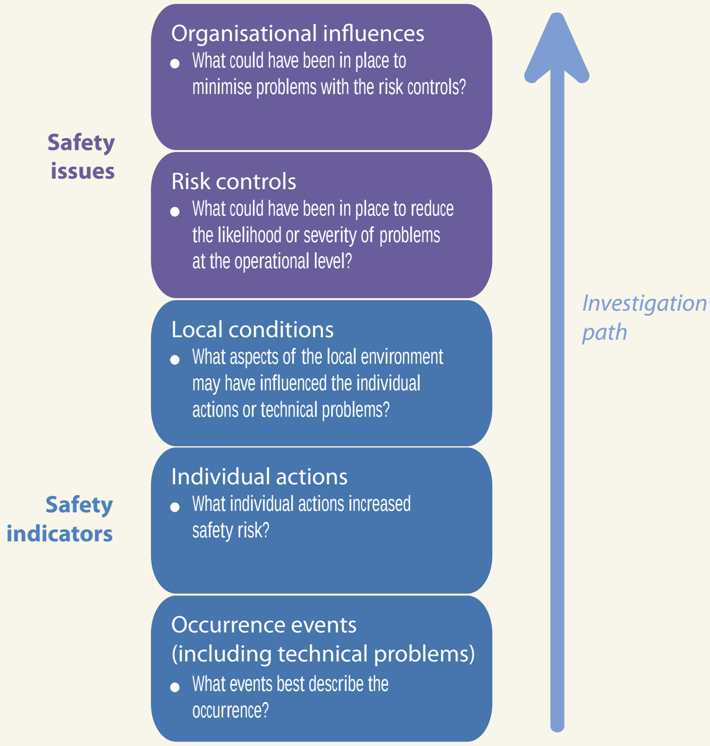
21 Walker, M.B. & Bills, K.M. (2008). *Analysis, Causality and Proof in Safety Investigations* (AR-2007-053), Canberra: Australian Transport Safety Bureau.

22 Reason, J. (1990). *Human error*. Cambridge, Cambs: University of Cambridge.

In the ATSB accident investigation model, safety factors that can contribute to the development of an occurrence are:

- technical events
- individual actions
- local conditions
- risk controls
- organisational influences.

Figure 59: The ATSB accident investigation model



Technical events refer to the unexpected, inadequate, or non-performance of aircraft equipment and components, and their associated parts and systems. This also includes the performance of facilities that support safe aircraft operations, such as navigational aids, lighting, and communication facilities. When equipment does not perform as required, the resulting event can be termed a 'technical problem'.

Individual actions are observable behaviours performed by operational personnel that increase safety risk. Many accidents and serious incidents involve a number of individual actions. It is important to view such actions as events that should not be reproduced under similar conditions in the future, rather than consider them as 'failures' of the individual(s) involved.

Local conditions exist in the immediate context or environment in which individual actions or technical events occur, and have an influence on those actions and events by increasing their likelihood or safety risk. Local conditions include characteristics of the individuals and the equipment involved, as well as the nature of the task and the physical environment.

Risk controls are the measures put in place by an organisation to facilitate and ensure the safe performance of operational personnel and equipment. Preventive risk controls are put in place to minimise the likelihood of undesirable local conditions, individual actions and occurrence events. Such controls include procedures, training, equipment design and work rosters. Recovery controls are put in place to detect and correct or minimise the adverse effects of local conditions, individual actions and occurrence events. Such 'last line' controls include warning systems, emergency equipment and emergency procedures.

Organisational influences are those conditions that establish, maintain or otherwise influence the effectiveness of an organisation's risk controls. Internal influences include activities such as hazard identification, risk assessment, change management and training needs analysis. External influences include the regulatory standards and surveillance provided by regulatory agencies. They also include a range of pressures, standards and other influences provided by organisations such as industry associations and international standards organisations.

General trends in safety factors

This report reviews contributing safety factors associated with investigated occurrences between 2001 and 2007. Safety factors are also assigned to non-investigated occurrences where possible. Over the 10-year reporting period, the way in which occurrences have been classified and the number of occurrences investigated, has varied. Consequently, this chapter will only examine the last seven years of data, from 2001 to 2007.

Generally, the ATSB investigates about 80 aviation safety occurrences per year, although this can vary from year to year. Between 2001 and 2007, there were 566 investigations during this period – 410 involving passenger transport aircraft, and 210 involving general aviation (GA) aircraft.[23]

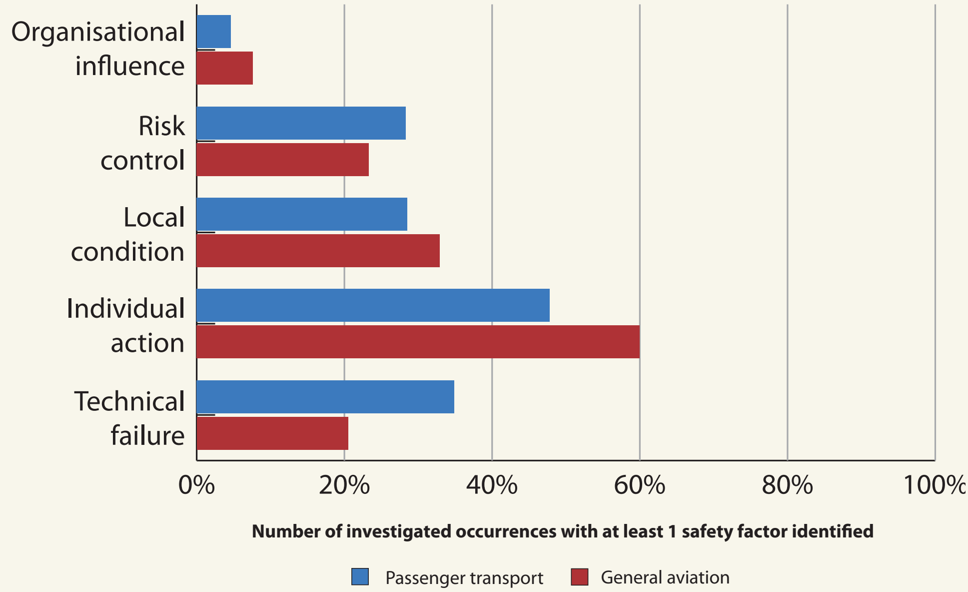
Figure 60 shows the number of investigated occurrences where at least one contributing safety factor was identified. Almost half (48 per cent) of passenger transport occurrences, and 60 per cent of GA occurrences had one or more individual actions identified as contributing to the occurrence.

Other common types of contributing safety factors identified in passenger transport occurrence investigations were technical failures (35 per cent of investigations), local conditions (29 per cent), and problematic risk controls (28 per cent). Organisational influences were the least frequent contributors, occurring in only five per cent of investigations.

For GA occurrence investigations, local conditions were identified in 33 per cent of investigations, and problematic risk controls in 23 per cent. Technical failures were only identified in 20 per cent of GA occurrence investigations, and organisational influences in only eight per cent.

23 Some occurrences involved more than one aircraft.

Figure 60: **Proportion of investigated occurrences with at least one safety factor identified, 2001 to 2007**



Technical failures

Between 2001 and 2007, there were 143 investigated occurrences involving passenger transport operations and 43 involving GA operations where a technical failure was identified as a contributing safety factor. The types of technical failures that occurred (Figure 61) were similar for both GA and passenger transport.

The most common technical failures were mechanical discontinuities (30 per cent of investigated occurrences). These were the disruption of a physical connection in a mechanical, hydraulic or pneumatic system. The most common discontinuities were loose fasteners, joints separating or disbonding, and fuel or pneumatic (oil and hydraulic fluid) lines separating/leaking.

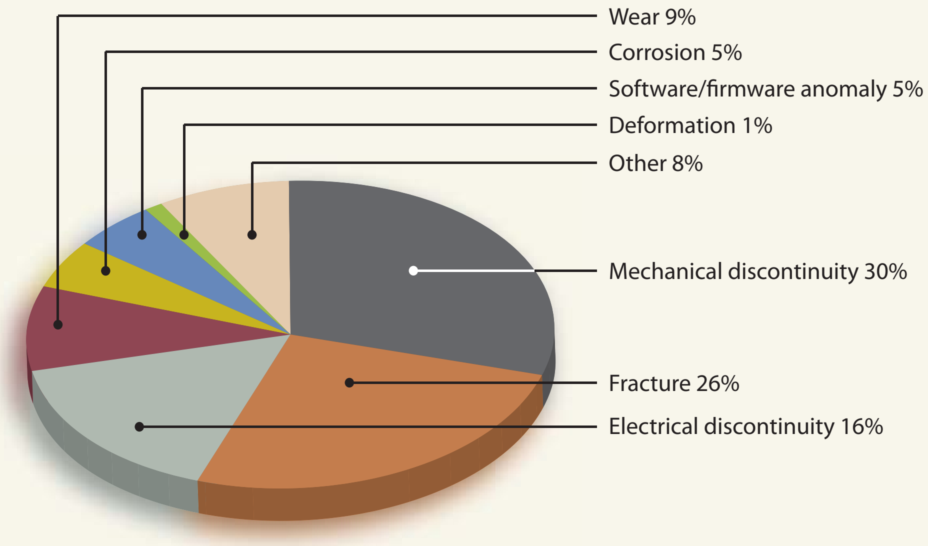
This was followed by fractures (the physical separation of parts of a component), which accounted for 26 per cent of technical failures. Common fractures were excessive stress and fatigue fractures in turbine blades and rotors, and connecting rod and shaft failures.

Electrical discontinuity accounted for 16 per cent of technical failures identified. These failures involved the disruption of an electrical connection at wiring, circuit, or integrated circuit level. The most common electrical discontinuities were blown fuses, short circuits, and wires fracturing or burning through.

A further nine per cent involved wear. The most common types of wear to components was due to the asymmetric movement of rotating components, causing rubbing, fretting, and galling (adhesive wear).

Corrosion, software and firmware anomalies, deformation, and other technical failures accounted for the remaining 19 per cent.

Figure 61: Technical failure safety factors identified for investigated occurrences (all occurrence and operation types), 2001 to 2007



Individual actions

There were 322 individual action safety factors identified for the 566 investigated occurrences from 2001 to 2007 – 196 involving passenger transport aircraft, and 126 involving GA aircraft. Although individual actions by operational personnel are involved in most accident sequences, these actions rarely occur in isolation. Rather than considering them as failures on the part of the individual operational personnel, individual actions are often the result of other contributing factors that also need to be identified. It is also important to remember that what people do normally makes sense to them at the time, and that they generally try to do the right thing; only very rarely do people intend to cause harm.

Individual actions data are presented separately for each of the occurrence types, with the exception of aerodrome and airways facilities (as only three investigations were conducted with this occurrence type associated between 2001 and 2007).

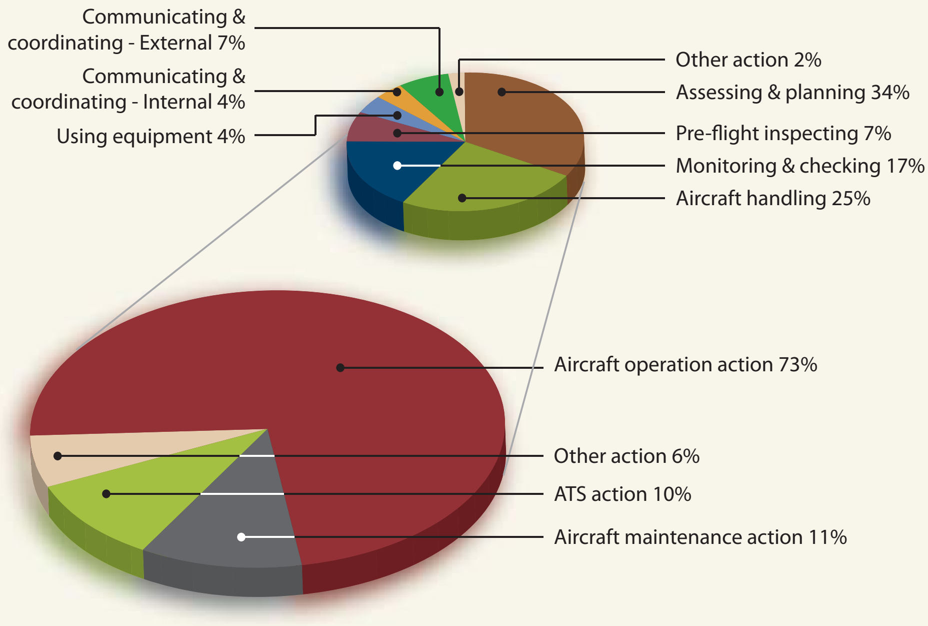
Individual actions in operational-related occurrences

The majority (73 per cent) of individual actions associated with operational-related investigated occurrences involved aircraft operation actions, that is, actions by the pilots or flight crew (Figure 62). Of the 340 aircraft operation actions identified, 34 per cent involved problems associated with assessment and planning activities such as pilot briefings. Common actions included not obtaining weather information, incorrectly calculating aircraft weight and balance, not allowing for sufficient fuel, and insufficient approach, waypoint, or circuit entry planning.

Aircraft handling actions that caused the aircraft to divert from the intended flight path or configuration accounted for a quarter of the aircraft operation actions identified. These problems generally involved the incorrect use of power and fuel settings, attitude control, stalls, speed on approach, inappropriate manoeuvres during emergencies, and excessive control inputs on landing (leading to bounces, ballooning, and heavy landings). They also included problems with the use of slats, flaps, spoilers, speed brakes, reverse thrust, propeller controls, brakes, trim, and other similar ancillary controls.

The next most frequent aircraft operation action involving flight crew actions was associated with awareness of aircraft-system states, weather, and traffic (monitoring and checking), which accounted for 17 per cent.

Figure 62: Operational-related investigated occurrences: associated individual actions (all operation types), 2001 to 2007



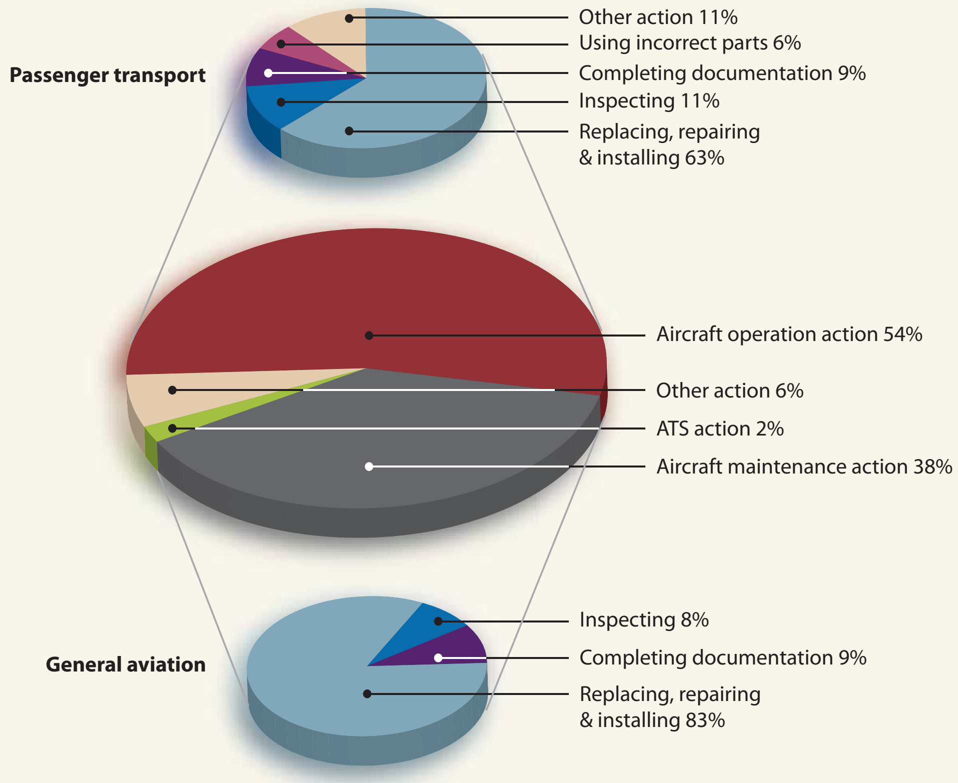
Individual actions in mechanical-related occurrences

There were 123 individual actions identified for investigated mechanical-related occurrences. About half (54 per cent) involved aircraft operation actions by the pilots or flight crew. The specific types of pilot actions were similar to those for operational-related occurrences (Figure 63).

Forty-seven (38 per cent) of the individual actions identified for mechanical-related occurrences were aircraft maintenance actions. In both passenger transport and GA operations, most concerned installation, replacement, and repairs to equipment during aircraft maintenance work (22 investigated occurrences in passenger transport operations and 10 in GA). These include items being installed incorrectly, under/over-torquing of bolts, and damage caused to parts during removal and installation.

To a much lower degree, aircraft maintenance actions also involved those associated with inspecting and documenting maintenance work conducted.

Figure 63: Mechanical-related investigated occurrences: associated individual actions, 2001 to 2007

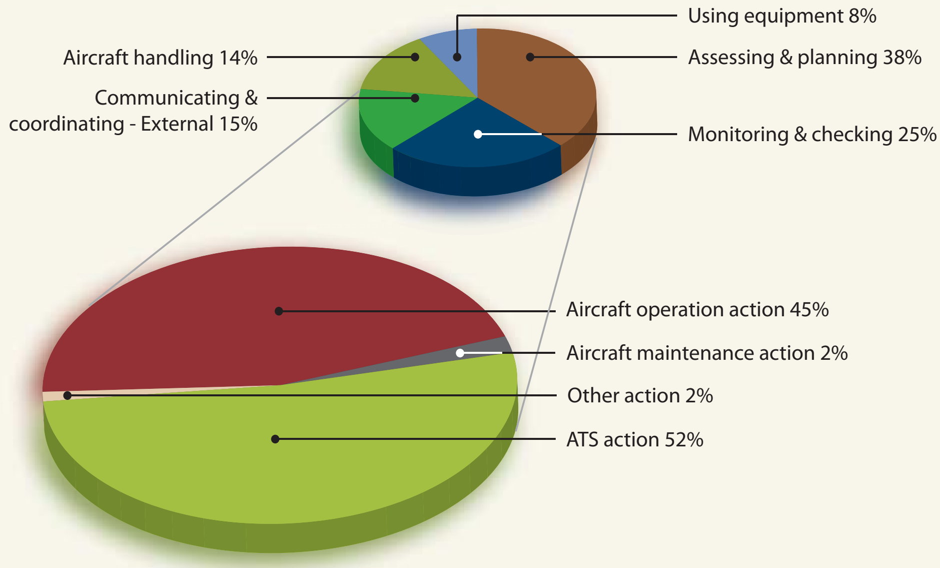


Individual actions in airspace-related occurrences

For the 112 investigated occurrences where an airspace-related event was involved, 75 involved passenger transport operations. Approximately half (52 per cent) of these were air traffic services (ATS) actions which increased safety risk (Figure 64). Of these, 27 were concerned with problems associated with assessment and planning activities by the air traffic controller. Such actions include providing path shortcuts to aircraft without an appropriate assessment of the implications, and not requesting assistance when under high workload. A further 23 investigated occurrences were associated with poor communication of relevant operational information to flight crew, other ATS personnel (not including handovers), or other relevant parties.

Aircraft operation actions were involved in 45 per cent of investigated airspace-related occurrences. Most of these were related to assessing and planning, as well as monitoring and checking activities (63 per cent in total).

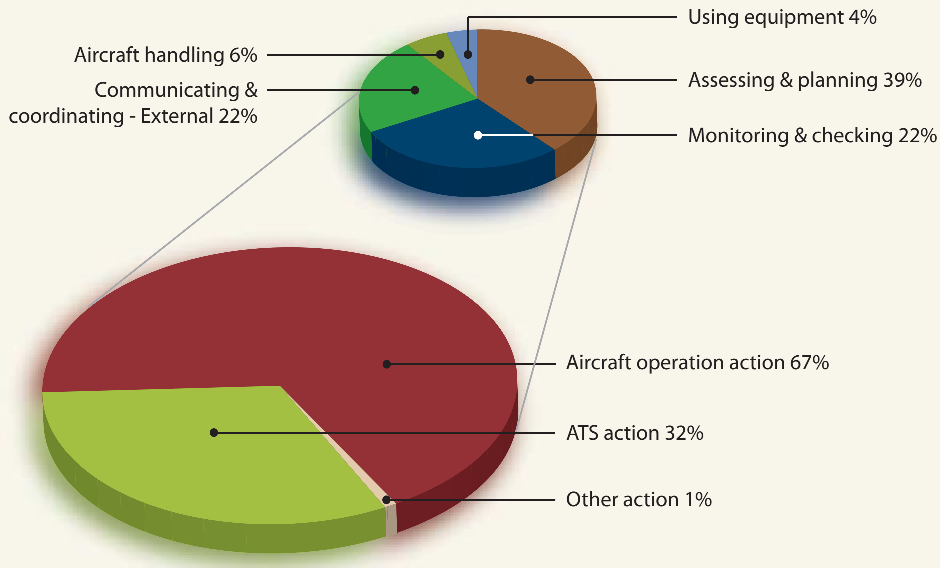
Figure 64: Passenger transport airspace-related investigated occurrences: associated individual actions, 2001 to 2007



In contrast, ATS-actions only accounted for one-third of individual actions in GA investigated airspace-related occurrences (Figure 65). However, it is important to note that most GA aircraft do not operate in controlled airspace. Aircraft operation actions were the main individual action identified, accounting for 49 of the individual actions associated with GA airspace-related investigated occurrences. Like passenger transport operations, most of these operation actions were related to assessing, planning, monitoring and checking.

Of the 23 ATS actions, 10 were communications related and nine involved assessing and planning.

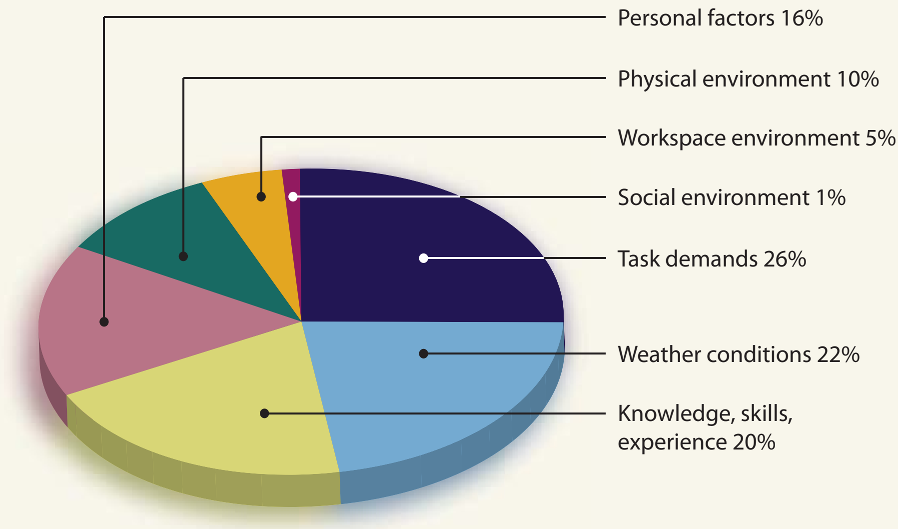
Figure 65: General aviation airspace-related investigated occurrences: associated individual actions, 2001 to 2007



Local conditions

The proportion of all local condition safety factors associated with investigated occurrences is presented in Figure 66. As there were only minimal differences between passenger transport and GA over the reporting period, the proportions presented below are combined.

Figure 66: Local conditions associated with investigated occurrences (all occurrence and operation types), 2001 to 2007



The most common local condition identified involved operator task demands, which were involved in 86 investigated occurrences (26 per cent). These mostly included distractions (31 occurrences) and high workload (23 occurrences). Distractions are specific interruptions, problems and events that are not of primary task importance and interfere with the ability of the individual to perform effectively. Common distractions were nearby traffic, and programming of global positioning system data. Some distractions involved air traffic control personnel, where they were distracted by activity at a neighbouring console, or by other aircraft in the airspace. High (mental) workload refers to situations where the number or complexity of task demands exceeds the ability of the individual to perform effectively. This was often due to high traffic density, late runway changes, or a complicated approach.

Weather-related issues accounted for 22 per cent of all local condition safety factors identified (72 cases). These included situations where aircraft performance or aircraft controllability had been influenced by the direction or magnitude of wind (25 per cent), limited visibility (18 per cent), turbulence (17 per cent), icing conditions including airframe icing, propeller icing, and carburettor icing (14 per cent), and windshear (11 per cent).

Issues with the pilot or flight crew's knowledge, skills and experience accounted for 20 per cent of local conditions. In these situations, the individual:

- did not have the required knowledge and/or skills to effectively conduct required tasks for normal operations, abnormal/emergency operations, or communication/teamwork tasks (43 per cent); or
- did not have sufficient total experience or recent experience to conduct tasks appropriately (40 per cent).

Personal factors accounted for 16 per cent of local conditions, and mostly involved pilot mental fatigue (time of day, length of shift, amount of sleep) and physical fatigue (36 per cent), and spatial disorientation (19 per cent).

A further 10 per cent of local conditions involved the physical environment. These mostly involved situations where the light conditions outside of the aircraft influenced the pilot's ability to detect or process visual information, including darkness, low light levels, and phenomena such as whiteout or sun glare. Problems associated with a lack of environmental cues were often related to visual illusions.

Risk controls

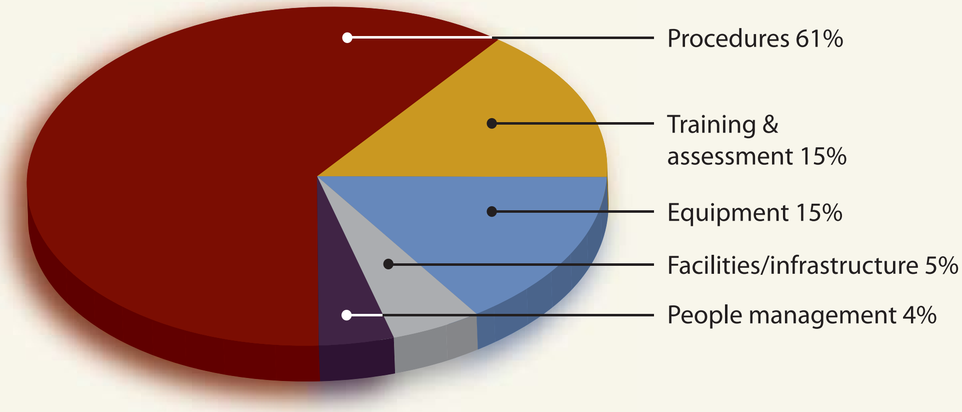
The majority (61 per cent) of problematic risk controls identified for investigated occurrences between 2001 and 2007 involved procedures (Figure 67). These were mostly due to problems associated with the consistency, completeness, and ease-of-use of procedures, checklists and work instructions used by operational or maintenance personnel.

Problems with the design, delivery or availability of training provided to operational personnel accounted for 15 per cent of the risk control issues. These issues related to induction training, and initial/recurrent training for normal operations, emergency operations, and crew resource management skills. They also included problems with the checking or evaluation of individuals' performance.

While both procedures and training/assessment relate to preventative risk controls, issues with recovery risk controls also have the potential to increase safety risk. A further 15 per cent of problematic risk controls mostly related to the performance of equipment designed to reduce risks. Commonly, this involved problems with the design or availability of:

- appropriate equipment that detects and/or provides cautions, advisory messages, alerts, or warnings of abnormal system states such as ground proximity warning systems (GPWS) or engine indicating and crew alerting system (EICAS) (28 per cent);
- displays or controls that made it difficult to detect or process information, or execute control actions. This included factors such as location, size, shape, lighting, labelling, and use of symbols (28 per cent); and
- personnel protection equipment such as barriers, crashworthiness design, seat belts, personal protective equipment, exits, life jackets, and fire extinguishers (17 per cent).

Figure 67: Risk controls associated with investigated occurrences (all occurrence and operation types), 2001 to 2007



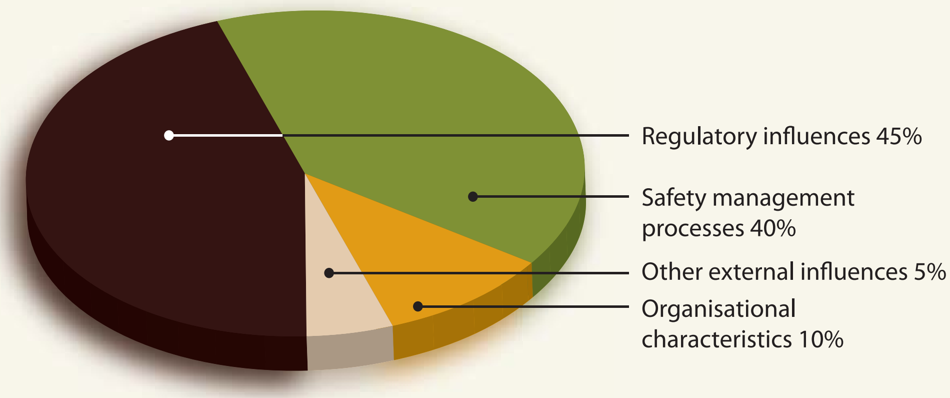
Organisational influences

The most common organisational influences involved in investigated occurrences between 2001 and 2007 were regulatory influences (45 per cent) and safety management processes (40 per cent) (Figure 68).

Regulatory influences included problems associated with the aviation safety regulation (Acts, Regulations, and associated advisory material such as Advisory Circulars) and compliance monitoring activities (accreditation, audit, inspection, intelligence gathering and enforcement) of the aviation regulator.

Safety management system safety factors refer to problems associated with the processes an organisation uses to establish, maintain and otherwise ensure the effectiveness of its risk controls. The most common safety management process issues were less than adequate risk assessments of operations, and operators not having a formalised flight safety program in place.

Figure 68: Organisational influences associated with investigated occurrences (all occurrence and operation types), 2001 to 2007



An immediately reportable matter (IRM) is a serious transport safety matter that includes accidents involving death, serious injury, and destruction or serious damage to aircraft or property; or occurrences when an accident nearly occurred.

Chapter 5

Reporting accidents and incidents

What do I report to the ATSB?

On 1 July 2003, the reporting obligations for the aviation industry changed with the introduction of the *Transport Safety Investigation Act 2003* (the TSI Act) and *Transport Safety Investigation Regulations 2003* (TSI Regulations). For the first time, the types of occurrences that need to be reported to the Australian Transport Safety Bureau (ATSB) were prescribed. These types of occurrences were classified as either immediately reportable matters or routine reportable matters.

An immediately reportable matter (IRM) is a serious transport safety matter that covers occurrences such as accidents involving death, serious injury, destruction or serious damage of aircraft or property, or when an accident nearly occurred. The list of immediately reportable matters can be found at <www.atsb.gov.au/pdfs/tsi_act_regs.pdf>.

A routine reportable matter (RRMs) is a transport safety matter that has not had a serious outcome and does not require an immediate report. However, transport safety was affected or could have been affected. The list of routine reportable matters are contained in the TSI Regulations, part 2.4, and includes a non-serious injury or the aircraft suffering minor damage or structural failure that does not significantly affect the structural integrity, performance or flight characteristics of the aircraft and does not require major repair or replacement of the affected components.

The types of occurrences that are classified as an IRM or RRM are dependent on the type of operation of the aircraft. The classification of some types of occurrences remains the same across all operation types, while others vary depending on whether the aircraft is involved in air transport operations (regular public transport and charter) or operations other than air transport (such as GA). This difference in reporting requirements may be seen in this report when particular comparisons between passenger transport and GA occurrences are made.

The TSI Regulations, including the list the types of occurrences that qualify as IRMs and RRMs, are available online at <www.atsb.gov.au/pdfs/tsi_act_regs.pdf>.

What are my reporting obligations?

Under section 18 of the TSI Act, IRMs must be reported to the ATSB by a responsible person as soon as is reasonably practical. The reason for this requirement is the need for ATSB investigators to act as quickly as possible in order to preserve valuable evidence, which may help to determine the proximal and underlying factors that led to a serious occurrence. A written report about an IRM must be submitted within 72 hours.

Under section 19 of the TSI Act, a responsible person who has knowledge of an RRM must report of the matter to the ATSB within 72 hours of the occurrence.

A responsible person includes people involved with the operation of the occurrence aircraft (crew members, aircraft owners, air traffic controllers, licensed aircraft maintenance engineers, ground handling crew), and rescue and fire fighting personnel involved in the response to an accident or incident, Civil Aviation Safety Authority (CASA) staff, and the operator of an aerodrome where the event occurred. A full explanation of a responsible person is provided in part 2.5 of the TSI Regulations.

How do I report to the ATSB?

Immediately reportable matters (accidents and serious incidents) must, in the first instance, be notified to the ATSB as soon as is reasonably practicable. The ATSB can be contacted toll free on its 24-hour notification service on 1800 011 034.

Written notifications for all IRMs, in addition to the immediate notification by telephone, need to be made within 72 hours. All other occurrences (RRMs) only require a written notification within 72 hours.

Written notifications can be completed and submitted:

- online using the ATSB notification form, available from: <www.atsb.gov.au/mandatory/asair/index.aspx>;
- printed and faxed to the ATSB (02 6274 6434); or
- by mail to:
  ATSB, Attn: Notifications,
  Reply Paid 967,
  Civic Square ACT 2608).

Confidential reporting of incidents or concerns can also be made using the confidential reporting system (REPCON).

What does the ATSB do with accident and incident data?

When the ATSB receives a notification of an aviation occurrence, several processes occur. The first step is an assessment of whether the occurrence should be formally investigated. If an on-site investigation is to be conducted, a team of investigators will generally be dispatched to the site as soon as possible.

All reportable occurrences are entered into the ATSB occurrence database (known as the 'Safety Investigation Information Management System' or SIIMS). Various details about the occurrence, the aircraft(s) and the operator are coded based on the available information, sometimes from multiple notifications. One or more occurrence type categories (what occurred) are then assigned to the occurrence, and one or more safety factors (why the occurrence occurred) are also coded (where available information makes this possible).

Information about accidents and serious incidents involving aircraft over 2,250 kg are also forwarded on to the International Civil Aviation Organization (ICAO) for inclusion in the ICAO accident/incident reporting (ADREP) occurrence database.

Once quality checks of the data are complete, the data can be used for research reports such as this one. Occurrence data is also used for research investigations on specific topics, keeping track of safety trends, and by investigators as part of their research into specific aviation occurrences.

Aviation safety statistics, research, and analysis reports produced by the ATSB using the occurrence data collected over the years can be found on the ATSB website <www.atsb.gov.au>.

Aviation Occurrence Database

The aviation occurrence database is a version of the ATSBs aviation database that is available for public use. This allows users to extract data about aviation accidents and incidents using a basic set of parameters derived from the ATSB's SIIMS database. The ATSB will continue to review additional data fields to add to the search capability.

The public can access the Aviation Occurrence Database online at <www.atsb.gov.au/aviation/aviation_statistics.aspx>.

What is REPCON?

REPCON is a voluntary confidential reporting scheme that allows any person who has an aviation safety concern to report it to the ATSB confidentially. Protection of the reporter's identity is a primary element of the scheme.

Any matter may be reported if it endangers, or could endanger the safety of an aircraft. Examples include: unsafe scheduling or rostering of crew; crew or aircraft operator bypassing safety procedures because of commercial pressures; and non compliance with rules or procedures.

A REPCON report may be made by anyone who observes or becomes aware of a reportable safety concern. Reports can be made:

- online: <www.atsb.gov.au/voluntary/repcon.aspx>
- via telephone: 1800 020 505;
- via fax: 02 6274 6461);
- email: repcon@atsb.gov.au; or
- by mail:
  Reply Paid 600;
  PO Box 600
  Civic Square, ACT 2608.

REPCON staff will assess reports for clarity, completeness and significance for aviation safety. To do this, the staff may need to contact the reporter. Once satisfied that the report is as complete as possible, the staff enter the de-identified content of the report into the REPCON database.

A de-identified version of the report may be used to issue an information-brief or alert bulletin to a person or responsible organisation in a position to take action in response to the safety concern. Additionally, the de-identified report may be passed on to the aviation regulator (CASA) to make the organisation aware of unsafe practices, procedures or conditions.

Chapter 6

Birdstrikes in Australia

Birdstrikes are an ever present safety risk in aviation, causing millions of dollars of damage to aircraft every year. While birdstrikes occur frequently, with only a small number resulting in injuries to aircraft occupants or significant aircraft damage, they continue to pose a major risk to aircraft, particularly during the takeoff and landing phases of flight. This was recently illustrated by the ditching of an Airbus A320 aircraft into the Hudson River in New York City in January 2009. In that case, a flock of geese flew in close proximity to the aircraft and several birds were ingested into both engines. Following a successful ditching, all 155 passengers and crew were rescued before the aircraft sunk to the bottom of the frozen river.

In June 2008, the Australian Transport Safety Bureau (ATSB) published a research report titled An analysis of Australian birdstrike occurrences 2002 to 2006. The purpose of this report was not only to examine trends in birdstrike data, but to provide a brief historical picture of birdstrike organisations, explore some of the main control measures, and to describe any important or emerging risks.

A total of 5,103 birdstrike occurrences were reported to the ATSB during the five year reporting period. The number of birdstrikes reported annually increased from about 750 in 2002 to 1,200 in 2006.

More specifically, the study found:

- That around seven per cent of birdstrikes resulted in aircraft damage.
- To date, no fatal civil aviation birdstrike accident has occurred in Australia. However, three of the 5,103 occurrences resulted in minor injuries to the pilot. Two of these involved facial injuries due to a shattered windscreen and perspex canopy.
- The most serious potential safety concern associated with birdstrikes on large aircraft is engine ingestion. Engine ingestion occurred in 296 (six per cent) of occurrences, and dual engine ingestion occurred in eight of these occurrences. Four of the eight dual engine ingestions involved some damage, but all aircraft were able to land without any injuries to crew or passengers.
- Two-thirds of birdstrikes involved regular public transport (RPT) operations, mostly from high capacity RPT aircraft.

- Most birdstrikes occurred at an aerodrome (81 per cent) or near an aerodrome (14 per cent). This was to be expected given the concentration of birds near the ground.
- Two loss of control accidents occurred as a result of birdstrikes. Both of these involved helicopters in which the tail rotor was struck by a bird.
- Overall, the birdstrike rate in Australia increased from around one to two birdstrikes per 10,000 total aircraft movements. Birdstrike rates for RPT were higher, ranging from 4.7 in 2002 to 6.7 birdstrikes per 10,000 movements in 2006.

Birdstrikes vary according to the type of aerodrome and location. General aviation (GAAP) aerodromes have a much lower birdstrike rate than their major aerodrome counterparts. At major aerodromes, the rate of birdstrikes ranged from 2.43 to 9.90 strikes per 10,000 total aircraft movements. Regional aerodromes had fewer birdstrikes on average, ranging from 1.03 to 7.25 strikes per 10,000 total movements.

The report also explored some of the reasons that may have led to an increase in birdstrikes in Australia. It appears that the number of damaging occurrences as a percentage of total birdstrikes for each year has stayed roughly the same, but the total number of reports has increased. This suggests that there are now more reports of non-damaging birdstrikes. A change in reporting practices is the most likely reason for the increase in birdstrike numbers.

Birdstrikes are a perennial risk for aircraft operators and aerodromes. No 'silver bullet' has been found to eliminate this risk; most bird hazard management strategies focus on reducing the risk to an acceptable level - this study was intended to assist industry to assess risk and clarify birdstrike trends.

Aviation Safety Research and Analysis reports are available from the ATSB website <www.atsb.gov.au> by following the links to the Aviation Safety – Aviation Research Publications area.

Appendix

About the ATSB

The ATSB is an operationally independent body located within the Department of Infrastructure, Transport, Regional Development and Local Government and is Australia's prime agency for transport safety investigations. Its mission is to help maintain and improve transport safety in Australia and public confidence in the safety of Australia's transport systems.

Among other things, the ATSB performs its work by conducting independent investigations of transport accidents and incidents and the making of safety action statements and recommendations that draw on the results of those investigations. It is not the purpose of the ATSB investigations to lay blame or provide a means for determining liability.

Under the *Transport Safety Investigation Act 2003* all accidents and incidents involving Australian civil aircraft must be reported to the ATSB. The ATSB will generally investigate those accidents or incidents which will yield the most useful safety benefits, however reporting of all accidents or incidents is still required to allow the ATSB access to accurate data for future statistical analysis. The ATSB can investigate accidents and the more serious incidents involving both general aviation (GA) and regular public transport (RPT), but does not have the resources to investigate accidents or incidents involving sports aviation (although it records events involving sport aviation into its database for future statistical analysis).

The role of other aviation bodies in Australia

The ATSB works closely with organisations such as CASA, Airservices Australia as well as various aircraft manufacturers and operators, and foreign investigation agencies with the aim of improving Australian aviation safety.

Data sources

Information on accidents, fatal accidents, fatalities, occurrence types and safety factors in this report was based on data derived from the Australian Transport Bureau's (ATSB) aviation safety occurrence database unless otherwise stated.

Data on pilot licences was derived from the Civil Aviation Safety Authority (CASA). Data on flight hours, aircraft registrations and passenger movements was derived from the collections produced by the Bureau of Infrastructure, Transport and Regional Economics (BITRE).

Various sporting aviation bodies were also contacted in order to provide any relevant data on non VH- registered aircraft that were available.

Glossary

Accident – an investigable matter involving an aircraft where:

a) a person dies or suffers serious injury as a result of an occurrence associated with the operation of the aircraft;

b) the aircraft is destroyed or seriously damaged as a result of an occurrence associated with the operation of the aircraft; or

c) any property is destroyed or seriously damaged as a result of an occurrence associated with the operation of the aircraft.

Aerodrome and airways facility (occurrence type) – occurrences related to aerodrome design, service or functionality; and those involving air traffic management facilities and equipment, navigation, and surveillance services.

Agricultural operations – operations involving the carriage and/or spreading of chemicals, seed, fertiliser or other substances for agricultural purposes, including the purposes for pest and disease control.

Airspace (occurrence type) – occurrences related to the separation, coordination and communication of aircraft operating in controlled airspace.

Approach – the phase of flight from 3,000 feet above ground level (AGL) to the runway threshold.

Charter – operations that involve the carriage of cargo or passengers but do not involve scheduled flights. The lack of scheduled flights and fixed departure and arrival points distinguishes charter operations from RPT operations.

Climb – the phase of flight above 3,000 feet AGL to ‘top of climb’.

Cruise – the phase of flight between ‘top of climb’ and ‘top of descent’.

Descent – the phase of flight from the ‘top of descent’ to 3,000 feet AGL.

Fatal accident – an aircraft accident in which at least one fatality results within 30 days of the accident.

Fatality – any injury acquired by a person involved in an aircraft accident and which results in death within thirty days of the accident.

Flying training – flying under instruction for the issue or renewal of a licence, rating, aircraft type endorsement or any other type of flying aimed at upgrading an individual's flight qualification, including solo navigation exercises conducted as part of a course of applied flying training. Check and training operations conducted by RPT operators are also included.

General aviation (GA) – covers non-scheduled flying activity with the exception of ultralights, gliders, hang gliders, gyroplanes, balloons and military aircraft. It can be divided between commercial and non-commercial operations. Commercial operations are those which are performed on a hire and reward basis, including agricultural operations, flying training and other aerial work. Non-commercial operations are those that are not performed for hire and reward such as private/business operations.

Hours flown – calculated from the time that the engine starts, with the intention of flight, to the time the engine stops after completion of the flight.

Incident – an occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operation.

Individual action – a safety factor in which observable behaviours performed by operational personnel (such as the pilot, flight or cabin crew, or ground maintenance and handling personnel) increased safety risk in an accident or incident.

Initial climb – the phase of flight from 50 feet above the runway to a height of up to 3,000 feet AGL.

Landing – the phase of flight from a position over the runway threshold until the aircraft exits the landing runway or comes to a stop, whichever occurs first.

Manoeuvring/airwork – the phase of flight where the aircraft is being manoeuvred to conduct activities including aerial agriculture, mustering, low level flying, fire fighting control, and stalls.

Mechanical (occurrence type) – those occurrences related to the malfunction or failure of an aircraft system, structure or component.

Military aviation – any aircraft registered to a military authority such as the Australian Defence Force.

Minor injury – an injury sustained by a person in an accident that was not a fatal or serious injury and does not require hospitalisation.

Missing aircraft – an aircraft is considered to be missing when the official search has been terminated and the wreckage has not been located.

Occurrence – an accident, serious incident, or incident.

Operational (occurrence type) – occurrences related to the process, procedure and handling of an aircraft.

Other aerial work – includes operations conducted for the purposes of aerial work other than 'flying training' and 'agricultural operations.' Operations classified as other aerial work include aerial surveying and photography, spotting, aerial stock mustering, search and rescue, ambulance, towing (including glider, target and banner towing), advertising, cloud seeding, fire fighting, parachute dropping, and coastal surveillance.

Passenger transport – includes all operations in which passengers are carried on an aircraft or helicopter for hire or reward. Operations classified as passenger transport are high capacity regular public transport (RPT), low capacity RPT, and charter.

Private/business – private flying is conducted for recreational or personal transport, while the business category refers only to the use of aircraft as a means of transport to support a business or profession, but the aircraft is not used to generate revenue directly. Both private and business operations will be referred to collectively as private operations for the purposes of this report.

Regular public transport (RPT) – refers to aircraft that transport passengers and/or cargo according to fixed schedules and fixed departure and arrival points in exchange for monetary reward. These services can be further divided into low and high capacity aircraft.

- **Low capacity RPT** – an RPT aircraft that provides a maximum of 38 passenger seats or a maximum payload no greater than 4,200 kg.
- **High capacity RPT** – an RPT aircraft that provides more than 38 passenger seats or a maximum payload greater than 4,200 kg.

Safety factor – events or conditions that increase safety risk, i.e. increase the likelihood of an accident or incident, or the severity of the adverse consequences associated with one. Safety factors include contributing factors. They also include other factors which were not contributing factors to a specific accident or incident, but have the potential of contributing to future accidents and incidents. In simple terms, safety factors represent how and why the accident or incident happened or could have happened.

Sport aviation – any aircraft excluded from the RPT, GA or military aircraft categories including ultralights, glider, hang gliders, rotorcraft and balloon aviation. Most, if not all sport aviation craft are registered with various sporting bodies rather than with the Civil Aviation Safety Authority (CASA), although exceptions to this rule occur.

Serious incident – an incident involving circumstances indicating that an accident nearly occurred.

Serious injury – an injury which is sustained by a person in an accident that requires, or would usually require, admission to hospital within seven days after the day when the injury was suffered.

Standing – the phase of flight after the first person boards the aircraft with the intention of flight until the aircraft commences taxiing or push-back; or, the aircraft having reached the parking position until the last person has exited the aircraft.

Takeoff – the phase of flight from the application of take-off power up to 50 feet above the runway.

Taxiing – the phase of flight where the aircraft is moving from the parking position to the departure runway, or leaving the landing runway for parking on completion of the flight.

Technical failure – a safety factor involving the unexpected, inadequate, or non-performance of equipment and components involved with an aircraft and their associated parts and systems. This includes the performance of facilities that support safe aircraft operations, such as navigational aids, lighting, and communication facilities.