Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY RESEARCH REPORT

Aviation Research AR-2007-061

Second edition

Australian Aviation Safety in Review: 2002 to 2006

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Australian Aviation Safety in Review: 2002 to 2006

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Abstract

In 2007 the Australian Transport Safety Bureau (ATSB) produced the inaugural edition of *Australian Aviation Safety in Review* as part of the ATSB's role to enhance public awareness of aviation safety. The Review has been developed to provide a readily accessible analysis of the Australian aviation sector, with a strong focus on safety trends. This publication covers all major categories of aircraft operations, from regular public transport (RPT) to general aviation (GA), and includes some information about sports aviation.

Demographic and activity data on Australian aviation is provided in order to provide a context within which to examine accident trends. Accidents are presented both in terms of the raw number of accidents and as rates per 100,000 hours flown, to enable a comparison between operational categories. The latest year for which flying hours are available is 2006. Accordingly, this edition of the *Australian Aviation Safety in Review* covers the five calendar years 2002 to 2006, offering insights and information about key trends and emerging issues.

This is the second edition of *Australian Aviation Safety in Review* and the ATSB intends to update this report in the future as a means of informing both the aviation community and the wider public about Australian aviation accident and activity trends.

Minister's foreword

I am delighted to release the second edition of the Australian Transport Safety Bureau's *Australian Aviation Safety in Review*. The inaugural edition established a new benchmark for presenting aviation safety data and this edition builds on that work and consolidates some of the key safety indicators that will be of great interest to the aviation community. It is particularly timely given the Green and White Paper process I have announced on behalf of the Government.

In keeping with the format developed for the first edition, this report provides data and analysis covering five calendar years (from 2002 to 2006) divided into four broad sections.

The first chapter deals with the size and structure of Australia's aviation sector, including some useful information about the number of aircraft registered in Australia, their average age and the amount of activity in different sectors.

The next two chapters delve into measures of aviation safety. Chapter 2 examines the number of accidents and fatal accidents and their rate expressed as a proportion of annual flying hours. Chapter 3 takes a closer look at the nature of accidents in Australia and analyses accidents by phase of flight.

In Chapter 4 the special topic covered is controlled flight into terrain, or CFIT accidents.

I trust this report provides a helpful reference for those seeking some quick facts about the safety of Australia's aviation sector. By better understanding the accident trends in aviation, we can work together to strengthen Australia's position as a world leader in aviation safety.

I commend the report to you.

Minister for Infrastructure, Transport, Regional Development and Local Government

Leader of the House

Aviation safety in Australia is administered through a tripartite relationship involving the Department (including the ATSB), Airservices Australia and CASA.

Chapter 1

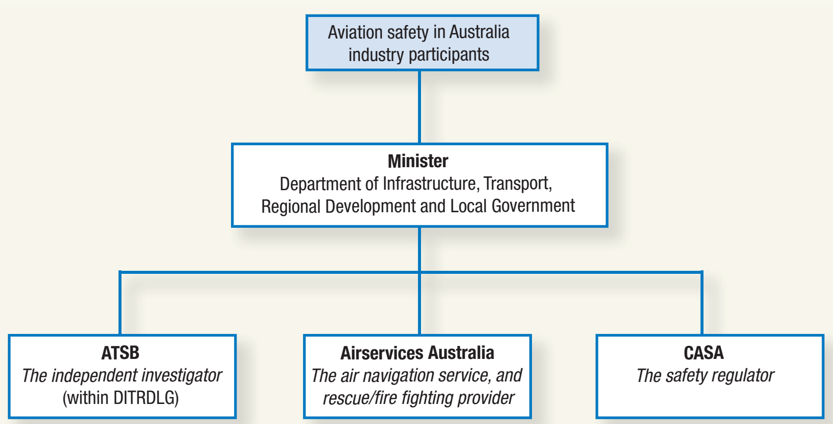
The Australian aviation sector

Who does what?

Aviation safety in Australia is administered through a tripartite relationship involving the Department of Infrastructure, Transport, Regional Development and Local Government (including the Australian Transport Safety Bureau), 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 transport accidents and incidents. 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 aviation operations in Australia and the operation of Australian aircraft overseas. On 1 July 2007, CASA's responsibilities expanded with the transfer of airspace regulation from Airservices Australia to CASA. CASA also provides safety education and training programs including a range of materials on a broad array of subjects such as safety management systems, pilot guides, and the publication of the *Flight Safety Australia* magazine.

FIGURE 1: Tripartite Government relationship for aviation safety



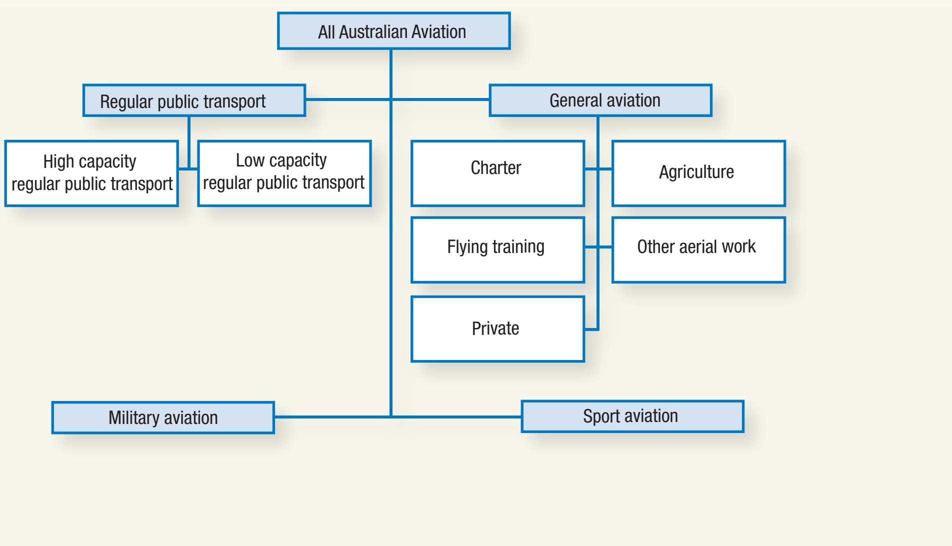
- Airservices Australia provides air traffic control management over an area that covers 11 per cent of the earth's surface. This not only covers the Australian flight information region, but also international airspace over the Pacific and Indian Oceans. Airservices Australia also provides the industry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

While each Government organisation has a distinct function, they share a common goal: *safe aviation*, and work in partnership with industry and each other.

How is Australia's aviation industry organised?

The Australian aviation industry is generally divided into four categories (Figure 2). The two main categories are regular public transport (often abbreviated to RPT), and general aviation (commonly referred to as GA).[1] 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, 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 flights, 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 composition of the Australian aviation industry



1. This arrangement reflects the categorisation of the aviation industry as it was in December 2006.

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 research and statistical analysis.

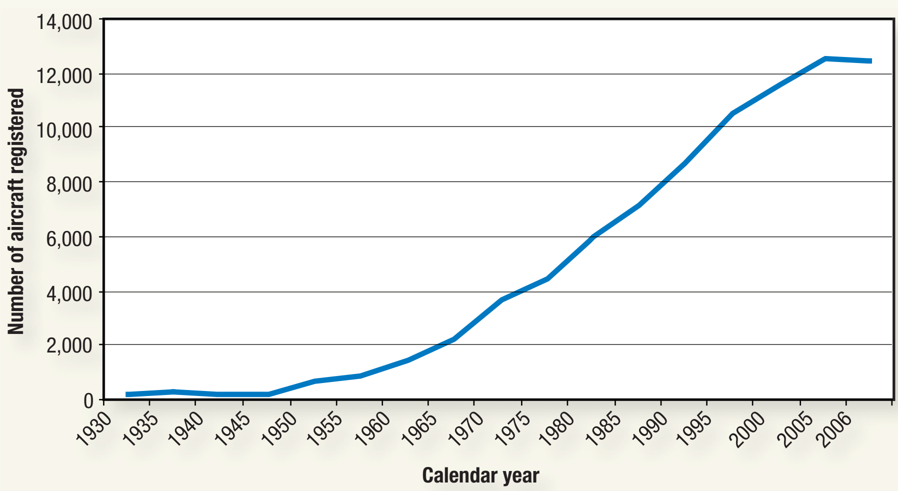
How many aircraft are registered in Australia?

Aircraft in Australia are registered with CASA[2]. Aircraft on the CASA civil aircraft register are assigned a registration number, which is also known as the 'tail' number. Every number is unique and is identified by the prefix 'VH' followed by three letters (e.g. VH-ABC).

The Australian aviation industry has experienced remarkable growth since the Second World War. In 1945, former Royal Australian Air Force aircraft no longer required for military service were released by the Commonwealth Disposals Commission for civilian use, resulting in the rapid re-establishment of aero clubs for pilot training. Australian airlines and the Department of Civil Aviation purchased US$500,000 worth of used aircraft from the United States Foreign Liquidation Commission, with the majority of these aircraft becoming the mainstay of the post-war airline development in Australia[3].

In 1945 the number of aircraft on the Australian civil register was 205. This increased to 750 aircraft in 1950, and by the end of 2006 there were 12,473 aircraft on the civil aircraft register (Figure 3). The vast majority of aircraft on the register operate within the GA sector of the industry.

FIGURE 3: Number of aircraft on the Australian civil register, 1930 to 2006



Source: CASA

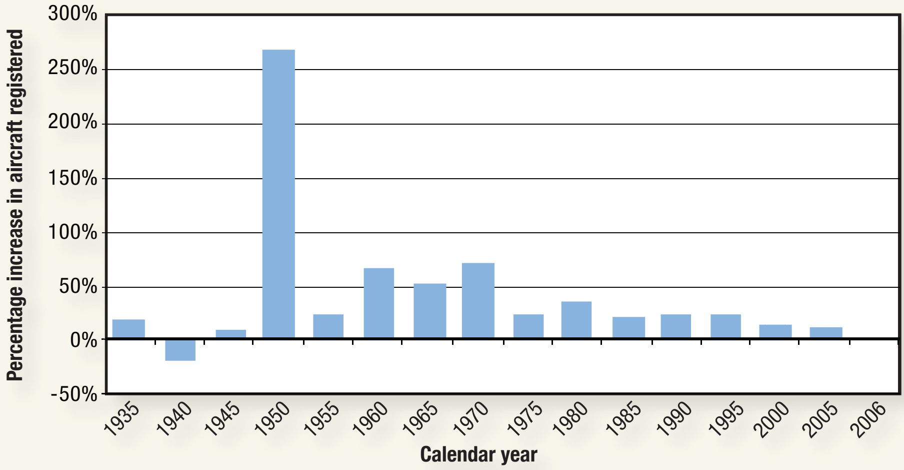
2. Some aircraft are registered with Recreational Aviation Australia, the organisation responsible for the administration of non-VH registered recreational and sport aviation aircraft in Australia.

3. Parnell, N. & Boughton, T. (1988). *Flypast: A Record of Aviation in Australia*. Canberra: AGPS.

Since 2000 the growth in aircraft registrations has slowed.

Since 2000, the growth in aircraft registrations has slowed, and for the first time since 1940, in 2006 there was a slight decrease in the number of aircraft on the Australian civil register (Figure 4). This may be attributed to the introduction of new CASA regulations relating to aircraft registrations. In this change, about 300 aircraft were removed from the register due to the aircraft owner not providing CASA with the required documentation for transition to the new rules. This, however, was a temporary state with some aircraft subsequently being re-registered under the new regulations.

FIGURE 4: Percentage increase in aircraft registrations, 1935 to 2006[4]



Source: CASA

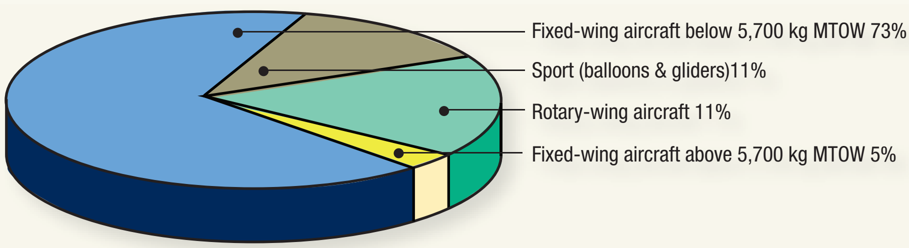
CASA records data on fixed-wing (aeroplanes) aircraft registrations according to categories determined by the aircraft's maximum take-off weight (MTOW). For historical purposes, fixed-wing aircraft are divided into two weight categories: aircraft with a MTOW below 5,700 kg and aircraft with a MTOW above 5,700 kg[5]. Aircraft below 5,700 kg generally include most aircraft in the GA category, from small two-seat training aircraft such as the Cessna 152 to aircraft used in charter and low capacity RPT operations such as the Piper PA-31 Chieftain and the Cessna 441 Conquest. Aircraft above this weight category include turboprop and turbofan aircraft found in corporate aviation, the airlines and some charter operations.

4. In 2006, there was a one per cent decrease in aircraft registrations.

5. Aircraft with a MTOW of 5,700 kg and below are referred to as 'below 5,700 kg' and aircraft with a MTOW of 5,701 kg and greater are referred to as 'above 5,700 kg'.

By the end of 2006, there were 9,152 fixed-wing aircraft on the Australian register, of which 73 per cent had a MTOW below 5,700 kg and five per cent were above 5,700 kg. While fixed-wing aircraft account for the greatest proportion of aircraft, the number of rotary-wing (helicopters) aircraft continues to grow, from 717 in 1997 to 1,322 in 2006 (Figure 5).

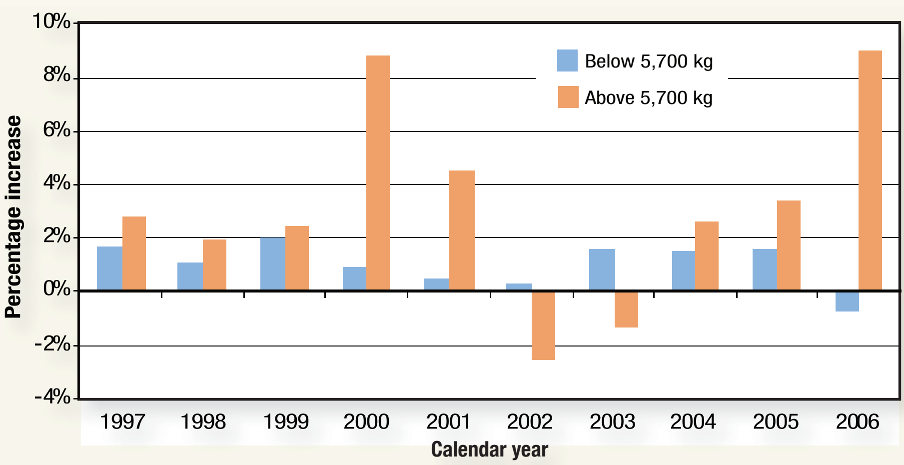
FIGURE 5: Proportion of aircraft by category, 2006



Source: CASA

The growth of fixed-wing aircraft with a MTOW below 5,700 kg remained low over the 1997 to 2006 period. The highest percentage increase occurred in 1999, with two per cent, and the lowest occurred in 2006, with a decrease of one per cent. On the other hand, the growth of fixed-wing aircraft with a MTOW above 5,700 kg experienced a greater degree of variability over the 10-year period (Figure 6). This is largely due to airlines upgrading their existing fleets, the acquisition of new aircraft, low capacity RPT operators expanding into high capacity operations, and the introduction of new entrants into the market. The slight decrease in 2002 and 2003, may be attributed to the de-registration of Ansett Australia's aircraft fleet, with aircraft being withdrawn from use or exported overseas.

FIGURE 6: Percentage increase in fixed-wing aircraft registrations, 1997 to 2006



Aircraft registrations at a glance

Number of aircraft registered	*2005*	*2006*
Fixed-wing aircraft below 5,700 kg MTOW	9,218	9,152
Fixed-wing aircraft above 5,700 kg MTOW	569	620
Rotary-wing aircraft	1,291	1,322
Sport	1,458	1,379
Total	**12,536**	**12,473**

High capacity RPT operations continue to dominate RPT flying activity in Australia, making up 85 per cent of the total RPT hours flown.

Annual flight hours

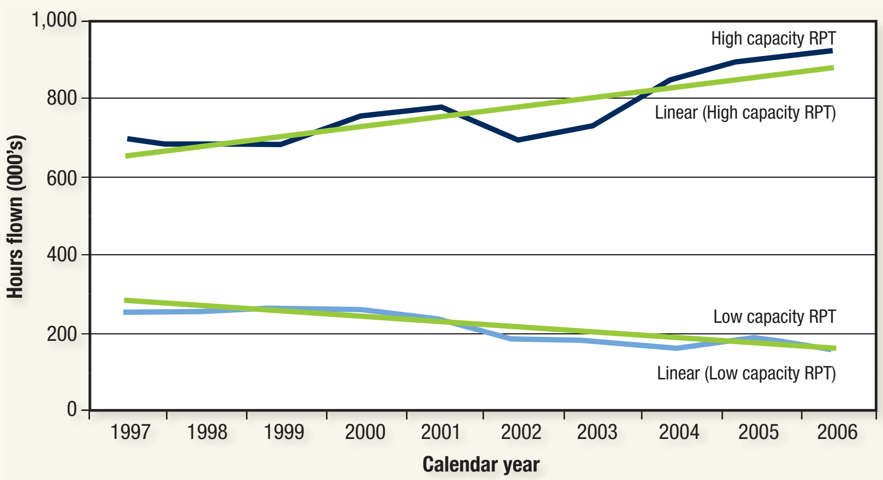
Regular public transport

Regular public transport (RPT) operators flew about 1.1 million flight hours in 2006, an increase of 0.5 per cent on 2005. High capacity RPT operations continued to dominate RPT flying activity in Australia, making up 85 per cent of the total RPT hours flown (Figure 7).

Between 1997 and 2006, high capacity RPT flying activity increased from 718,160 hours in 1997 to 953,777 hours in 2006. The years 2002 and 2003 saw a temporary setback in growth with the demise of Ansett Australia in the second half of 2001, the decline in tourism as a result of the September 11, 2001 terrorist attacks in the United States and in Bali, Indonesia on 12 October 2002, and the spread of the sudden acute respiratory syndrome (SARS). This decline was short lived as new entrants to the market, Virgin Blue and Jetstar, and the expansion of the Qantas domestic fleet restored growth. Of the high capacity RPT hours flown, about two-thirds are domestic/regional flights, while the remaining one-third are international flights. The demand for air transport has seen passenger numbers increase, particularly in the domestic/regional market. Since 1997, the number of passengers travelling within Australia has increased by 70 per cent. For international operations, passenger numbers have increased by 20 per cent. The growth in high capacity RPT is expected to continue with the introduction of Tiger Airways Australia in 2007 and V Australia in 2008, the expansion of Jetstar's international operations, Asia Air X operating flights to/from the Gold Coast, and low capacity RPT airlines expanding into high capacity RPT operations.

In comparison, low capacity RPT flying activity remained relatively stable at the beginning of the 10-year period, with the highest number recorded in 2000 (285,667 hours). Since this time the trend has been downwards. In 2006, there were 173,358 hours flown in low capacity RPT operations, a decrease of 13 per cent from the previous year.

FIGURE 7: Flying hours for high and low capacity RPT, 1997 to 2006



Source: BITRE

Why VH-?

The basis for registration markings used on today's aircraft originated from wire telegraphy. In the early days of radio communications, every radio station and operator along a telegraph line was assigned a radio callsign generally consisting of one to three characters and based on the geographic location, or personal or ship names. However, as there were very few standards relating to callsigns, some radio stations were assigned identical callsigns. The Service Regulations of the Berlin and London Radiotelegraphic Conventions stated that radio callsign letters must consist of a group of three letters, which are distinguishable from one another.

In 1913, the first systematic allocation of radio callsign letters was made at The London International Radiotelegraphic Conference where a partial allotment of call letters was assigned to the nations that signed the convention. With the consent of these nations, the call letters were modified by the International Bureau at Berne and published on 23 April 1913. These allocations were for use by all radio users including ground stations and ships. At this stage, aircraft were not considered a specific target for radio callsign letters.

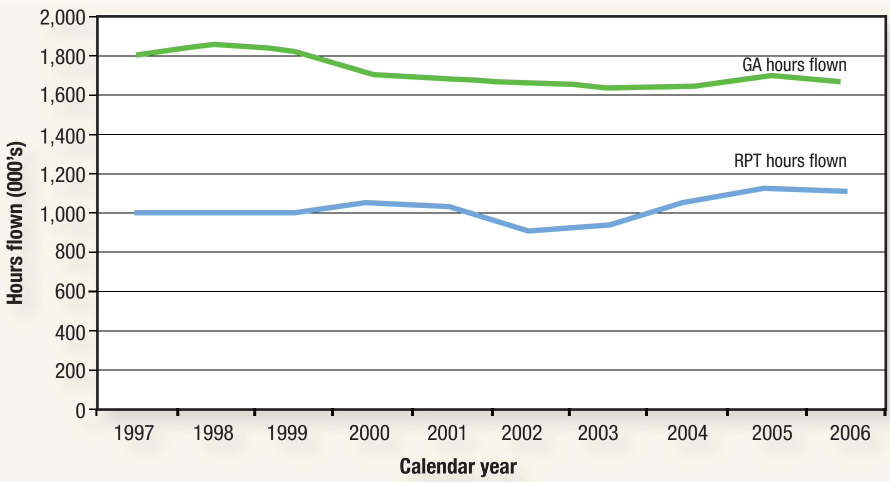
The allocation of call letters for aircraft registrations did not become widespread until the end of the Great War in 1919 when The International Commission for Air Navigation (ICAN) in Paris made allocations specifically for aircraft registrations based on the 1913 callsign list. British Commonwealth countries were allocated the letter 'G' with the next one or two letters indicating the countries within the Commonwealth. Australia was assigned 'G-AU'.

At the International Radiotelegraph Convention in Washington in 1927, a revised list of nationality and registration markings was produced. This list was adopted by ICAN in 1928 and remains the basis for those in use today. The Commonwealth of Australia was allocated the prefixes VH (civil aircraft), VI and VJ (coastal radio stations), VK (amateur radio), VL and VM (military aircraft post WWII). From January 1929, Australian aircraft began displaying the registration mark 'VH'.

General aviation

In 2006, GA aircraft flew around 1.7 million flight hours, about 600,000 hours more than RPT aircraft. Given that GA aircraft account for more than 80 per cent of the aircraft registered in Australia, the number of hours flown per aircraft, on average, is considerably less for GA aircraft compared with RPT aircraft. In the past 10 years, GA activity has been trending slightly downwards, with the highest number of hours recorded in 1998 (1,868,353 hours) and lowest in 2004 (1,634,646 hours flown) (Figure 8).

FIGURE 8: Flying hours for GA, 1997 to 2006

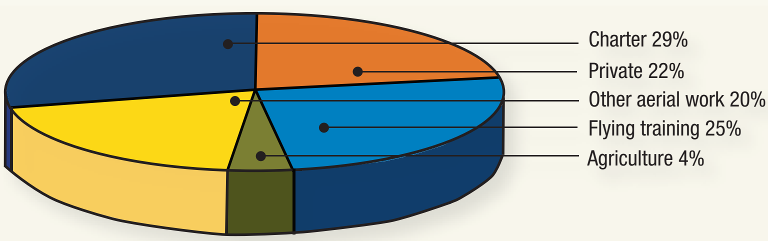


Source: BITRE

General aviation by type of operation

The majority of activity in the GA sector involved charter operations, accounting for 29 per cent of GA flying hours in 2006. This was followed by flying training, private and other aerial work operations (Figure 9).

FIGURE 9: Distribution of flying hours for GA, 2006



Source: BITRE

Charter: charter operations have experienced variable activity over the past decade. Between 1997 and 1999, charter activity was on the rise. Between 2000 and 2003, this trend changed, with activity falling to the lowest level recorded in the 10-year period to 423,087 hours. Since 2003, charter activity experienced a turn around, with the hours flown for the past three years averaging about 475,000 each year (Figure 10). This recent increase may be partly attributed to the resources boom, particularly in Western Australia, where charter aircraft are used for transporting personnel and equipment to and from the mines.

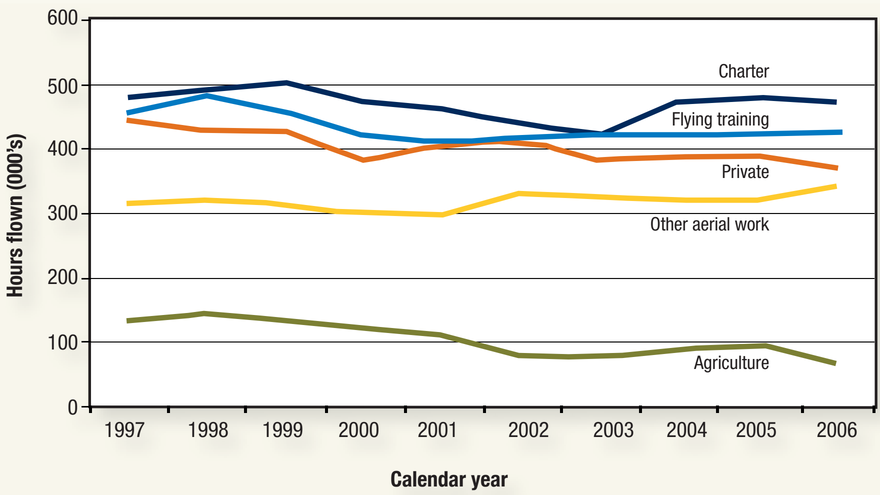
Flying training: has experienced a similar pattern to charter operations, with the highest number of hours flown recorded in 1998 and the lowest in 2001. Over the last four years, flying training has stabilised, with 428,434 hours recorded in 2006 (Figure 10).

Private: the overall trend for private flying has been downwards over the past decade, decreasing further to 371,639 hours in 2006 (Figure 10). In part, this may due to the increasing number of private pilots now flying non-VH registered aircraft.

Other aerial work: for the first half of the decade, activity declined to 300,231 hours in 2001. Since this time, other aerial work activity has increased, with the highest number of hours in the decade recorded in 2006 (343,500 hours flown) (Figure 10).

Agriculture: while aerial agriculture accounted for only four per cent of the total GA flying hours in 2006, this sector's contribution to the agricultural industry in spraying, seeding and fertilising crops is significant. Over the last decade, flying hours in this sector have declined. In part, this may be a consequence of a prolonged drought in many areas of rural Australia, particularly the decline in hours for 2002, 2003 and 2006. In 2006, aerial agriculture flew around half the hours flown in 1997 and one-third less than 2005 (Figure 10).

FIGURE 10: Flying hours for GA by operation, 1997 to 2006



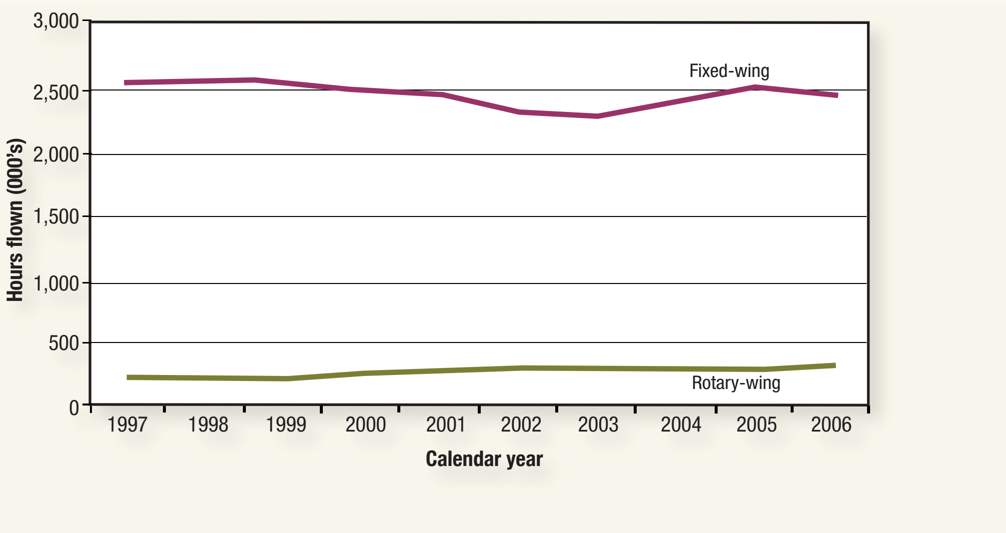
Source: BITRE

Fixed-wing and rotary-wing aircraft

Fixed-wing and rotary-wing aircraft have different operational capabilities that lend themselves to different functions. For example, fixed-wing aircraft are typically used for carrying passengers, transporting cargo, and travelling long distances. Rotary-wing aircraft are optimised for travel over shorter distances, for activities into confined spaces, and for operations close to the ground such as surveying and photography, spotting, emergency medical services, search and rescue, and mustering.

As discussed earlier in the chapter, the number of rotary-wing aircraft on the Australian register has been on the rise. This has also been reflected in the number of hours flown with 249,973 hours recorded in 1997 to 340,091 hours in 2006 (Figure 11). The growth of rotary-wing aircraft in Australia reflects that of the broader international trend with the demand for new helicopters increasing, particularly for VIP transportation, deep water oil exploration, and search and rescue operations.

FIGURE 11: Flying hours for fixed-wing and rotary-wing aircraft, 1997 to 2006

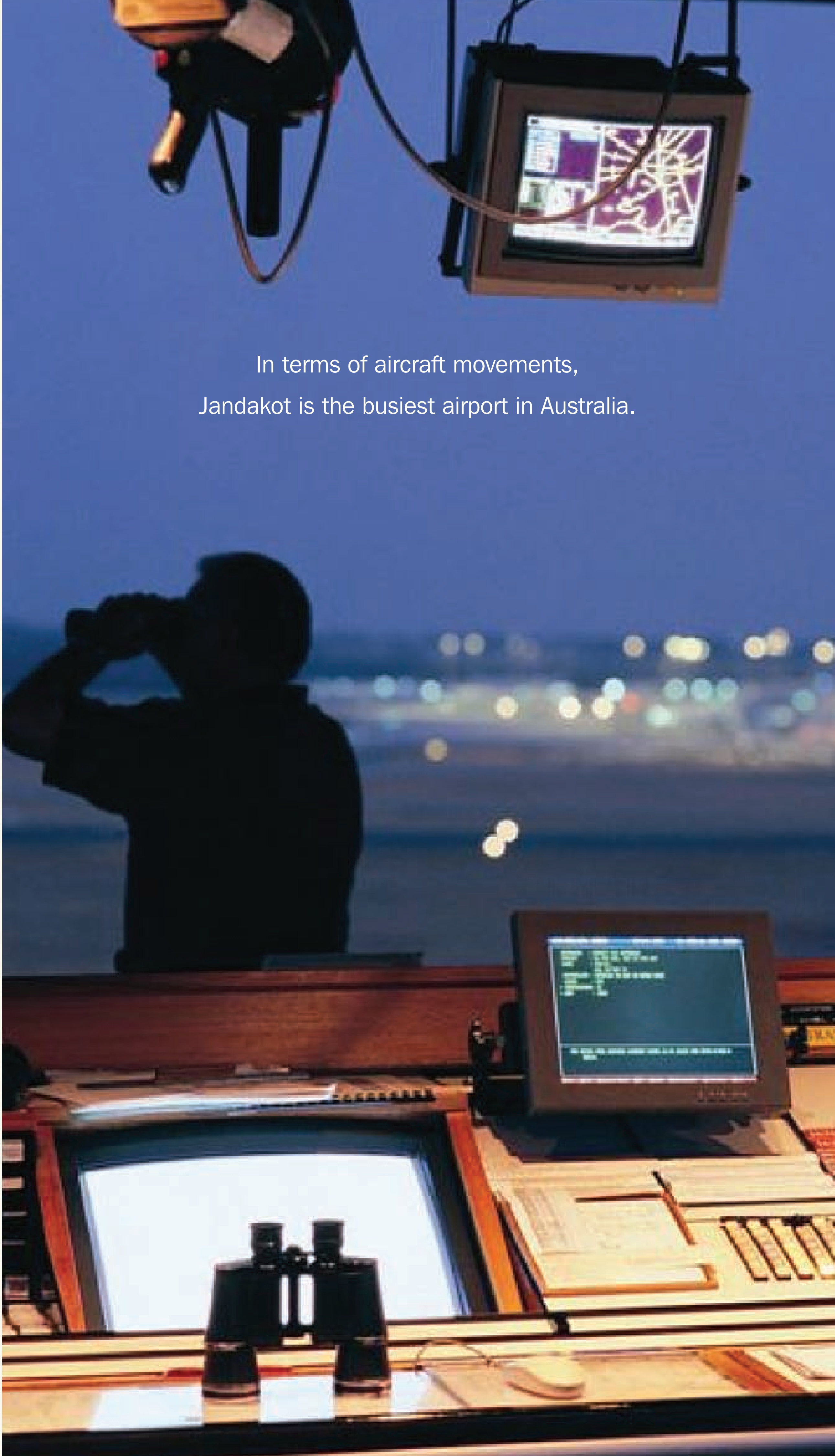


Source: BITRE

Annual flights hours at a glance

Operation type	*2005*	*2006*
RPT		
High capacity RPT[6]	922,618	953,777
Low capacity RPT	199,215	173,358
GA		
Private	389,666	371,639
Flying training	420,408	428,434
Agriculture	101,889	68,466
Other aerial work	324,565	343,508
Charter	477,531	473,499
Aircraft type		
Fixed-wing	2,507,627	2,472,591
Rotary-wing	328,264	340,091

6. High capacity RPT hours include both domestic/regional and international hours flown.



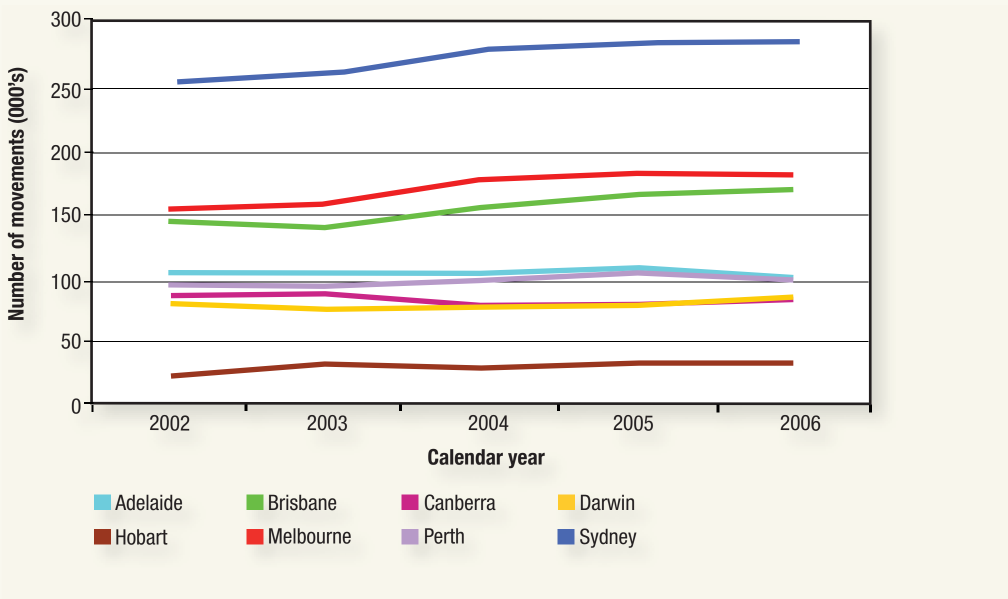
In terms of aircraft movements,
Jandakot is the busiest airport in Australia.

Aircraft movements

The number of takeoffs, landings and circuits undertaken at certain airports are collected by Airservices Australia[7]. Commonly referred to as aircraft movements, this information provides a useful indicator of the density of traffic at the varying airports.

Generally, Australia's capital city airports cater for RPT operations. However, airports such as Perth also service charter companies, particularly for transporting personnel to and from the mines. Of the capital city airports, Sydney, Melbourne and Brisbane have the greatest number of aircraft movements (Figure 12). This is understandable given that the majority of Australia's population is located on the eastern seaboard and that the majority of international flights also make their first destination port on the east coast. Along with the introduction of low cost carriers and competitive air fares across the airlines, flying has become a more accessible form of transportation for the travelling public.

FIGURE 12: Aircraft movements at capital city airports, 2002 to 2006



Source: Airservices Australia

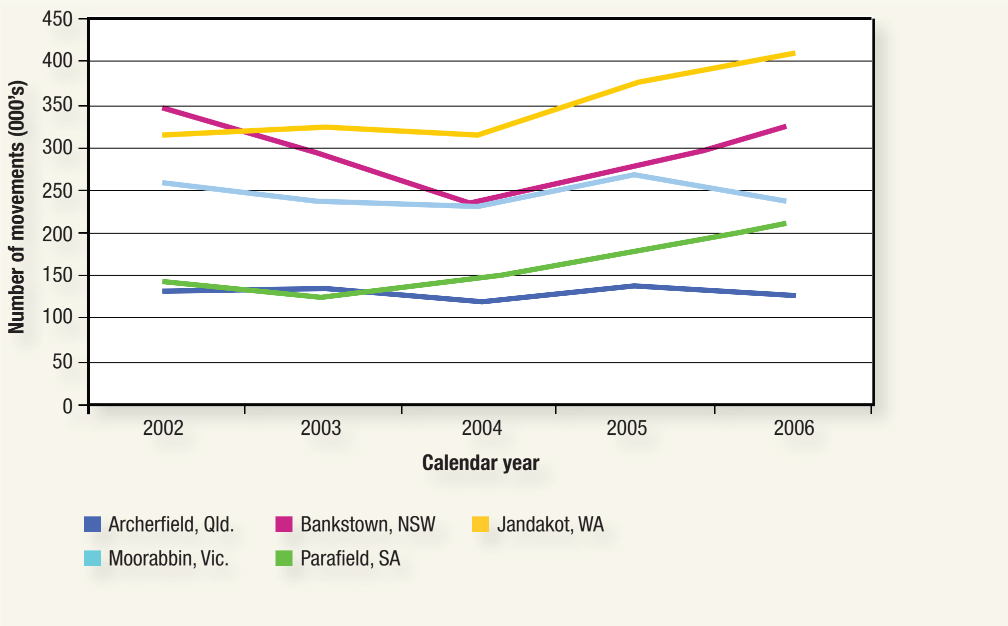
7. The number of aircraft movements may be underestimated as data is only recorded during hours of tower operation.

General Aviation Airport Procedures airports, known as GAAP airports, cater for high volumes of GA aircraft covering a broad range of activities. For example, Jandakot airport services organisations such as the Royal Flying Doctor Service, CALM Forest and Bushfire Patrol, the West Australian Police Air Support, and is the training base for international airline pilots with Singapore and China Southern flying colleges operating at the airport.

The majority of GAAP airports are located near capital city airports. For example, the respective GAAP airports for Sydney, Brisbane and Adelaide are Bankstown, Archerfield and Parafield.

Of the GAAP airports, Jandakot recorded the highest number of aircraft movements, with 407,148 movements in 2006. This was followed by Bankstown, which recorded 323,306 movements. In fact, the number of movements at each of these airports was more than that recorded for Sydney in 2006. The number of aircraft movements at Jandakot, Bankstown and Parafield airports increased markedly from 2004. In terms of aircraft movements, Jandakot is the busiest airport in Australia (Figure 13).

FIGURE 13: Aircraft movements at GAAP airports, 2002 to 2006



Source: Airservices Australia

Aircraft movements at a glance

Capital city airports	***2005***	***2006***
Adelaide, SA	106,840	99,286
Brisbane, Qld.	164,538	167,244
Canberra, ACT	77,306	81,830
Darwin, NT	77,924	83,240
Hobart, Tas.	30,344	30,576
Melbourne, Vic.	180,278	179,732
Perth, WA	101,648	99,560
Sydney, NSW	281,738	283,158
GAAP airports		
Archerfield, Qld.	141,466	131,744
Bankstown, NSW	275,846	323,306
Jandakot, WA	372,300	407,148
Moorabbin, Vic.	264,734	236,302
Parafield, SA	177,432	209,818

Aircraft age

The average age of aircraft

The average age of aircraft on the Australian register varies considerably between the major airlines and the GA/regional aircraft fleet.

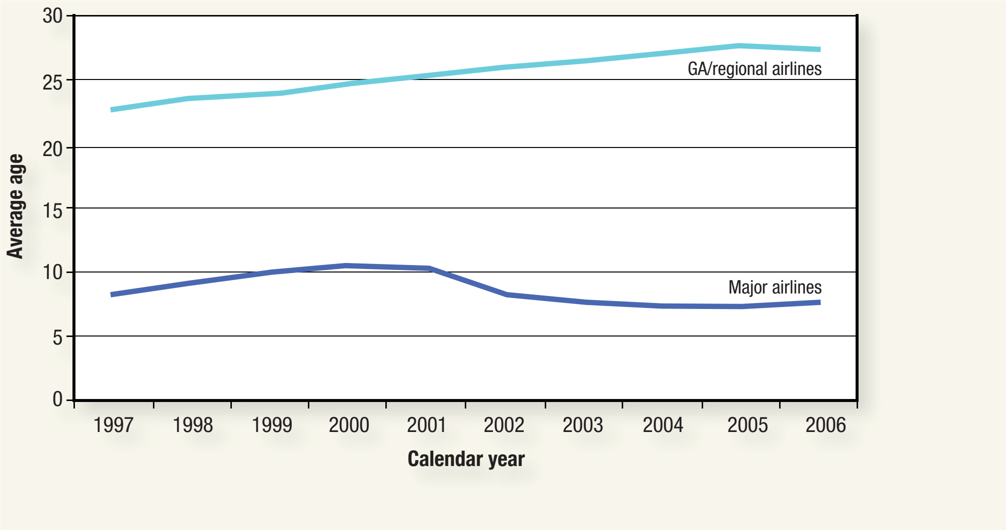
In the first half of the decade, the average age of the major airline fleet was on the rise, with the highest average of 10 years recorded in 2000 and 2001. However, the collapse of Ansett Australia in 2001 gave way for older aircraft to be replaced by new Boeing 737 and Airbus A320 aircraft operated by Virgin Blue and Jetstar, and the fleet update of Qantas. Since this time, the average age has declined, with the last four years maintaining an average age of seven years (Figure 14). The average age looks set to remain low in the future, with a number of new aircraft planned to be put into service by Australia's major airlines, including the introduction of Embraer E-Jets, Boeing 777, and Airbus A380 aircraft. This may further decrease with the market entry of Tiger Airways, which commenced Australian domestic operations in late 2007 using new generation Airbus A320s.

In comparison, the average age of aircraft operating in GA and regional airlines is considerably higher. Over the last five years, the average age has increased from 23 years in 1997 to 28 years in 2006 (Figure 14). The majority of aircraft operating within the GA sector of the industry are piston-engine aircraft.

As highlighted in an ATSB report which looked at the impact of ageing aircraft on aviation safety, the increasing average age of piston-engine aircraft is not unique to Australia. The average age of these type of aircraft in the United States is similar. This is unsurprising as the majority of GA aircraft registered in Australia were produced in the US. Between 1982 and 2004, there was a significant increase in the price of new GA aircraft in the US. For example, a new Cessna 172 cost approximately US$100,000 in 1982 and over US$150,000 in 2004 (in constant 2004 dollars). This increase was largely the result of lawsuits against aircraft manufacturers in the 1980s and early 1990s. As a result, aircraft deliveries fell from around 17,000 aircraft in the late 1970s to less than 500 aircraft by 1994. Manufacturers such as Cessna ceased production of single engine piston fixed-wing aircraft and Piper Aircraft Company went into bankruptcy. In 1994, the *General Aviation Revitalization Act* was passed, which limited liability for GA aircraft manufacturers to 18 years. Since this time, the production of GA aircraft has increased.

Regional airlines using 10–19 seater type aircraft are also finding it difficult to source replacement aircraft with few new types being produced today and a strong worldwide demand for used aircraft in this capacity range.

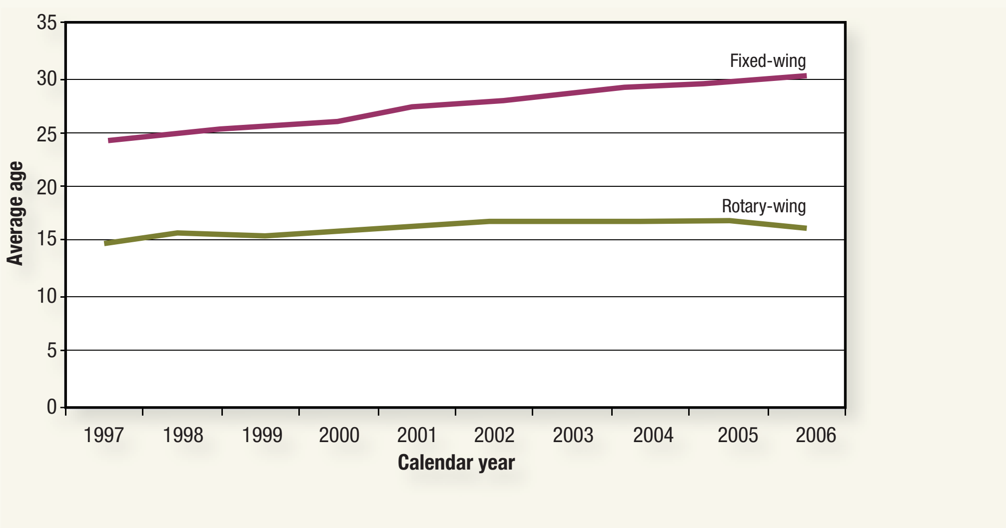
FIGURE 14: Average age of aircraft, 1997 to 2006



Source: BITRE

The average age of the rotary-wing aircraft fleet has remained stable over the decade largely due to the low number of helicopters on the aircraft register. Fixed-wing aircraft on the other hand continue to increase from an average age of 24 years in 1997 to 30 years in 2006 (Figure 15). These figures are similar to those for the GA/regional airlines fleet, which is expected given the dominance of the GA fleet on the aircraft register, approximately 80 per cent.

FIGURE 15: Average age of fixed-wing and rotary-wing aircraft, 1997 to 2006



Source: BITRE

Average age of aircraft at a glance

Fixed-wing aircraft	*2005*	*2006*
Piston engine	30 years	31 years
Turboprop	17 years	16 years
Turbofan (below 50,000 kg)	17 years	16 years
Turbofan (50,000 kg to 100,000 kg)	6 years	7 years
Turbofan (above 100,000 kg)	11 years	12 years
Rotary-wing aircraft		
Piston engine	15 years	13 years
Turboshaft	22 years	21 years

How many licenced 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 a fixed-wing or rotary-wing aircraft.

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 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.

Private pilot licence (PPL): Private pilots may fly themselves or passengers anywhere in Australia for recreational purposes.

Commercial pilot licence (CPL): 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): Air transport pilots may fly an aircraft as pilot in command or co-pilot in any operation, including a large airline type aircraft.

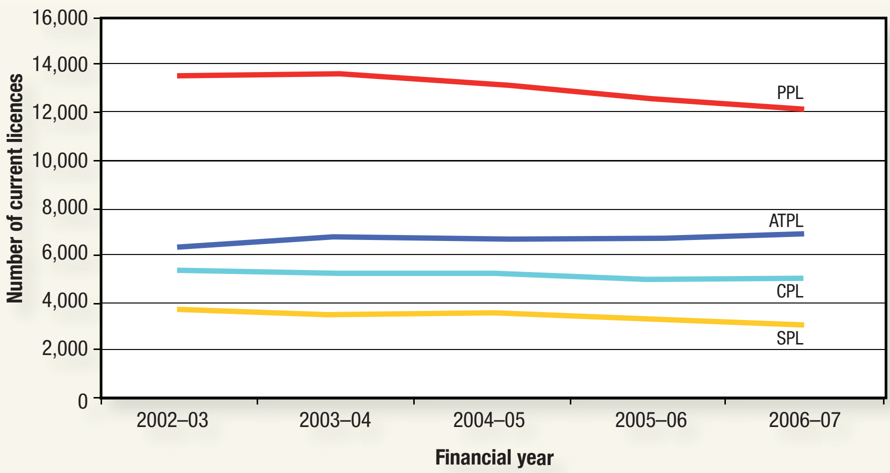
Number of pilot licences issued[8], 2002–03 to 2006–07

A pilot's flying skills and knowledge is tested throughout the course of his or her training by completing both theoretical and practical exams. Pilots are also required to undertake a medical examination to assess their general fitness. Many of these exams are conducted by the aviation industry or medical examiners on behalf of CASA. For a pilot licence to be current, the holder must have a valid medical certificate for that category of licence.

As holders of higher categories of licence will normally hold a licence in a lower category gained during their earlier training, the data here refers to the highest category of licence.

Overall, the past five years has seen a decline in the number of people in Australia holding a current pilot licence, from 29,093 in 2002–03 to 26,948 in 2006–07. This included student pilots who have passed the general flying progress test and are now allowed to carry passengers within the local flying training area. The PPL continues to remain the most common, making up 45 per cent of the current licences held in 2006–07. The next most common licence was the ATPL followed by the CPL (Figure 16).

FIGURE 16: Number of current pilot licences, 2002–03 to 2006–07

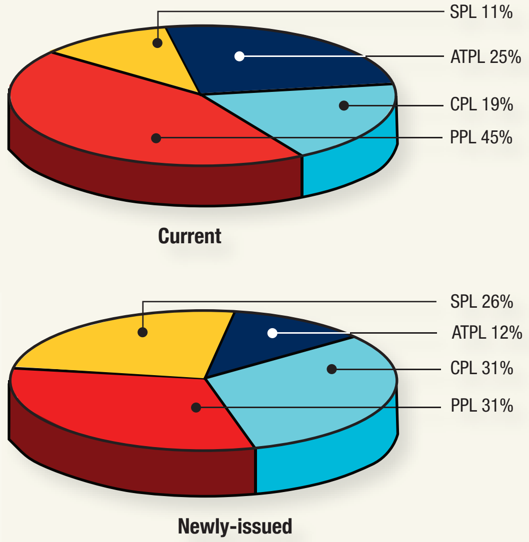


Source: CASA

Collectively, 44 per cent of licence holders are allowed to fly in a commercial capacity (ATPL and CPL), that is, for hire or reward, while the remaining 56 per cent fly for recreational purposes only (PPL) or are learning to fly (SPL). This was also similar for the number of newly issued licences with the CPL and ATPL together accounting for 43 per cent and the PPL and SPL making up the remaining 57 per cent (Figure 17).

8. Pilot licence numbers provided by CASA are based on financial years.

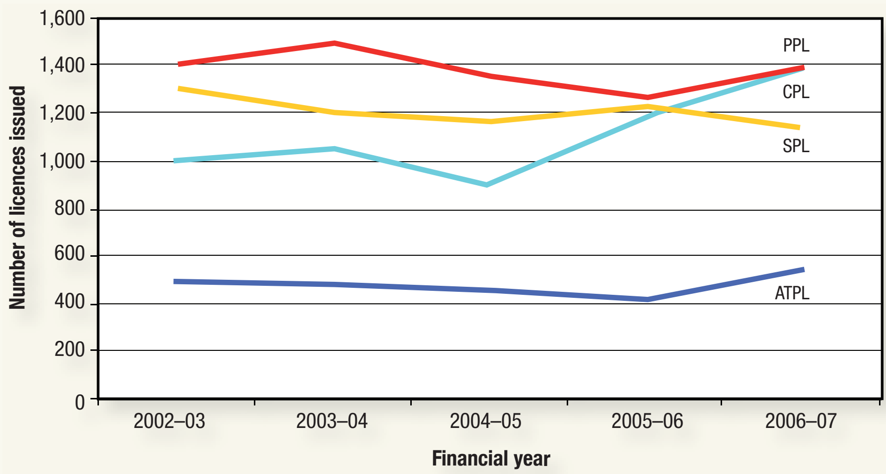
FIGURE 17: Proportion of current and newly-issued pilot licences, 2006–07



Source: CASA

With the exception of the SPL, 2006–07 saw a turnaround in the number of newly issued ATPLs and PPLs compared with the previous year. The number of newly issued CPLs was at its highest for the five-year period (Figure 18). In recent times, there has been considerable media attention about the lack of commercial pilots available, with some airlines suspending flights as a consequence of flight crew shortages. This increase in CPL issues may reflect the recent introduction of cadet pilot schemes in a number of airlines. These programs train people with no flying experience to become commercial pilots who then fly for that airline. It is possible that over the next couple of years, the number of CPLs issued will continue to increase as a result of such initiatives and help replace those leaving the industry.

FIGURE 18: Number of newly-issued pilot licences, 2002–03 to 2006–07



Source: CASA

The skills shortage in the aviation industry is not limited to pilots.

What is the multi-crew pilot licence (MPL)?

In response to airline's requesting a training path that focuses specifically on training pilots to operate in the airline environment, the International Civil Aviation Organization introduced a new type of pilot licence in November 2006 called the multi-crew pilot licence or MPL.

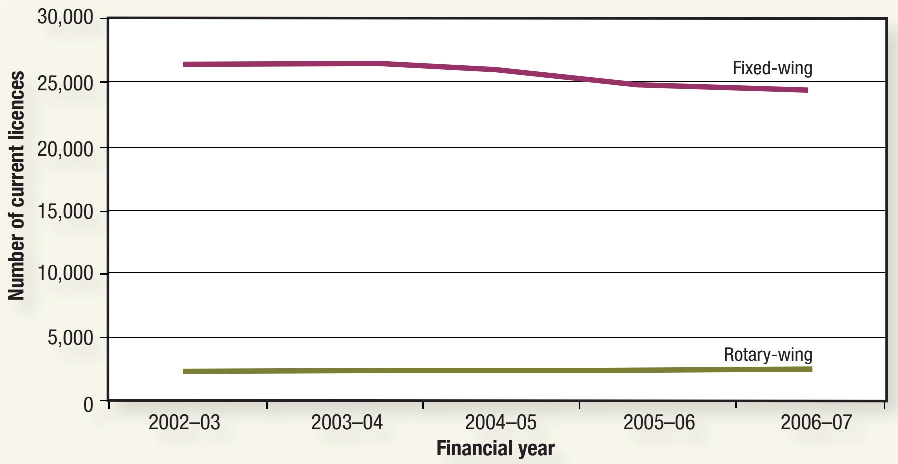
Traditionally, pilots are trained to operate in single-pilot operations and then later progressing to multi-crew operations. The purpose of the MPL is to train pilots from the beginning of their flying training to become a co-pilot on multi-crew aircraft. The MPL makes greater use of flight simulators, adopts competency-based training methods and applies human factors and threat and error management throughout all phases of flight training.

This type of licence is currently not regulated in Australia; however, CASA is currently running a project which sets out to provide regulatory cover for the issue of an MPL by proposing amendments to Part 5 of the Civil Aviation Regulations 1988 Qualifications of flight crew[9].

9. CASA. (2007). Multi-Crew Pilot Licensing (MPL). Retrieved 15 April, 2008, from <www.casa.gov.au/newrules/parts/061/FS0602.asp>

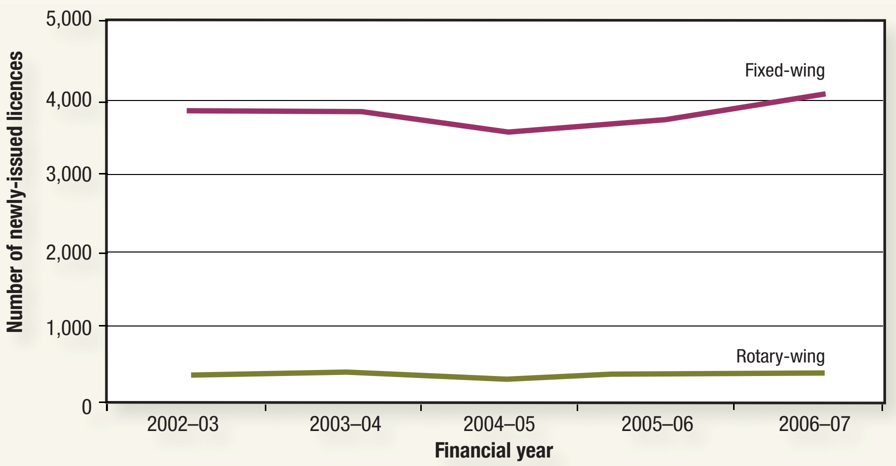
The last five years has seen the popularity of rotary-wing aircraft continue to grow, with the number of aircraft registrations and hours flown increasing. This trend has also been evident in the number of licences despite the fact that fixed-wing aircraft continue to dominate, accounting for about 90 per cent of the total number of current and newly-issued licences in 2006–07 (Figure 19 and Figure 20). Since 2002–03, the number of current rotary-wing pilot licences has increased by 11 per cent to 2,463 licences in 2006–07. In comparison, the number of current fixed-wing pilot licences has decreased by nine per cent since 2002–03.

FIGURE 19: Number of current pilot licences by aircraft type, 2002–03 to 2006–07



Source: CASA

FIGURE 20: Number of newly-issued pilot licences by aircraft type, 2002–03 to 2006–07



Source: CASA

Licenced pilots at a glance

Number of licenced pilots

By licence type:	2005–06	2006–07
Air transport	6,626	6,777
Commercial	5,036	5,023
Private	12,510	12,054
Student	3,352	3,094
Total	**27,524**	**26,948**
By aircraft type:		
Fixed-wing	25,137	24,485
Rotary-wing	2,387	2,463

Aircraft maintenance engineer licences

While the quality and skills possessed by pilots will influence the safety of flights, the quality of maintenance given to the aircraft on the ground is also critically important. Aircraft maintenance engineers (AMEs) are responsible for maintaining and servicing the aircraft, as well as its engines and systems. CASA is responsible for the licencing of AMEs and there are five categories of AME licences: airframes, engines, electrical, instruments and radio. These categories allow licence holders to certify maintenance only on specific parts of the aircraft; however, an AME is permitted to apply for more than one category. After an AME has accumulated four years experience and passed the theoretical exams administered by CASA, he or she can apply to become a licenced aircraft maintenance engineer (LAME).

Number of aircraft maintenance engineer licences

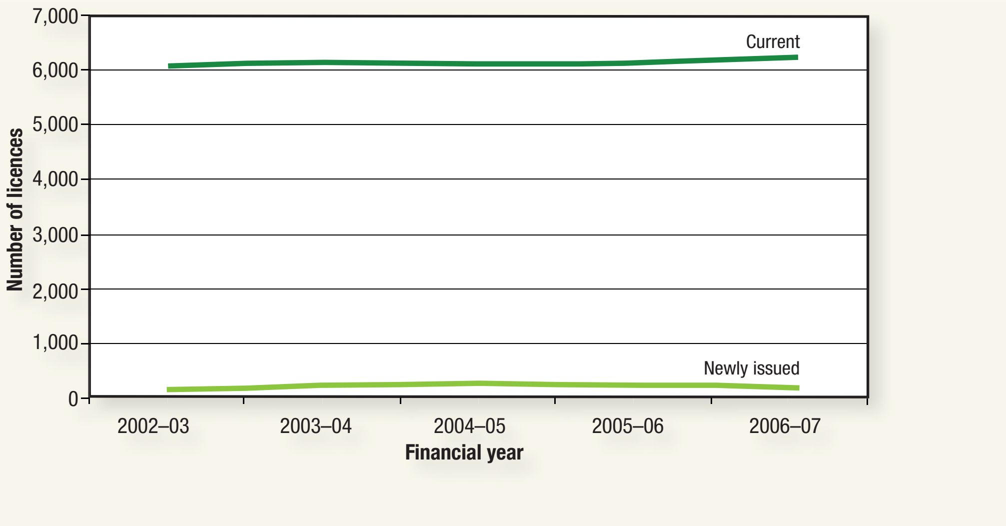
The number of current AME licences continues to increase slowly, with 6,222 licences in the 2006–07 financial year, an increase of one per cent from the previous year. In 2002–03, there were 139 newly-issued AME licences. This increased to 224 in 2004–05 and has since decreased to 209 in 2006–07 (Figure 21).

Aircraft maintenance 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 21: Number of AME licences, current and newly-issued, 2002–03 to 2006–07



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 aircraft maintenance engineers. The shortfall in LAMEs is expected to continue as aircraft fleet sizes increase in response to the demand for air transport services and the average aircraft age also rises, in particular, the GA aircraft fleet.

As at 1 July 2007, both the AME (avionics) and AME (mechanical) trades were added to 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 over 30 years <www.toolsforyourtrade.com.au>. In an effort to encourage people to take up a career as a LAME, CASA offers a scholarship program, which provides financial support for the payment of tools, textbooks, and travel/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>.

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 organisations such as the Sports Aircraft Association of Australia (SAAA), Australian Ballooning Federation (ABF), Gliding Federation of Australia (GFA) and Recreational Aviation Australia (RA-Aus). Many of these organisations issue their own pilot certificates and ratings.

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

- **Ultralights:** are small fixed-wing aircraft registered with RA-Aus. The authority for pilot and maintenance licensing of ultralight aircraft is also delegated to the RA-Aus. Aircraft registered with the RA-Aus are not permitted to have an MTOW greater than 544 kg (or 614 kg for seaplanes). Ultralight aircraft are emerging as a viable alternative to VH-registered GA aircraft, which has led to a thriving aircraft manufacturing industry in Australia.
- **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.
- **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 these are known as microlights or trikes.
- **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 ABF, while ballooning for commercial purposes is administered by CASA.

Sport aviation data

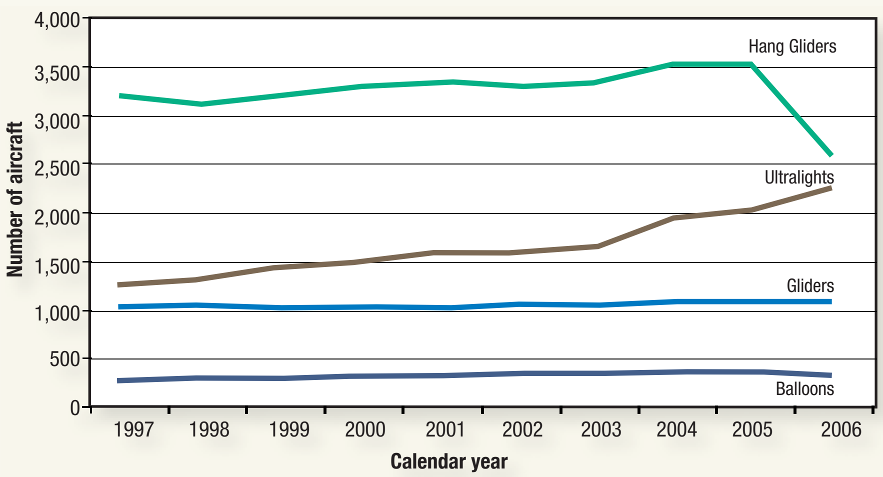
Data for sports aircraft tend to be held by different sporting bodies rather than with CASA. Sporting bodies use different methods to keep track of aircraft registrations. For example data on gliders, hang gliders and gyroplanes are recorded in financial year by their respective sporting bodies while data on ultralights are kept in calendar year format. Another problem is that, while CASA is obligated to keep updated records of aircraft registered with them, sporting bodies can vary in terms of their recording obligations. This can result in missing or incomplete data.

Obtaining accurate accident data for sport aircraft is also more challenging. The lack of reliable data on accidents involving sport aircraft has resulted in their omission from this report. Nevertheless, sufficient demographic data on sport aircraft has been gathered for this report to present an indicator of sport activity in recent years.

Sport aircraft registrations, 1997 to 2006

Between 1997 and 2006, hang gliders (including paragliders and microlights) dominated sport aircraft registrations. However, a sudden decline in hang glider registrations from 3,577 in 2005 to 2,637 in 2006 has seen the gap between hang gliders and ultralights reduce. At the same time, there has been an increase in the number of ultralight registrations. Since 1997, the number of ultralights has increased from 1,266 in 1997 to 2,297 in 2006. In 2005, hang gliders accounted for half of all sport aircraft registrations and ultralights 29 per cent. In 2006, hang gliders accounted for 41 per cent of sport registrations and ultralights accounted for 36 per cent. This change may reflect a possible shift from people flying hang gliders, paragliders and microlights towards ultralights (Figure 22).

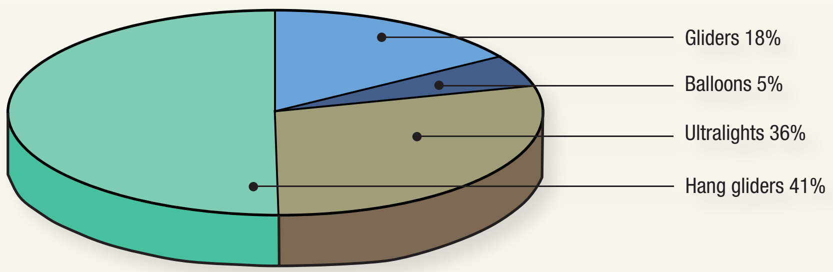
FIGURE 22: Number of registered sport aircraft, 1997 to 2006



Source: BITRE

The number of balloons and gliders remained relatively stable over the decade. Balloons continue to remain the smallest group in sport aviation accounting for five per cent, while gliders account for 18 per cent (Figure 23).

FIGURE 23: Proportion of sport aircraft registrations, 2006



Source: BITRE

Chapter 2
Aviation accidents, fatal accidents and fatalities

The ATSB accident and incident database

The 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 from 1 July 2003. Annex 13 was also enacted through 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 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.

Accident numbers and rates

This section sets out the number of accidents, fatal accidents and the number of fatalities for the period 2002 to 2006, involving VH-registered aircraft. The data is drawn from the ATSB's aviation safety database. However, numbers of accidents alone does not represent the complete picture. In order for the data to be properly interpreted and for meaningful comparisons to be made, it is necessary to calculate the accident rate. This is calculated as the number of accidents in a given period divided by the number of hours flown in that category of operation. The accident, fatal accident and fatality rates are normally calculated per 100,000 hours flown.

It is also important to understand that accidents occur when aircraft occupants receive serious or fatal injuries and/or the aircraft incurs substantial damage. 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 it is boarded with the intention of flight 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.

This section examines accident numbers and rates for regular public transport (RPT) operations and the various types of general aviation activity.

Regular public transport accident statistics

Regular public transport accident, fatal accident and fatality numbers, 2002 to 2006

Between calendar years 2002 and 2006 inclusive, there were a total of 14 accidents involving RPT operations. Of these, five involved high capacity RPT aircraft and nine involved low capacity RPT (Figure 24).

The five high capacity RPT accidents involved:

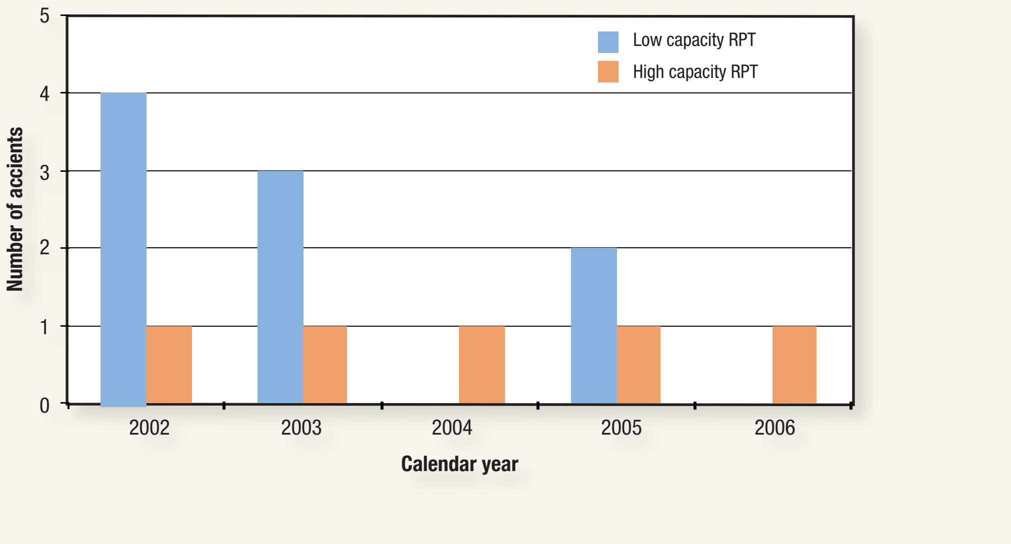
- A flight attendant falling and breaking a leg when the Boeing 767-200 aircraft encountered windshear (2002).
- Passengers and crew members receiving serious injuries as the result of an evacuation from the aircraft (a Boeing 747-400 in 2003 and an Airbus A330 in 2005).
- A ground collision from a disabled persons lift colliding with the winglet of a parked Boeing 737-800 aircraft (2004).
- The left wing tip of a foreign registered Boeing 747-400 aircraft colliding with the right horizontal stabiliser of an Australian registered Boeing 767-300 while taxiing for departure, causing substantial damage (2006).

The nine low capacity RPT accidents involved:

- A Piper Aircraft Corporation PA-31 aircraft running off the end of the runway and down an embankment (2002).
- A birdstrike resulting in substantial damage to the horizontal stabiliser of a Fairchild Industries Inc. SA227-DC Metro (2002).
- The nose wheel tyre of a Cessna 404 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 Aircraft Corporation PA-31-350 aircraft inadvertently landing with the landing gear in the retracted position (2003).

- The landing gear retracting while a Piper Aircraft Corporation PA-31 aircraft was on the ground (2003).
- The Piper Aircraft Corporation PA-31-350 aircraft intentionally landing with the landing gear retracted due to a mechanical problem (2005).
- A Fairchild Industries Inc. SA227-DC Metro aircraft impacting terrain, while on approach to land (2005).

FIGURE 24: RPT accidents, 2002 to 2006



Over the five year period, there was only one fatal accident recorded involving an RPT aircraft. This was the accident of a low capacity RPT Fairchild Metroliner aircraft on 7 May 2005, which impacted terrain during an approach to Lockhart River aerodrome, Queensland. The accident claimed the lives of all 15 persons on board the aircraft, making it Australia's worst civil air accident since 1968.

Regular public transport accident, fatal accident and fatality rates per 100,000 flight hours, 2002 to 2006

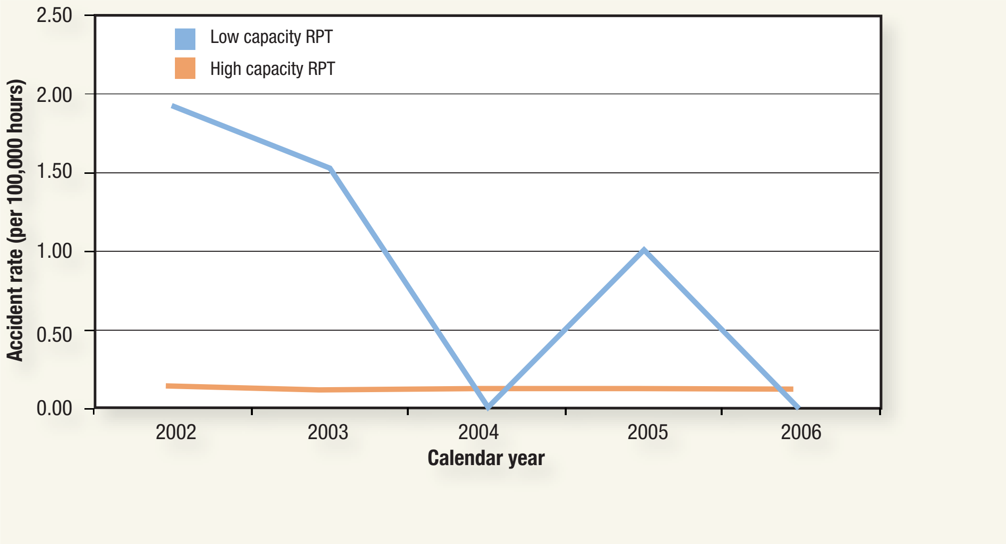
The accident, fatal accident and fatality rates for both high capacity and low capacity RPT continue to remain low, reinforcing the results of previous ATSB studies that found Australia is among world leaders in aviation safety (Figure 25).

The number of high capacity RPT accidents has remained constant, with one accident recorded each year for the past five years. The associated accident rate, however, declined from 0.14 accidents per 100,000 hours in 2002 to 0.10 in 2006. This rate decrease reflects the increase in the number of hours flown by high capacity RPT over this time.

In comparison, the number of accidents involving low capacity RPT has been more variable with four accidents in 2002 and zero in 2006. Similarly, the accident rate for low capacity RPT was 1.92 accidents per 100,000 hours in 2002 and zero in 2006.

Given the low number of accidents involving RPT aircraft, it is important to realise that the accident numbers and rates are more sensitive to relatively small fluctuations compared with operations that have higher accident numbers and rates.

FIGURE 25: RPT accident rates per 100,000 hours flown, 2002 to 2006



To date, Australia has recorded no hull losses or fatal accidents involving high capacity RPT aircraft. The low capacity RPT fatal accident and fatality rate remained at zero until the Lockhart River accident in 2005 when the fatal accident rate increased to 0.50 accidents per 100,000 hours and the fatality rate jumped to 7.53. Both rates returned to zero in 2006.

7 May 2005, Fairchild Aircraft Inc. SA227-DC Metro 23, near Lockhart River aerodrome, Qld

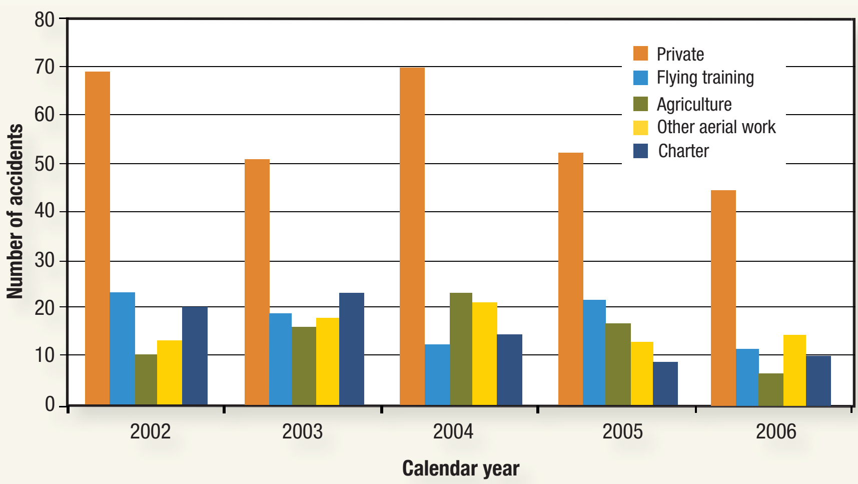
General aviation accident statistics

The general aviation (GA) sector of the industry covers a diverse set of flying activities ranging from aerial mustering to flying training to charter operators carrying passengers and cargo on a non-scheduled basis, albeit in aircraft generally much smaller than those used in RPT operations. 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 Glossary for definitions).

General aviation accident, fatal accident and fatality numbers, 2002 to 2006

Of the GA categories, private operations continue to dominate, with 287 accidents recorded between 2002 and 2006. However, the last three years has seen accidents for private operations decrease by 35 per cent from 69 accidents in 2004 to 45 accidents in 2006. The number of accidents involving aerial agriculture and flying training operations decreased by 56 per cent and 50 per cent respectively from 2005 to 2006. Charter accidents increased slightly to 10 accidents in 2006; however, this is still a 58 per cent decrease from 2003, where 24 charter operation accidents were recorded. Other aerial work, which includes aerial mustering, surveying and fire fighting operations, also increased from 12 accidents in 2005 to 15 accidents in 2006 (Figure 26).

FIGURE 26: GA accidents, 2002 to 2006



Fatal accidents involving flying training has generally been low with the exception of 2003, where five fatal accidents were recorded. This has since reduced, with zero fatal accidents recorded in 2005 and 2006. Aerial agriculture fatal accidents also remain low with three fatal accidents and three fatalities recorded across the five years (Figure 27 and Figure 28).

In 2002, charter operations involved four fatal accidents. This reduced, with 2005 and 2006 recording one fatal accident in each year. However, over the five years there were a total of 25 fatalities involving this type of operation (Figure 27 and Figure 28).

The number of fatal accidents has remained relatively stable for other aerial work operations, however, the number of fatalities increased from one in 2005 to eight in 2006. Two of the three fatal accidents involved aerial surveying activities, which often involve a number of people on board the aircraft assisting with the inspection (Figure 27 and Figure 28).

The number of fatal accidents and fatalities involving private operations consistently increased after 2003, despite the fact that the number of accidents decreased. The lowest number of fatal accidents occurred in 2003, with three fatal accidents. This increased to 12 accidents in 2006. The lowest number of fatalities occurred in 2002, with 10 fatalities recorded. Since this time, the number of fatalities has almost doubled to 21 in 2006 (Figure 27 and Figure 28). The ATSB is seeking to identify why fatal accidents involving private operations have increased despite the fact that accidents have decreased.

FIGURE 27: GA fatal accidents, 2002 to 2006

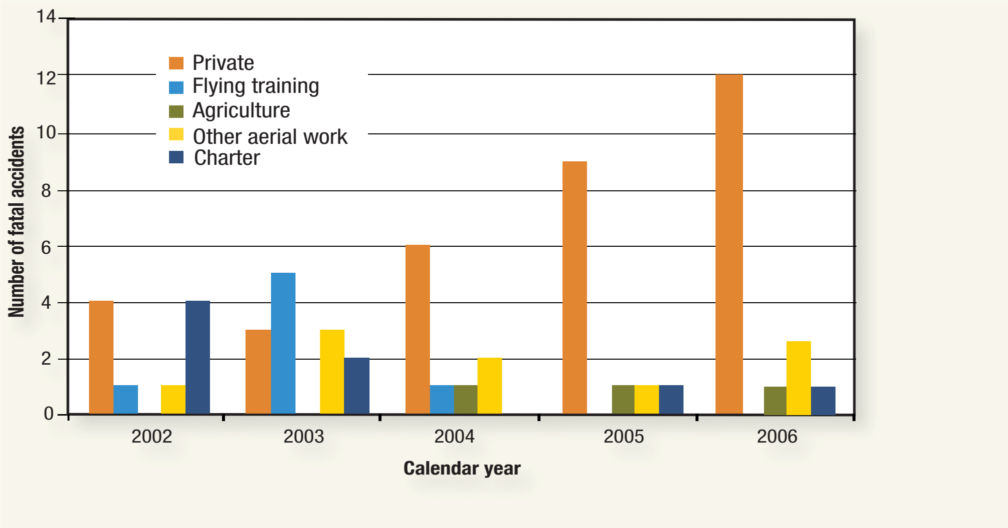
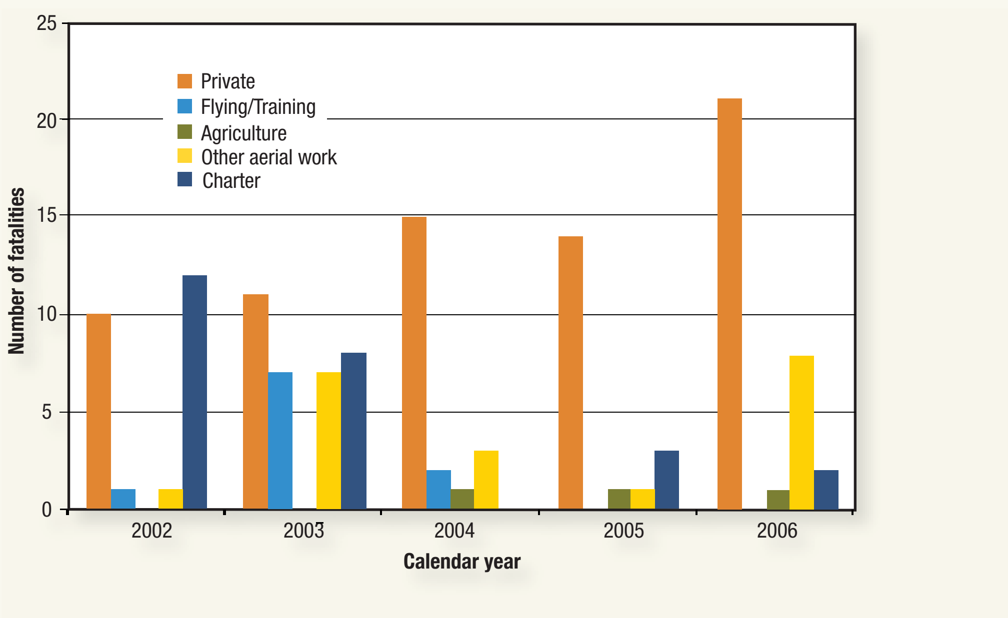


FIGURE 28: GA fatalities, 2002 to 2006



The following are brief summaries of the fatal accidents involving GA aircraft in 2006:

- Five of the seven occupants of a Cessna U206 aircraft received fatal injuries when, shortly after takeoff, the aircraft suffered an apparent partial engine failure, impacted trees about 1,200 m from the end of the runway, and became submerged in a dam (Willowbank, Qld.).
- Both occupants of a Beech Aircraft Corp 58 Baron aircraft were fatally injured after it impacted the ground inverted in a steep nose-down attitude, consistent with a loss of control situation (4 km east of the McArthur River Mine Aerodrome, NT).
- A Brantly International Inc B-2B helicopter was observed to commence a slow descent, then contacted powerlines, tumbled in the air and impacted the ground while the pilot was on a private flight to gain further experience. The pilot, the sole occupant, was fatally injured.
- The three occupants of a Bell Helicopter Co 206B (III) helicopter were fatally injured when the helicopter struck powerlines while conducting an aerial noxious weed survey (15 km east of Parkes Aerodrome, NSW).
- The pilot of a Wytwornia Sprzeyu Komuni Dromader M18A aircraft was fatally injured while conducting fire-bombing operations when the aircraft impacted terrain (approximately 20 km south-south-west of Cootamundra, NSW).
- The Robinson Helicopter Co R44 was being operated on a series of aerial survey flights approximately 100 km to the north of Mt Isa Airport, Qld. The helicopter failed to arrive at a pre-arranged rendezvous point and the wreckage of the helicopter was found the next day. The four occupants were fatally injured.
- The two occupants of an amateur-built SH2R aircraft were fatally injured when it impacted the ground (Mildura Airport, NSW).
- The pilot of a Cessna 188B Agwagon aircraft was fatally injured after it was reported to have departed from a field adjacent to a local water-ski area (about 8 km from the departure area, 56 km south-west of Narrandera, NSW).
- An amateur-built Lancair 360 aircraft departed Townsville, Qld on a private flight to Archerfield Aerodrome, Qld. While inbound to Archerfield, the pilot reported difficulties in finding the aerodrome. Witnesses reported seeing the aircraft's left wing drop and the aircraft appeared to enter a spin before descending straight down, colliding with a tree and then a creek. The pilot was fatally injured.
- Shortly after takeoff from Bankstown Aerodrome, NSW, the engine of an amateur-built Lancair 360 aircraft was heard to malfunction. The aircraft rolled into a steep right turn. Engine power was heard to return, but sounded intermittent. After turning approximately 90 degrees, the aircraft rolled out of the turn before the turn steepened again to the right. The aircraft impacted a taxiway, the pilot was fatally injured.
- An amateur-built EXEC 162F helicopter impacted the ground near Mount Beauty, Vic. The pilot received fatal injuries and the helicopter was destroyed.
- While in the circuit at Bathurst Island Aerodrome, NT, the Beech Aircraft Corp A36 Bonanza aircraft suffered a loss of engine power due to fuel starvation. The aircraft impacted terrain 2.4 km north-west of the aerodrome. The pilot, who was the sole occupant, sustained fatal injuries.

- A private flight with a pilot and four passengers on board was being conducted within a station property near Mount Vernon, Vic. The Cessna 172L aircraft was later discovered destroyed after it had impacted the ground. Two of the passengers were fatally injured.
- The flight departed from Bathurst, NSW for a 25-minute joy flight with the pilot and one passenger on board but failed to return. The wreckage of the British Aircraft Corp 167 Strikemaster was located about 20 km to the north-east of Bathurst. The pilot and passenger were fatally injured.
- While on descent to Gladstone Airport, Qld, a Piper Aircraft Corporation PA-31-350 aircraft's radar track disappeared from air traffic control. The aircraft was subsequently found to have impacted terrain approximately 9 km south-east of Raglan, Qld. The pilot and two passengers were fatally injured.
- An Air Tractor Inc AT-802A aircraft was reported to have impacted the ground during a flight to replenish the hopper for further spraying, 56 km east of Collarenebri, NSW. The pilot was fatally injured.
- The aircraft departed from a private airstrip at Nelson, Vic. with the pilot being the sole occupant on board. During the initial climb, the Auster Aircraft Ltd J1B aircraft was observed making a low-level right turn towards two hangars where three people were standing to watch the departure. The aircraft was observed striking powerlines. The aircraft impacted the ground inverted, at a steep angle. The pilot was fatally injured.

General aviation accident, fatal accident and fatality rates per 100,000 flight hours, 2002 to 2006

Accident numbers alone cannot provide a complete picture of safety trends. It is also important to consider the amount of flying activity each category has undertaken.

The contrast in accident numbers compared with the fatal accident numbers for private operations was also evident in the rate data. The accident rate decreased from 13.34 accidents per 100,000 hours in 2005 to 12.11 in 2006 (Figure 29). In comparison, the fatal accident rate increased from 2.31 fatal accidents per 100,000 hours in 2005 to 3.23 in 2006 (Figure 30). The fatality rate also increased from 3.59 fatalities per 100,000 hours to 5.65 in 2006 (Figure 31).

The accident rate for aerial agriculture continued to decrease in 2006 to the lowest point over the past five years (Figure 29). The fatal accident and fatality rates increased slightly, even though the actual fatal accident and fatality numbers have remained the same. This is most likely a reflection of the decrease in the number of hours flown experienced in 2006 (Figure 30 and Figure 31).

Once again, some degree of caution should be taken when looking at these results due to the low number of accident, fatal accident and fatality numbers recorded each year.

FIGURE 29: GA accident rates, 2002 to 2006

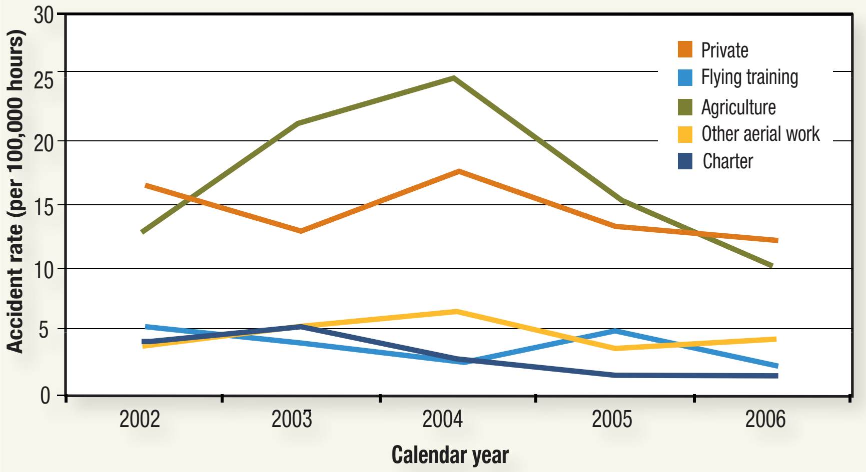


FIGURE 30: GA fatal accident rates, 2002 to 2006

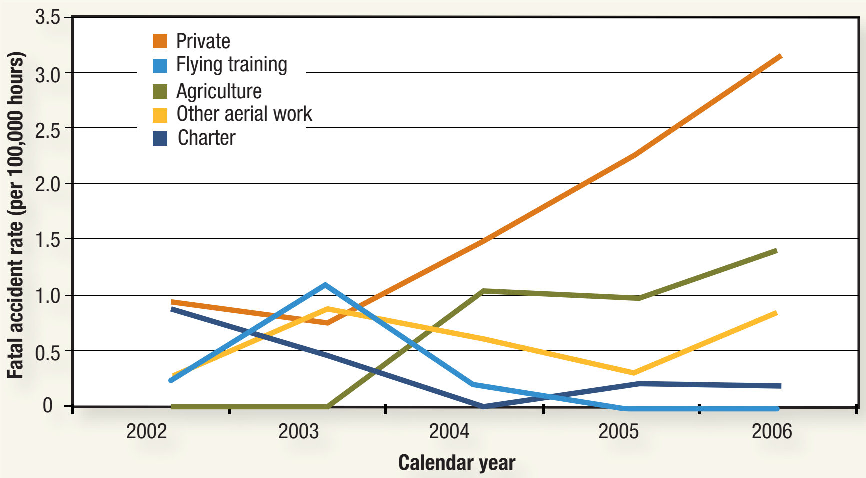
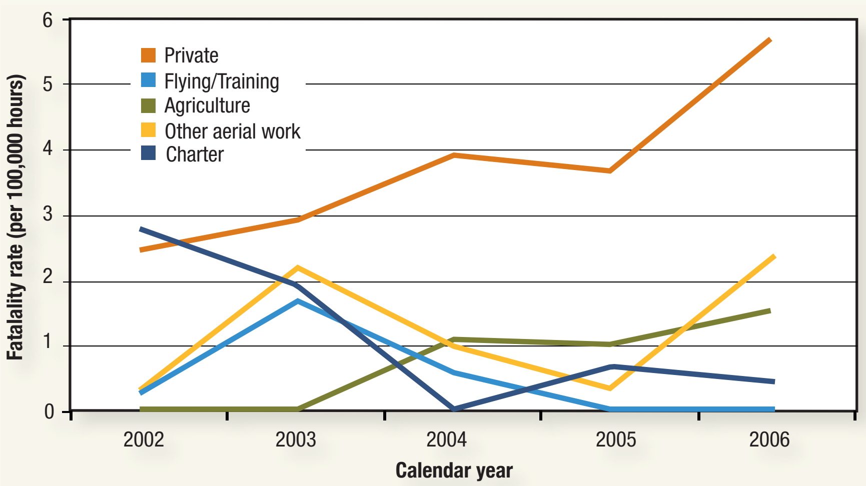


FIGURE 31: GA fatality rates, 2002 to 2006



Accidents by sector at a glance

Number of accidents

	Accidents		Fatal accidents		Fatalities	
	2005	2006	2005	2006	2005	2006
RPT						
High capacity RPT	1	1	0	0	0	0
Low capacity RPT	2	0	1	0	15	0
GA						
Charter	9	10	1	1	3	2
Agriculture	16	7	1	1	1	1
Other aerial work	12	15	1	3	1	8
Flying training	22	11	0	0	0	0
Private	52	45	9	12	14	21
Total	**114**	**89**	**13**	**17**	**34**	**32**

Accidents rates (per 100,000 hours)

	Accidents		Fatal accidents		Fatalities	
	2005	2006	2005	2006	2005	2006
RPT						
High capacity RPT	0.11	0.10	0.00	0.00	0.00	0.00
Low capacity RPT	1.00	0.00	0.50	0.00	7.53	0.00
GA						
Charter	1.88	2.11	0.21	0.21	0.63	0.42
Agriculture	15.70	10.22	0.98	1.46	0.98	1.46
Other aerial work	3.70	4.37	0.31	0.87	0.31	2.33
Flying training	5.23	2.57	0.00	0.00	0.00	0.00
Private	13.34	12.11	2.31	3.23	3.59	5.65

Fixed-wing versus rotary-wing accident statistics

Fixed-wing and rotary-wing accident, fatal accident and fatality numbers, 2002 to 2006

The number of fixed-wing aircraft on the Australian register has nearly doubled over the last decade. While the increase in registrations slowed from 2005 to 2006, it is still showing an upward trend. Rotary-wing (helicopter) operations remain a small but growing segment of the Australian aviation industry. Similarly, the number of newly issued pilot licences for rotary-wing aircraft has been increasing over the same period, and the trend has continued in 2006.

The number of rotary-wing aircraft on the Australia civil aircraft register is still relatively small; however, the proportion of accidents compared with fixed-wing aircraft is relatively high. Rotary-wing aircraft account for 23 per cent of the accidents between 2002 and 2006, however, they make up only 11 per cent of the aircraft on the Australian civil aircraft register. The number of rotary-wing accidents decreased from 31 in 2005 to 25 in 2006. All of the rotary-wing accidents in the five-year period occurred in GA. The number of rotary-wing fatal accidents doubled to four in 2006, yet the number of fatalities increased from two to nine in 2006. This jump in fatalities was the result of two aerial surveying accidents, which accounted for seven fatalities.

Accidents involving RPT and GA fixed-wing aircraft decreased from 83 accidents in 2005 to 64 in 2006 (Figure 32). In 2002, the number of GA fixed-wing fatal accidents was eight. This decreased to six in 2004 but has since more than doubled to 13 in 2006 (Figure 33). This was also similar for the number of associated fatalities, with 19 in 2002, 15 in 2004 and 23 in 2006 (Figure 34). There was only one fatal accident involving an RPT fixed-wing aircraft between 2002 and 2006, which resulted in 15 fatalities (the Lockhart River accident).

Fixed-wing and rotary-wing accident, fatal accident and fatality rates per 100,000 hours, 2002 to 2006

The proportion of accidents between fixed-wing and rotary-wing aircraft is reflected in the rate data, with rotary-wing aircraft remaining much higher. However, both aircraft types experienced a decrease in the accident rate in 2005 and 2006. The fatal accident and fatality rate for rotary-wing aircraft has been unstable over the past five years compared with the fixed-wing aircraft rates. This variability may be partly attributed to the small number of rotary-wing aircraft on the register, and consequently, any small increase in accident numbers has a greater influence on the associated rate.

From 2004, both the fatal accident and fatality rate for GA fixed-wing aircraft increased in line with the actual numbers.

FIGURE 32: Fixed-wing and rotary-wing accidents, 2002 to 2006

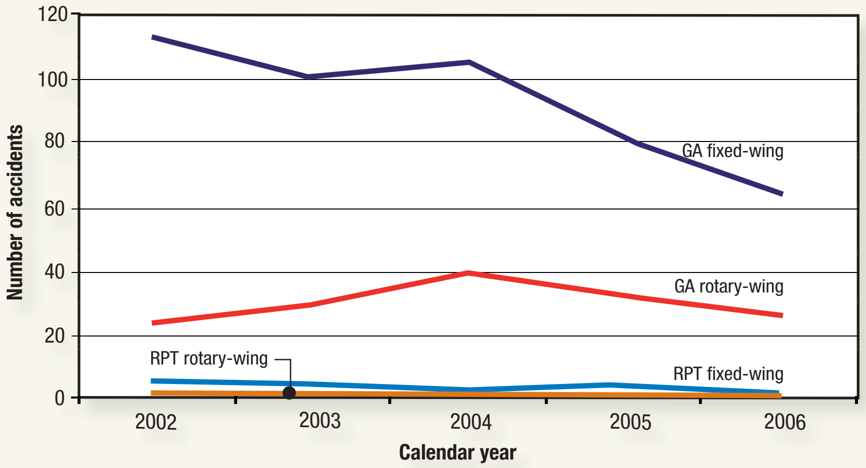


FIGURE 33: Fixed-wing and rotary-wing fatal accidents, 2002 to 2006

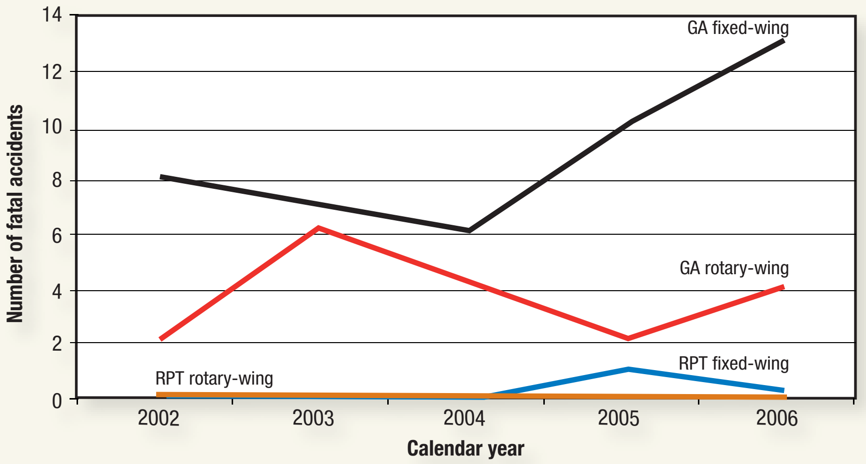


FIGURE 34: Fixed-wing and rotary-wing fatalities, 2002 to 2006

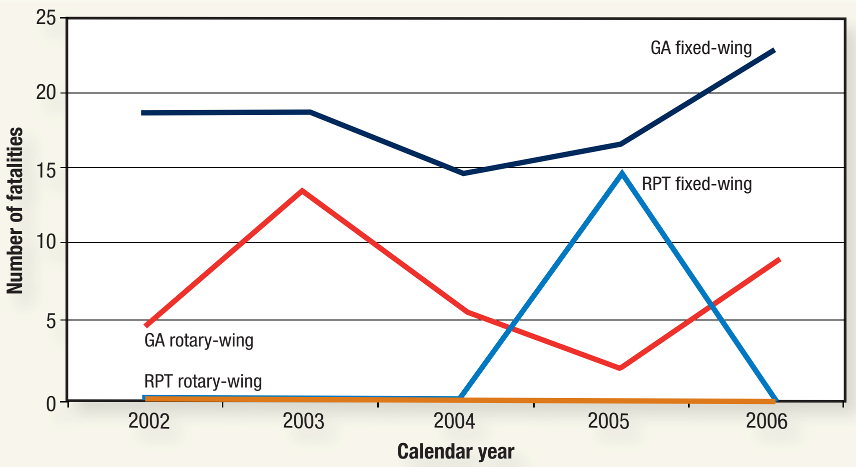


FIGURE 35: Fixed-wing and rotary-wing accident rates, 2002 to 2006

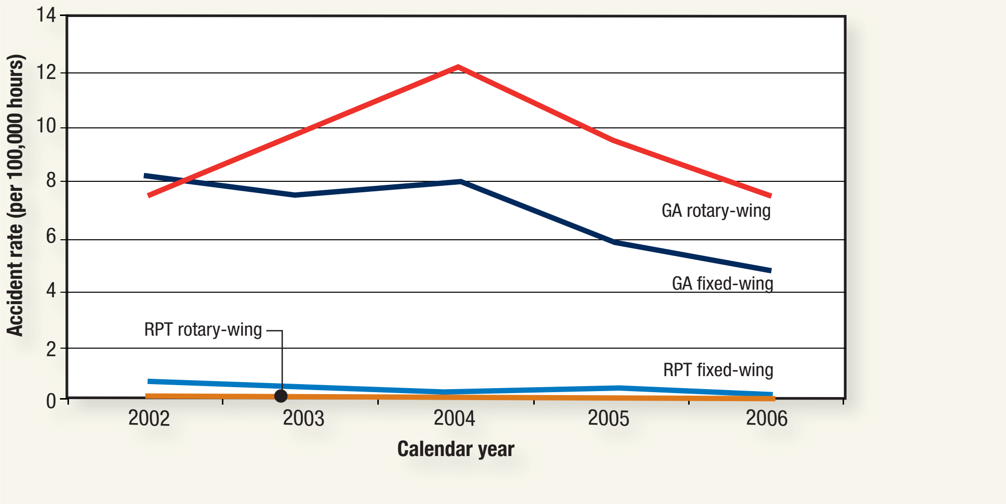


FIGURE 36: Fixed-wing and rotary-wing fatal accident rates, 2002 to 2006

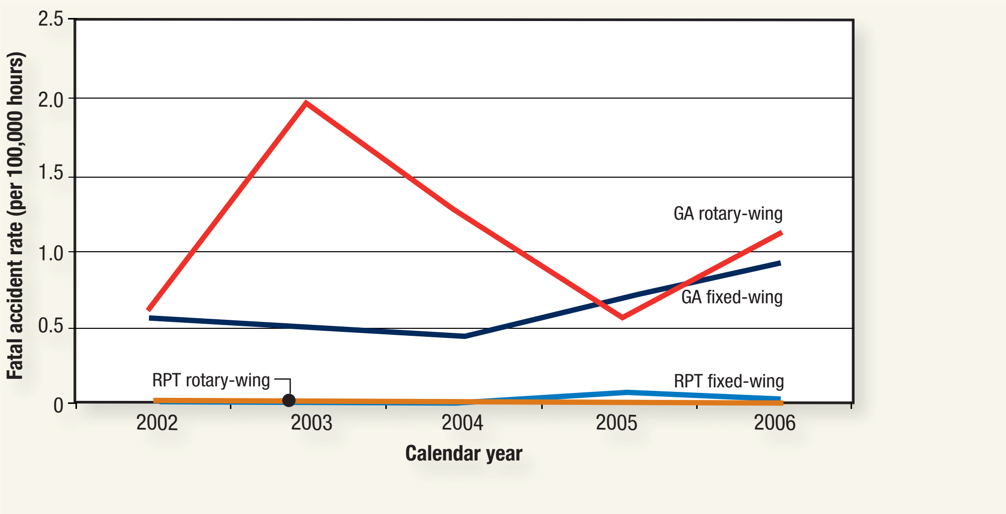
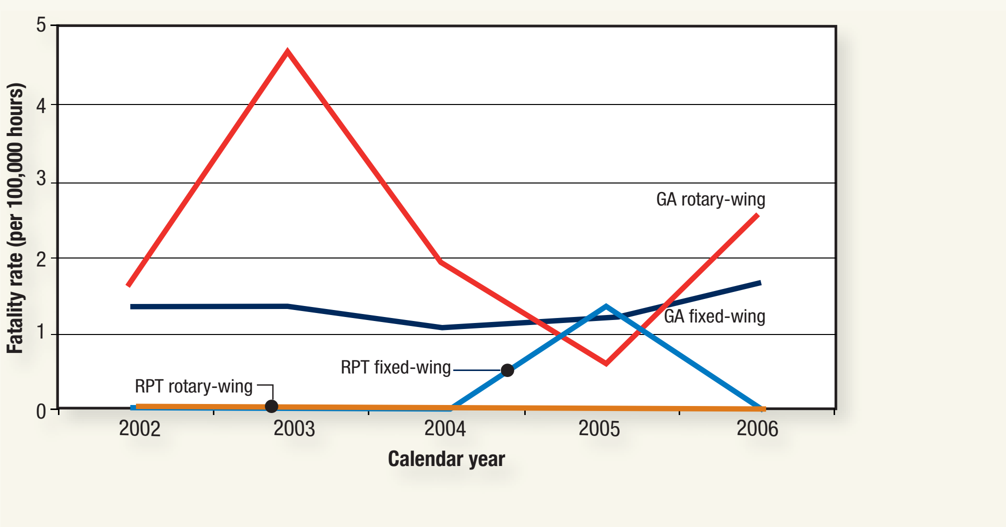


FIGURE 37: Fixed-wing and rotary-wing fatality rates, 2002 to 2006



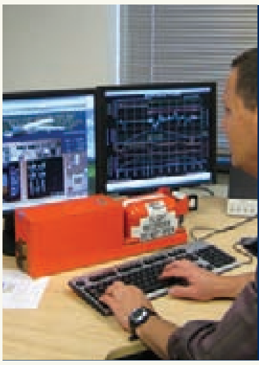
Fixed-wing versus rotary-wing accidents at a glance

Number of accidents

		Accidents		Fatal accidents		Fatalities	
		2005	2006	2005	2006	2005	2006
RPT							
	Fixed-wing	1	1	1	0	15	0
	Rotary-wing	2	0	0	0	0	0
GA							
	Fixed-wing	80	63	10	13	17	23
	Rotary-wing	31	25	2	4	2	9
Total		**114**	**89**	**13**	**17**	**34**	**32**

Accidents rates (per 100,000 hours)

		Accidents		Fatal accidents		Fatalities	
		2005	2006	2005	2006	2005	2006
RPT							
	Fixed-wing	0.27	0.09	0.09	0.00	1.34	0.00
	Rotary-wing	0.00	0.00	0.00	0.00	0.00	0.00
GA							
	Fixed-wing	5.77	4.68	0.72	0.97	1.23	1.71
	Rotary-wing	9.44	7.35	0.61	1.18	0.61	2.65



Chapter 3
Aviation accident analysis

The preceding sections set out some basic measures of aviation activity and accident rates in Australia in the period 2002 to 2006. This chapter takes a closer look at the nature of accidents in Australia over this period, to provide some insights about the types of accidents, and the phase of flight where those accidents occurred.

The clear majority of accidents in Australia occur in general aviation (GA), and more specifically, within the private flying category. Only a small proportion of accidents result in fatal injuries. To gain insights into safety implications, it is important to take a closer look at the kinds of accidents that occur, and which part of the flight most accidents occur.

Before examining the pattern of accidents, it is worth noting that accidents are complex occurrences, often involving a chain or sequence of events. The challenge is to classify an accident meaningfully, and in doing so, capture the main character of the accident. The distinction between mechanical and operational factors and their contribution to the accident is sometimes blurred. Nevertheless, this report classifies the accident according to the event in the sequence from when an accident was inevitable, which may not be the first event in the accident sequence. The aim has been to ensure that the classification of accidents has been consistent, so that useful comparisons can be made.

The data analysed in this section covers all VH-registered aircraft, including gliders and balloons. In the period 2002 to 2006 there were five accidents involving balloons and 36 involving gliding operations. None of the ballooning accidents involved fatalities. However, seven of the gliding accidents, including three in 2006, involved fatal injuries to the occupants.

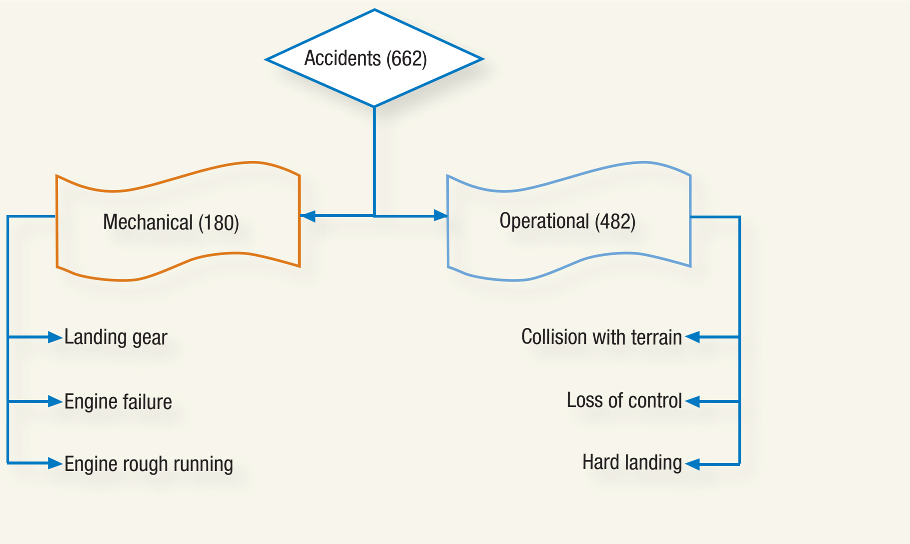
Classifying accidents

For the purpose of this report, the ATSB has classified accidents between 2002 and 2006 as either mechanical or operational. The event type data for accidents still under investigation was obtained from the preliminary investigation report. However, throughout the course of the investigation process, further information may be obtained and the accident may be reclassified.

Two accidents were excluded from the analysis as there was insufficient information to determine whether mechanical or operational factors played a primary role in the accident (Figure 38).

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

FIGURE 38: The proportion of mechanical and operational accidents, 2002 to 2006



Accidents: mechanical

Of the 662 classified accidents between 2002 and 2006, 180 or 27 per cent involved some form of mechanical event (Figure 39 and Figure 40). About half of these mechanical-related accidents were powerplant or propulsion problems. Of the 95 powerplant/propulsion accidents, 59 involved a total powerloss to the engine, while 22 involved a partial powerloss to the engine.

The next most common mechanical-related accident involved airframe events. Like 2005, the majority of these accidents involved a problem with the aircraft's landing gear. In particular, these involved the gear collapsing during the landing or the gear failing to extend properly in flight. Of the 78 airframe-related accidents, 65 were landing gear problems. Seven of these were recorded in 2006, slightly below the nine accidents recorded in 2005.

Only a small number of accidents involving system events were recorded over the five years. Three of these involved a problem with the electrical system, which subsequently resulted in the aircraft's landing gear failing to extend. The remaining four accidents involved problems with the fuel system. For smaller, single-engine aircraft, the options for handling a fuel system problem are often limited and pilots may be forced to conduct a landing into a nearby paddock or to ditch the aircraft into water.

Of the 72 fatal accidents recorded between 2002 and 2006, eight were the result of mechanical-related problems. These fatal accidents accounted for 20 of the 154 fatalities over the five years.

FIGURE 39: Number of mechanical-related accidents[10] and fatal accidents, 2002 to 2006

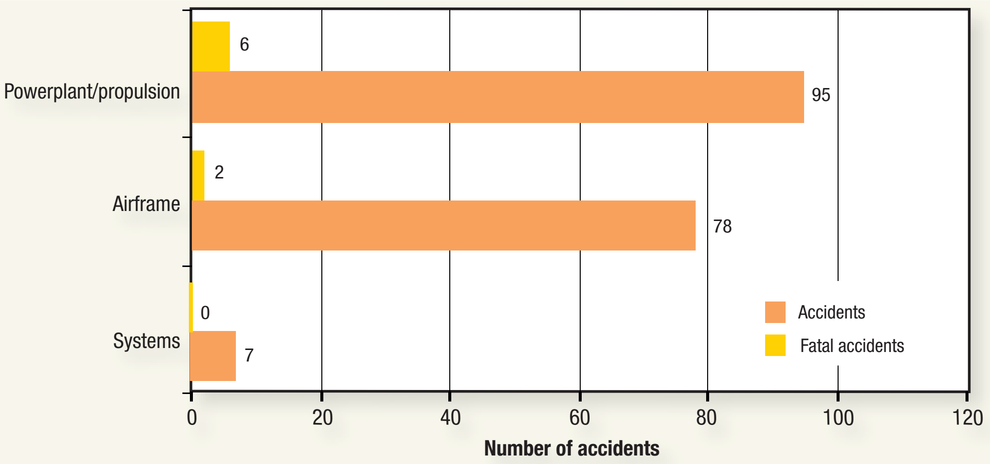
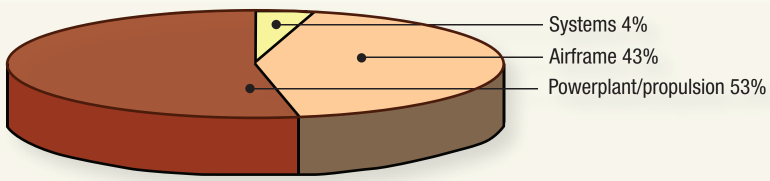


FIGURE 40: Proportion of mechanical accident events, 2002 to 2006



Mechanical-related accidents at a glance

	2005	2006
Airframe	11	8
Powerplant/propulsion	14	17
Systems	3	1
Total	**28**	**26**

10. The term 'accident' represents all accidents, that is, non-fatal and fatal accidents, unless otherwise stated (e.g. fatal accident).

Accidents: operational

About three quarters of the accidents recorded between 2002 and 2006 were operational-related events (Figure 41).

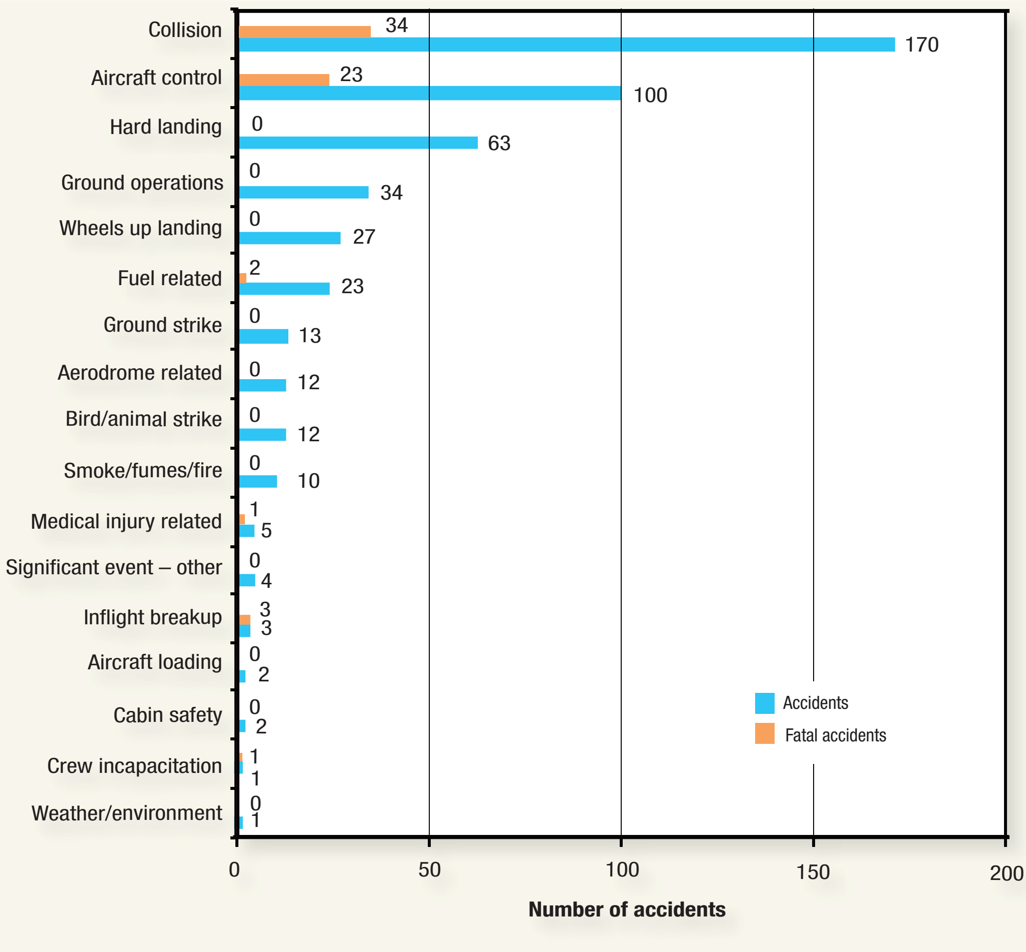
Overall, the total number of operational-related accidents continued to decline over the five years from 111 in 2002 to 70 in 2006. The six most common accident types with operational-related events were the same as for 2005: collision, aircraft control, hard landings, wheels-up landings, ground operations and fuel related. With the exception of ground operation accidents and wheels-up landings, the other top three categories decreased in 2006. Most notable was the decrease in the number of hard landings from 16 in 2005 to four in 2006. Ground operation accidents increased by four and wheels up landings increased by one.

Accidents involving collisions continue to dominate, accounting for 35 per cent of the operational-related accidents between 2002 and 2006. Over half of the 170 collision accidents involved a collision with terrain. This was followed by wirestrikes with 29 accidents, and collisions on the ground with 27 accidents. The next most common operational-related accident involved aircraft control. The majority of these accidents (86 per cent) involved aircraft loss of control. Seventeen of these had weather as a contributing factor. Incorrect configuration was cited in 13 of the 100 accidents and these typically involved the landing gear inadvertently been retracted on the ground instead of the flaps.

The proportion of accidents over the five years involving operational-related events was 73 per cent. For fatal accidents, this was higher with 89 per cent. Collisions accounted for 53 per cent of operational-related fatal accidents and 58 per cent of operational-related fatalities. This was followed by aircraft control, which accounted for 36 per cent of the fatal accidents and 31 per cent of the fatalities.

5 February 2007, Cirrus SR22, Cecil Park area, NSW.

FIGURE 41: Number of operational-related accidents, 2002 to 2006



Operational-related accidents at a glance

	2005	2006
Collision	28	26
Aircraft control	23	18
Hard landing	16	4
Ground operations	5	9
Wheels up landing	2	3
Total	**74**	**60**

Accidents linked to operational-related events continue to remain the most prevalent type of aircraft accident. The proportion of operational-related accidents to mechanical–related accidents has remained fairly consistent over the period (Figure 42). This picture is slightly different for fatal accidents, with mechanical-related events accounting for four (24 per cent) fatal accidents in 2003, but zero in 2005 (Figure 43).

FIGURE 42: Proportion of operational and mechanical-related accidents, 2002 to 2006

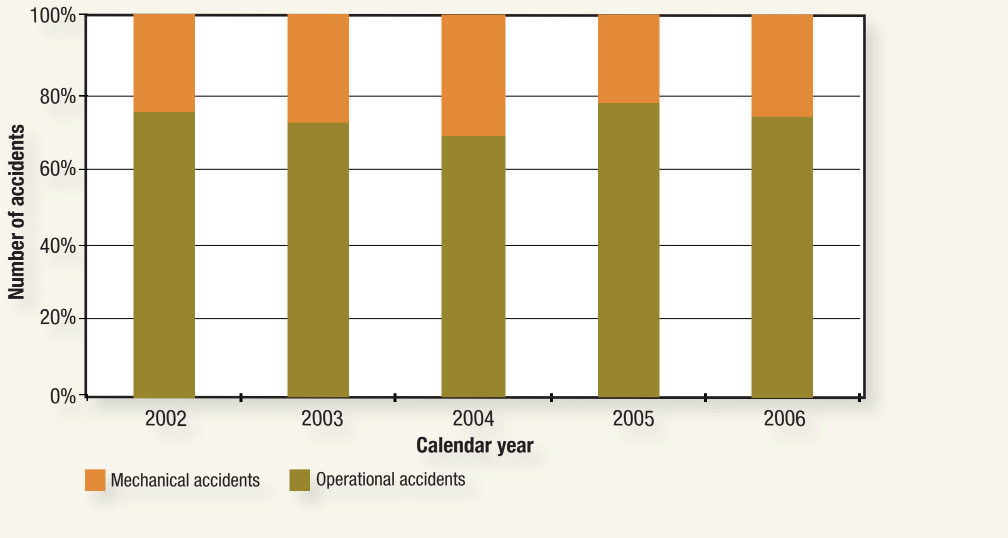
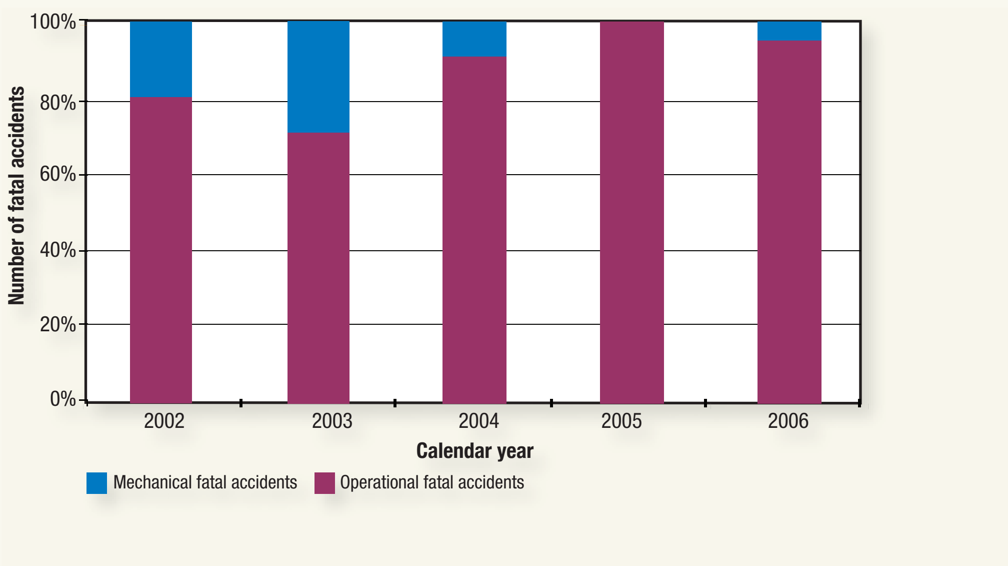


FIGURE 43: Proportion of operational and mechanical-related fatal accidents, 2002 to 2006



Phase of flight analysis

The most common phase of flight for accidents is the takeoff/initial climb and approach/landing, as the aircraft is flying near to or on the ground. Together, these phases accounted for just under 70 per cent of the total number of accidents between 2002 and 2006 (Figure 44). From this, it could be assumed that these phases make up a similar proportion of the fatal accidents. However, this isn't the case. These phases accounted for only 41 per cent of the fatal accidents over the five-year period. The climb, cruise, manoeuvre and descent phases similarly accounted for 41 per cent of the fatal accidents. However, these phases made up 23 per cent of the total number of accidents (Figure 45). Aircraft travelling at normal cruise speeds involve greater levels of kinetic energy when 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.

Of the 72 fatal accidents recorded between 2002 and 2006, the phase of flight could not be determined in 11 cases. With the exception of one fatal accident, 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.

FIGURE 44: Proportion of accidents by phase of flight, 2002 to 2006

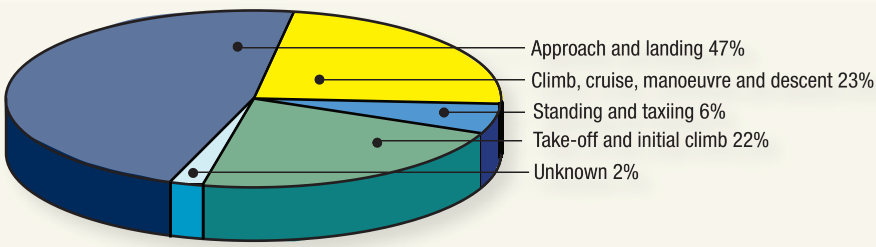
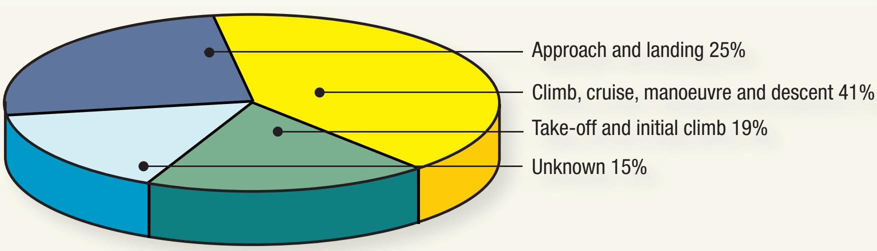


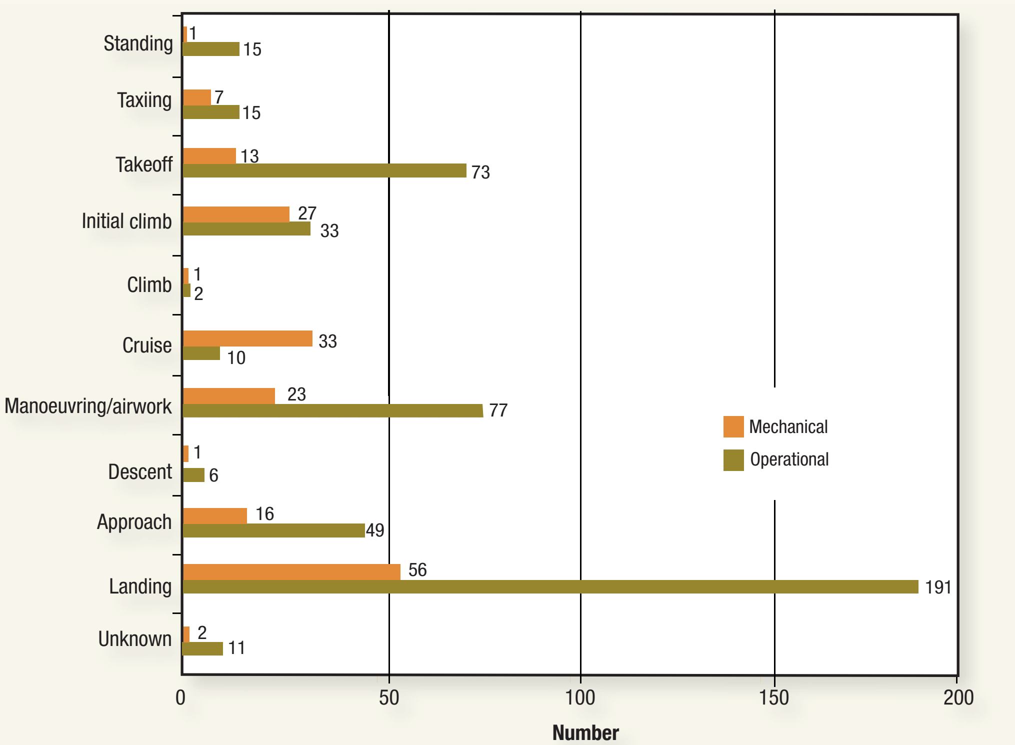
FIGURE 45: Proportion of fatal accidents by phase of flight, 2002 to 2006



Of the 664 accidents recorded by the ATSB in the period 2002 to 2006, 247 or 37 per cent occurred during the landing phase of flight. The majority of these accidents involved problems with the aircraft's landing gear (22 per cent), hard landings (22 per cent), and aircraft control (17 per cent), in particular, a loss of aircraft control and the pilot inadvertently retracting the landing gear instead of the flaps when on the ground. The next most common phase of flight was the manoeuvring/airwork phase, accounting for 15 per cent of the accidents. Of this phase, collisions with terrain and wirestrike accidents were the most prevalent. This was followed by the take-off phase, which recorded 86 accidents or 13 per cent. These accidents involved loss of aircraft control, collisions with terrain, and runway excursions (Figure 46).

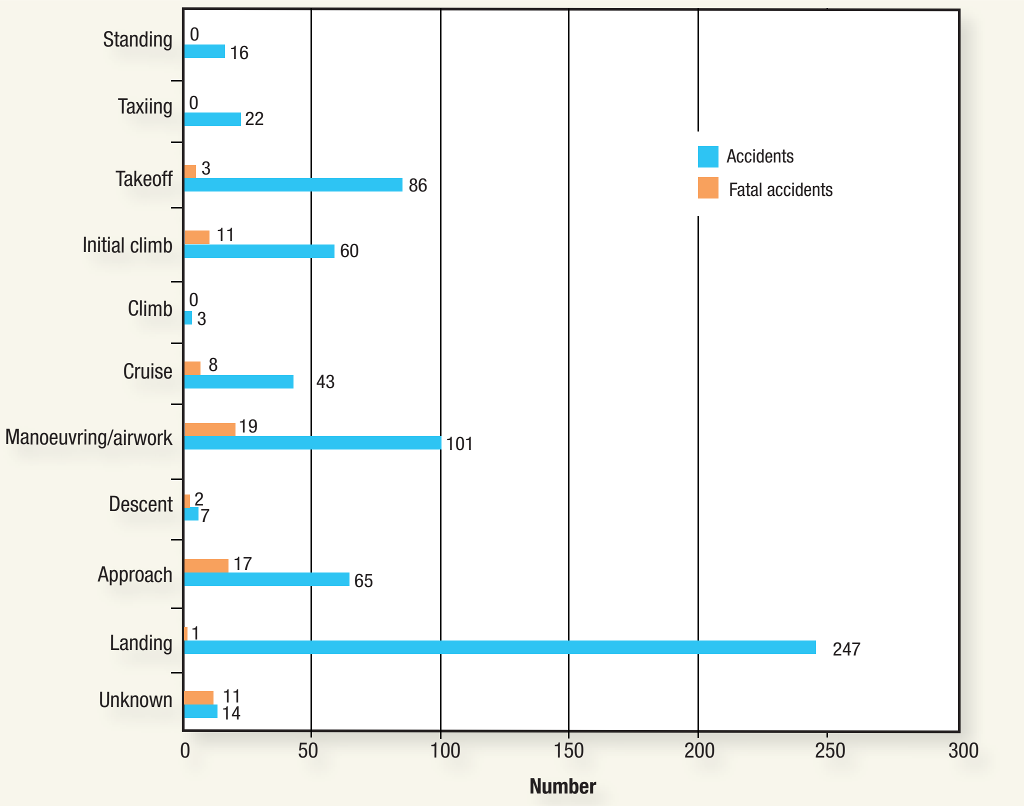
While only six per cent of accidents occurred in the cruise phase of flight, 77 per cent of these were the result of a mechanical-related problem. This included 21 accidents where the aircraft suffered either a partial powerloss or complete engine failure and the pilot was forced to the land the aircraft immediately. As a result of the forced landing, the aircraft suffered substantial damage or was destroyed. None of the aircraft occupants received any serious or fatal injuries (Figure 46).

FIGURE 46: Number of accidents by phase of flight and classification, 2002 to 2006



While the landing phase accounted for the greatest proportion of accidents, only a small number resulted in some form of injury to the aircraft occupants, with one fatality, four serious injuries and 27 minor injuries. Conversely, a large number of the accidents resulted in aircraft damage with 17 aircraft destroyed and 229 with substantial damage. The highest number of fatal accidents occurred in the manoeuvring/airwork phase closely followed by the approach phase. This included six loss-of-control accidents and five wirestrikes (Figure 47).

FIGURE 47: Number of accidents and fatal accidents by phase of flight, 2002 to 2006

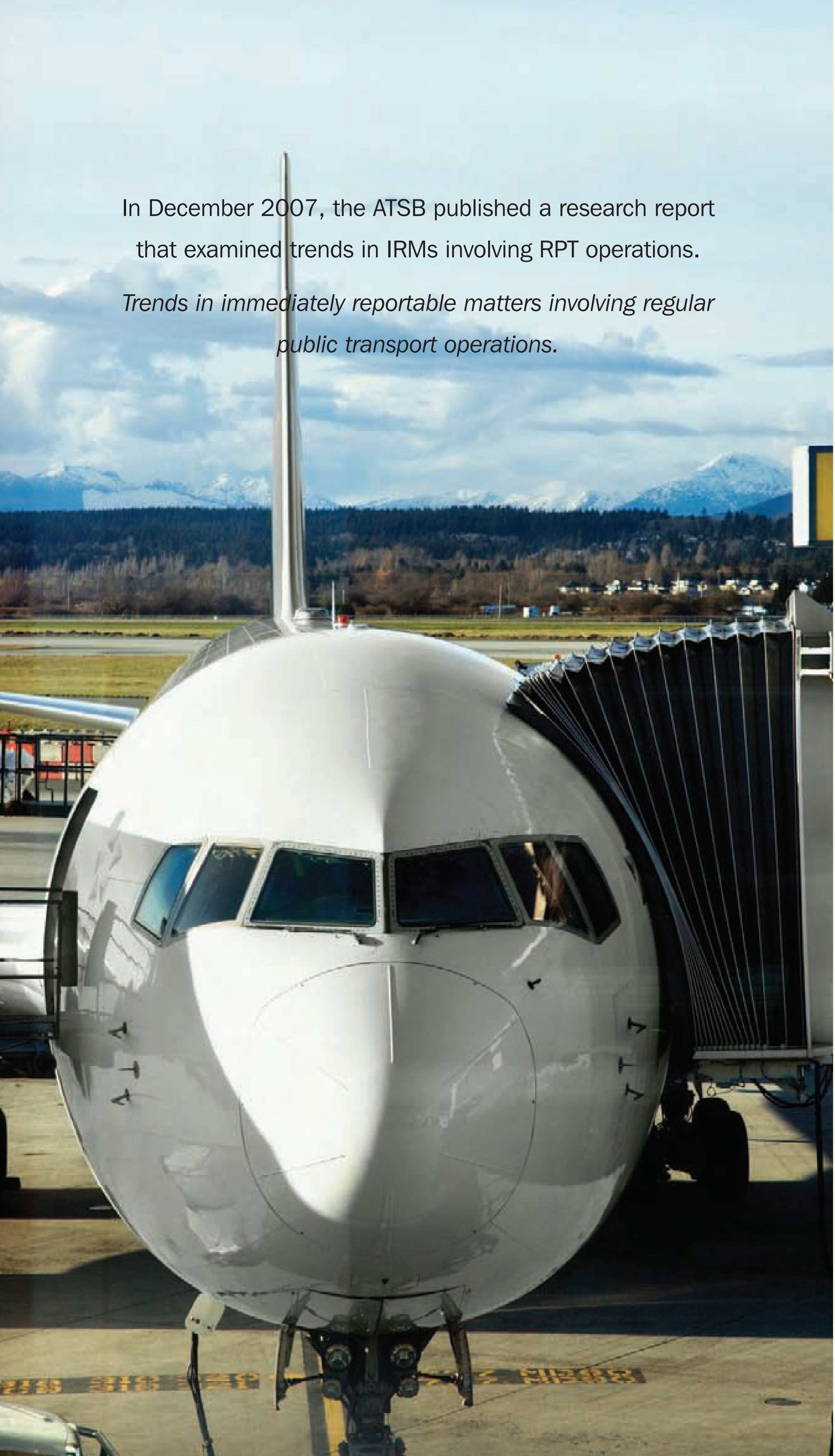


Accidents – phase of flight at a glance

	Accidents		Fatal accidents	
	2005	2006	2005	2006
Standing	5	2	0	0
Taxiing	1	2	0	0
Takeoff	15	12	0	0
Initial climb	11	15	2	3
Climb	0	1	0	0
Cruise	9	6	2	1
Manoeuvring/airwork	20	15	6	3
Descent	2	3	0	2
Approach	11	11	3	6
Landing	45	25	0	0
Unknown	5	5	4	5
Total	**124**	**97**	**17**	**20**

In December 2007, the ATSB published a research report that examined trends in IRMs involving RPT operations.

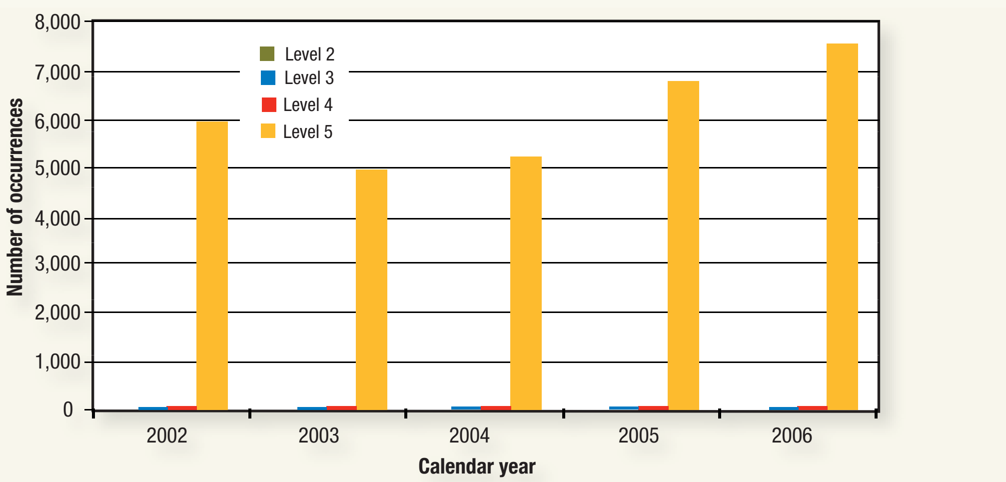
Trends in immediately reportable matters involving regular public transport operations.



What about incidents?

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. Each year a substantial number of occurrences (accidents and incidents[11]) are sent to the ATSB via fax, phone, mail, email, internet, and from the Airservices Australia Electronic Safety Incident Reporting System (ESIR). In the 2006–07 financial year, the ATSB received in excess of 13,300 aviation notifications, of which 7,832 were classified as occurrences. Of these occurrences, 7,720 or 96 per cent were incidents. While there are certain factors that may affect the number of incidents reported to the ATSB each year, such as improved reporting cultures, changes to airspace procedures, the introduction of new airlines etc., incidents can provide an indicator of safety within the industry (Figure 48).

FIGURE 48: Number of Level 1 to Level 5 occurrences (see Glossary) entered into the ATSB's aviation safety database, 2002 to 2006



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

11. The term 'incident' is used here to collectively describe both incidents and serious incidents.

In December 2007, the ATSB published a research report that examined trends in IRMs involving RPT operations[12]. The report looked at both accident and incident data in the period from mid 2001 – before the introduction of the TSI Act – to mid 2006, to inform the aviation community of any important safety trends and to provide the travelling public with a better appreciation of the types of occurrences reported to the ATSB.

As accidents were extremely rare in RPT operations, the report focused primarily on incident data.

The report looked at a selection of incident types including violations of controlled airspace (VCA); breakdowns of separation (BOS) and 'airproxes'; fire, smoke, explosions or fumes; crew injury or incapacitation; fuel exhaustion; and uncontained engine failures. The report found:

- Violations of controlled airspace involve aircraft entering controlled or restricted airspace without appropriate clearances from air traffic control. There was a total of 82 airspace violations recorded over the five years, and the ATSB found a downward trend for these incidents.
- A breakdown of separation occurs when the distance between aircraft is less than that required by prescribed standards. In many cases where separation breaks down, the aircraft will still be some considerable distance apart. Of the 462 incidents recorded, only two per cent were serious enough to warrant further investigation by the ATSB. Breakdown of separation events had increased, but only at about the same rate that airline activity has increased.
- Other incidents examined by the ATSB included reports of crew incapacitation and cabin fumes. Serious crew injury or illness was rare, supporting the findings from an earlier study by the ATSB[13]. The ATSB also received 140 notifications of fumes. Sources of fumes included oil or solvent residues following maintenance activities, failed or overheated electrical or mechanical components, or passenger's luggage. Smoke or fumes from burning food in the galley was also common.
- IRM categories such as uncontained engine failures and fuel exhaustion were rare, or absent.

The results of the study indicated that despite an increase in RPT activity, the number of IRM occurrences remained stable or declined. When measured in relation to airline activity, the trend rate was generally downwards.

This study highlights the value of a strong safety reporting culture and provides encouraging data concerning safety trends in Australian airline operations.

12. ATSB. (2007). *Trends in immediately reportable matters involving regular public transport operations*. Canberra: Australian Transport Safety Bureau.

13. Newman, D. G. (2007). *Pilot incapacitation: Analysis of medical conditions affecting pilots involved in accidents and incidents 1 January 1975 to 31 March 2006* (B2006/0170). Canberra: Australian Transport Safety Bureau.

What are your reporting obligations?

The immediately reportable matters (IRMs) and routine reportable matters (RRMs) are further divided into sections based on the operation type of the aircraft. These are:

- all aircraft operations
- air transport operations
- aircraft operations other than air transport operations

The prescribed reportable matters and operation type can be found in Section 2.3 and 2.4 of the *Transport Safety Investigation Regulations 2003* (TSI Regulations).

The TSI Regulations not only list the accidents and incidents that should be reported to the ATSB, but also the time frame within which the ATSB should be notified. For example, if a 'responsible person' has knowledge of an IRM, then that person must report it to the ATSB in the first instance as soon as reasonably practicable. This is usually by telephone. Also, if a responsible person has knowledge of an IRM or RRM, the person must provide a written report to the ATSB within 72 hours. The TSI Regulations also defines who is considered a responsible person.

For more information on the TSI Act and Regulations, go to the ATSB website at: <www.atsb.gov.au/about_atsb/legislation/index.aspx>

The controlled flight into terrain (CFIT) accident was identified as one of aviation's historic killers.

...CFIT accidents and incidents in Australia are a rare event.

However, when they do occur, there is a high risk of fatal injuries to the aircraft occupants.

Chapter 4
Controlled flight into terrain

How common are CFIT accidents and incidents in Australia?

While air travel is one of the safest modes of transportation[14], controlled flight into terrain (CFIT) remains one of the leading causes of fatal commercial aircraft accidents. Identified as one of 'aviation's historic killers', CFIT has claimed the lives of more than 35,000 people since the emergence of civil aviation in the 1920s[15]. Given the catastrophic nature of CFIT, the international aviation community has invested a considerable amount of time and resources to prevent CFIT. Most notable are the efforts made by the Flight Safety Foundation through CFIT awareness and education, and the introduction of terrain awareness technologies such as the Ground Proximity Warning System and Terrain Awareness and Warning System. Even though these measures have, directly or indirectly, contributed to a reduction in the number of CFIT accidents involving commercial jet aircraft since 1998, CFIT remains a risk, hazard and challenge.

In December 2007, the ATSB published a research report on CFIT[16]. The aim of the study was to provide an overview of CFIT from an international perspective, explore the initiatives introduced in combating CFIT, and examine CFIT accidents and incidents in the Australian context.

Globally, there has been a number of well-publicised CFIT accidents involving large passenger transport aircraft such as that of a Boeing 757 in Cali, Colombia in 1995, and a Boeing 737 in Dubrovnik, Croatia in 1996. While there have been no CFIT accidents involving large passenger transport aircraft within Australia, there has been a number of CFIT accidents involving smaller aircraft, most recently including that of a Piper Cheyenne near Benalla, Victoria in 2004, a Piper Chieftain at Mount

14. ATSB. (2007). *Annual review 2007*. Canberra: Australian Transport Safety Bureau.

15. Bateman, D. (1999). *The introduction of enhanced ground-proximity warning systems (EGPWS) into civil aviation operations around the world*. Paper presented at the 11th EASS 'Flight Safety: Management, Measurement and Margins', Amsterdam, Netherlands.

16. ATSB. (2007). CFIT: *Australia in context 1996 to 2005*. Canberra: Australian Transport Safety Bureau.

Hotham, Victoria in 2005, and a Fairchild Metro 23 at Lockhart River, Queensland in 2005.

A search of the ATSB's aviation safety database between the period 1996 and 2005 identified 25 CFIT accidents and two CFIT incidents. Of the 25 CFIT accidents, 15 were fatal accidents resulting in 47 fatalities.

The efforts of the international aviation community have largely focused on the air transport sector. This is entirely understandable given the high number of fatalities associated with one CFIT accident involving a large passenger aircraft. However, CFIT occurs in all sectors of the aviation industry. In Australia, general aviation accounted for the greatest proportion of CFIT accidents, fatal accidents and fatalities. Only one CFIT occurrence over the reporting period involved regular public transport operations (VH-TFU, Lockhart River, Queensland, 7 May 2005). This one accident accounted for nearly one-third of all CFIT fatalities, highlighting the seriousness of CFIT accidents and the reason they remain high on the agenda of aviation safety organisations worldwide.

In line with international experience, nearly two-thirds of CFIT accidents and incidents in Australia occurred in the approach phase of flight, with half of these during an instrument approach. During the last decade, Australia has seen the emergence of satellite-based instrument approaches, such as the area navigation global navigation satellite system (RNAV (GNSS)) in place of the traditional terrestrial-based navigation aids. Nearly half of Australia's CFITs during an instrument approach involved RNAV (GNSS). This type of approach offers considerable benefits in terms of accurate tracking, but without augmentation, it lacks the capacity to provide vertical guidance. The results of the study suggest that there is scope to reduce CFIT further by implementing approaches with vertical guidance (APV), which provide vertical guidance on approaches much like precision approaches. This capability can assist pilots with maintaining vertical and lateral situational awareness and hence, reduce the risk of CFIT. Currently, Australia is examining the options available for the provision of RNAV (GNSS) approaches with vertical guidance.

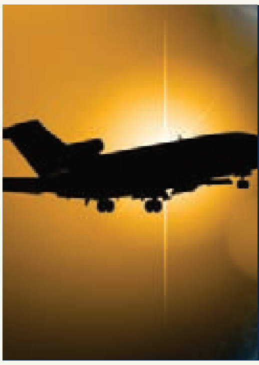
Satellite-based technology has also provided an alternative means to Australia's existing, yet ageing, air traffic management infrastructure by way of automatic dependent surveillance broadcast (ADS-B) and GNSS. These systems together can provide a more accurate means of navigation and increase situational awareness for pilots when coupled with cockpit terrain displays.

Advancements in technology over the years has also seen the GPWS evolve with the development of a new generation of systems called terrain awareness (avoidance) and warning systems (TAWS). In addition to the 'look-down' capability provided by GPWS, TAWS provides a 'look-ahead' capability, which uses aircraft position data, aircraft altitude, and a worldwide terrain database to predict potential conflicts between the aircraft's flight path and the surrounding terrain.

The results of this study challenged some of the underlying assumptions often made about CFIT. That is, these types of accidents and incidents can occur in conditions of clear visibility and in areas with no significant terrain features.

Overall, the study found that CFIT accidents and incidents in Australia are a rare event. However, when they do occur, there is a high risk of fatal injuries to the aircraft occupants. This emphasises the seriousness of CFIT and the need for a continued focus on developing preventative strategies to reduce the risk of CFIT further.

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.



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 research and 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 generally 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).

While a tripartite Government relationship for aviation safety in Australia exists between the Department (including the ATSB), the Civil Aviation Safety Authority and Airservices Australia, it is crucial that the ATSB independently undertakes investigations and the analysis of safety data without fear or favour. In doing so, it helps to improve safety and maintain public confidence that the safety of the aviation transport system is not being compromised.

Data sources

Information on accidents, fatal accidents and fatalities in this report was based on data derived from the Australian Transport Bureau's (ATSB) aviation safety occurrence database and examines VH-registered aircraft only.

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 Transport and Regional Economics (BTRE) now 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

Glossary

Accident – An occurrence which takes place between the time the first person boards the aircraft with the intention of flight until such time as the last person has disembarked, in which:

a) a person is fatally or seriously injured as a result of:

   a. being in the aircraft

   b. direct contact with any part of the aircraft including parts which have become detached from the aircraft, or

   c. direct exposure to jet blast

   except when the injuries are from natural causes, self inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or

b) the aircraft incurs substantial damage or is destroyed; or

c) the aircraft is missing or is completely inaccessible.

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.

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 charter, 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.

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.

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 levels – The following classification of aviation transport safety matters is intended to serve as a suggested starting point based on initial information. This guidance is not intended to cover all possible scenarios but illustrates a broad range of typical events. It is expected that judgment will be required in order to categorise some events which do not neatly fit these categories or where the circumstances, potential safety value and available resources suggest that they should be assigned a different level.

Occurrence level 1:

- An accident involving one or more high capacity air transport (scheduled and non-scheduled) passenger aircraft with fatalities.
- An accident involving one or more high capacity air transport (scheduled and non-scheduled) passenger aircraft without fatalities:

where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future High Capacity Air Transport accidents.

- A serious incident (as defined by ICAO see Attachments A & B) involving one or more High Capacity Air Transport (scheduled and non-scheduled) passenger aircraft:

    where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future High Capacity Air Transport (scheduled and non-scheduled) accidents.

Occurrence level 2:

- An accident involving one or more high capacity air transport cargo aircraft with fatalities and serious injuries.
- An accident involving one or more high capacity air transport cargo aircraft without fatalities and serious injuries:

    where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future High Capacity Air Transport cargo aircraft accidents.

- An accident involving one or more low capacity air transport (scheduled) passenger aircraft with a significant number of fatalities (for example, it may involve more than five fatalities) and serious injuries.
- An accident involving one or more low capacity air transport (scheduled) passenger aircraft without fatalities or with a relatively low level of fatalities (eg less than five) and serious injuries

    where there was a significant risk of more fatalities or serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future Low Capacity Air Transport (scheduled) accidents.

- A serious incident involving one or more low capacity air transport (scheduled) passenger aircraft:

    where there was a significant risk of multiple fatalities (eg more than five) and serious injuries and a substantial commitment of investigative resources is likely to significantly mitigate future Low Capacity Air Transport (scheduled) accidents.

- An accident involving one or more low capacity charter (non-scheduled) aircraft with fare-paying passengers and multiple fatalities and serious injuries (for example it may involve more than five fatalities):

    where a substantial commitment of investigative resources is likely to significantly mitigate future Low Capacity Air Transport (scheduled) and charter (non-scheduled) accidents.

Occurrence level 3:

- An accident involving one or more low capacity air transport passenger (scheduled) or charter (non-scheduled) aircraft with fatalities and/or serious injuries not classified as a level 2 investigation.
- An accident involving air transport cargo operations with fatalities.
- An accident involving one or more training aircraft with fatalities.

- An accident without fatalities involving one or more high or low Capacity air transport aircraft not classified as a level 1 or 2 investigation and where investigation is likely to significantly mitigate future accidents.
- An accident involving one or more general aviation aircraft (other than sport aviation) with fatalities.
- An accident involving one or more charter or other general aviation aircraft:

  where there was a significant risk of fatalities or serious injuries and a substantial commitment of investigative resources would significantly mitigate accidents.

- A serious incident involving one or more high or low capacity air Transport passenger aircraft not classified as a level 1 or 2 investigation and where investigation is likely to significantly mitigate future accidents.
- A serious incident involving one or more air transport cargo, charter or training aircraft where investigation is likely to significantly mitigate future accidents.
- An incident involving one or more high or low capacity air transport aircraft where investigation is likely to significantly mitigate future accidents.

Occurrence level 4:

- An accident involving a foreign aircraft covered by Article 26 of the Chicago Convention that is not being investigated as level 1, 2, or 3.
- An accident involving one or more charter or general aviation aircraft (other than sport aviation) without fatalities:

  where a limited commitment of investigative resources could significantly mitigate future aviation accidents.

- An accident or serious incident involving Australian designed and manufactured aircraft types on the Australian Register with international safety implications not being investigated as level 1, 2, or 3.
- An accident or serious incident involving one or more high or low capacity air transport aircraft not being investigated as level 1, 2, or 3.
- A serious incident involving one or more non air transport aircraft:

  where a limited commitment of investigative resources could significantly mitigate future accidents.

Occurrence level 5:

- An accident (including with fatalities) or serious incident involving a sport aviation aircraft unless foreign and required to be investigated under Article 26 of the Chicago Convention.
- An accident involving aircraft without fatalities:

  where the potential safety lessons do not, after initial review, justify the commitment of investigative resources. Basic incident data will be filed for statistical purposes.

- A serious incident or incident involving aircraft:

  where the potential safety lessons do not, after initial review, justify the commitment of investigative resources. Basic incident data will be filed for statistical purposes.

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.

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

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

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 injury – An injury which is sustained by a person in an accident and which:

a) requires hospitalisation for more than 48 hours, commencing within seven days from the date the injury was received; or

b) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); or

c) involved lacerations which cause severe haemorrhage, nerve, muscle or tendon damage; or

d) involves injury to any internal organ; or

e) involves second or third degree burns, or any burns affecting more than 5 per cent of the body surface; or

f) involves verified exposure to infectious substances or injurious radiation.

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.