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Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Aviation Research and Analysis Report – AR-2011-020
Final (Amended)

Aviation Occurrence Statistics 2001 to 2010

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ISBN and formal report title: see ‘Document retrieval information’ on page v

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DOCUMENT RETRIEVAL INFORMATION

Report No.	Publication date	No. of pages	ISBN	ISSN
AR-2011-020	20 May 2011 (Amended July 2011)	77	978-1-74251-150-4	1837-2430

Publication title

Aviation Occurrence Statistics: 2001 to 2010

Prepared By

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608 Australia
http://www.atsb.gov.au

Reference Number

Apr11/ATSB23

Acknowledgements

Activity data was provided by the Bureau of Infrastructure, Transport and Regional Economics.

Abstract

In 2010, uncontained engine failures occurred on two high capacity aircraft (a Boeing 747 and an Airbus A380); two air transport aircraft almost collided in non-controlled airspace, coming within 40 metres of each other; and a cockpit window blew out of a Metro aircraft at about 20,000 feet, resulting in a rapid cabin decompression. These are some of the occurrences described in a new report on occurrence data for the period 2001 to 2010. The Australian Transport Safety Bureau (ATSB) has tabled a list of frequently occurring events and presents them in this report along with trends over time.

During 2010, the top five most frequently occurring events for air transport relating to accidents and serious incidents were aircraft separation, aircraft control, powerplant and propulsions systems, miscellaneous events and terrain collisions, runway events and ground operations. For air transport incidents they were wildlife strikes, failure to comply, mechanical systems, miscellaneous and airframe events. For general aviation aircraft involved in accidents and serious incidents, the top five most frequently occurring events were terrain collisions, aircraft control, powerplant and propulsion, aircraft separation and runway events. Where general aviation aircraft were involved in an incident, the top five most frequently occurring events were airspace incursion, failure to comply, wildlife strikes, runway events and aircraft separation.

General aviation operations continue to have a fatal accident rate per million departures that is about 4.3 times higher than for air transport. The general aviation accident rate per million departures is about three times higher than air transport. No fatal accidents were recorded in high capacity air transport between 2001 and 2010. During 2010, there was one fatal accident in low capacity air transport, and charter operations recorded no fatal accidents. Between 2001 and 2010, most fatal accidents in air transport were in charter operations. Charter aeroplanes and helicopters have a similar accident and fatal accident rate. In air transport, charter operations offer the best potential target for safety improvement.

In general aviation, there were 147 fatal accidents and 236 people killed between 2001 and 2010. The general aviation accident and fatality rate is not evenly dispersed across all sub-groups or types of aircraft. Of all general aviation sub-groups, private/business flying has the highest fatal accident rate and the greatest number of fatalities (135 people between 2001 and 2010). Agriculture has the highest accident rate and second highest fatal accident rate. This is followed by mustering, survey and photography, and flying training. In aerial work, helicopters have a higher accident and fatal accident rate than aeroplanes. In contrast to this, flying training and private operations helicopters have a higher accident rate than aeroplanes, but overall, are associated with a smaller number of total fatalities.

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DOCUMENT AMENDMENT

A number of changes have been made to this document since it was first published in May 2011. The *number* of occurrences reported have remained the same, and only the *rates* of occurrences per departure or hours flown have changed. The substantive differences between general aviation (GA) and air transport remain unchanged, as does the difference between charter operations in air transport and high and low capacity RPT operations. The changes in this report have been necessary because computer code used to generate the original report was coupled in a way that over or under-estimated accident and fatal accident rates in some cases. This document has been revised in the following way:

- The Bureau of Infrastructure, Transport and Regional Economics (BITRE) has provided the ATSB with new departures and hours data for low and high capacity aircraft, which previously did not include some freight only flights. As well, foreign and VH- registered international departures have been reallocated to take account of one aircraft operator with both VH- and ZK- registered aircraft; these were previously included in Australia departures data. Charter departure figures have been thoroughly revised to take account of a previously conservative estimate of charter departures. This has had the effect of *reducing* the accident and fatal accident rate per departures in charter aircraft. The accident and fatal accident rate per hours flown remains essentially unchanged. It is necessary to estimate charter departures because the data collected by BITRE does not record charter-specific departures. The Air Operators Certificate survey by the Civil Aviation Safety Authority cannot be used as it only records passenger carrying charter operations, not freight.
- All GA departures and hours figures have been reduced by the amount of hours performed and estimated departures performed in charter operations. Although this has changed year-on-year comparisons and the pooled accident rate, the fatal accident rate between 2001 and 2010 has only increased a small amount. This is, in part, due to the relative size difference between the number of fatal accidents and the total denominator figure.
- Aerial work accident rates have been revised, with agriculture being included in the total aerial work category. The ATSB uses the definition of aerial work in Civil Aviation Regulation 206, except that it excludes flying training. This is because flying training is thought to be a discrete enough operation entity to warrant separation from other aerial work categories. This has had the effect of reducing the aeroplane accident rate by comparison with the helicopter accident rate; these were reported as being similar in the previous report.
- Revised agriculture data shows it has the highest accident rate, and a fatal accident rate similar to private/business flying.

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THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

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TERMINOLOGY USED IN THIS REPORT

Occurrence: accident or incident.

Accident: an occurrence involving a aircraft where:
(a) a person dies or suffers serious injury; or
(b) the aircraft is destroyed or seriously damaged; or
(c) any property is destroyed or seriously damaged (TSI Act, 2003).

Incident: an occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation (ICAO Annex 13).

Serious incident: an incident involving circumstances indicating that an accident nearly occurred (ICAO Annex 13).

Serious injury: an injury that requires, or would usually require, admission to hospital within 7 days after the day when the injury is suffered (TSI Regulations, 2003).

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ABBREVIATIONS

ATSB	Australian Transport Safety Bureau
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BOS	Breakdown of Separation
CASA	Civil Aviation Safety Authority
FTC	Failure to comply
GA	General aviation
IFR	Instrument flight rules
IRM	Immediately reportable matter
MTOW	Maximum take-off weight
NM	Nautical miles
PIC	Pilot in command
RPT	Regular public transport
RRM	Routine reportable matter
SIIMS	Safety Investigation Information Management System
VFR	Visual flight rules

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OPERATION TYPES USED IN THIS REPORT

This report provides data relating to the following operational types:

- **Commercial air transport:** Commercial air transport refers to scheduled and non-scheduled commercial operations used for the purposes of transporting passengers and/or cargo for hire or reward. Specifically, this includes:
  - ***High capacity regular public transport*** (RPT). Regular public transport operations[1] conducted in high capacity aircraft. A high capacity aircraft refers to an aircraft that is certified as having a maximum capacity exceeding 38 seats or a maximum payload exceeding 4,200 kg.
  - ***Low capacity RPT***. Regular public transport operations conducted in aircraft other than high capacity aircraft. That is, aircraft with a maximum capacity of 38 seats or less, or a maximum payload of 4,200 kg or below.
  - ***Charter***. Charter operations involve the carriage of passengers and/or cargo on non-scheduled operations by the aircraft operator, or the operator's employees, in trade or commerce, excluding RPT operations.[2]
- **General aviation:** General aviation is all flying activities outside of scheduled (RPT) and non-scheduled (charter) passenger and freight operations. General aviation in this report does not include Australian non-VH registered aircraft. General aviation does include:
  - ***Aerial work***: including ambulance and emergency medical services, agriculture, mustering, search and rescue, fire control, and survey and photography.
  - ***Flying training***.
  - ***Private, business and sports aviation***. Sports aviation includes gliding, parachute operations, and acrobatics.

[1] RPT operations are conducted in accordance with fixed schedules to and from fixed terminals over specific routes.

[2] In this report, charter operations (for both occurrences and departures/hours flown) mostly refer to charter operations in low capacity aircraft. High capacity charter operations by predominantly high capacity RPT-orientated airlines are not routinely differentiated from regular public transport operations in either occurrence reports (to the ATSB) or activity reports (to BITRE).

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1 INTRODUCTION

1.1 Background to the report

Each year, the Australian Transport Safety Bureau (ATSB) receives accident and incident notifications from pilots, airline operators, air traffic control, maintenance personnel, aerodrome operators and emergency services authorities. The reporting of these aviation accidents and incidents, collectively termed occurrences, assists the ATSB in monitoring safety through its core functions of independent investigation and the analysis of data to identify emerging trends.

The types of occurrences that are required to be reported to the ATSB are detailed in the Transport Safety Investigation Regulations 2003. These occurrences are categorised as either immediately reportable matters (IRMs) or routine reportable matters (RRMs) depending on the seriousness of the event and the category of operation. To see the full list of IRMs and RRMs, visit the ATSB's website at www.atsb.gov.au/about_atsb/legislation.aspx.

This publication has been significantly enhanced and expanded compared with previous editions, and will continue to be refined in coming editions. The *Aviation occurrence statistics* report will be updated and published annually.

1.2 Data sources

1.2.1 Occurrence data

The accident and incident data collected by the ATSB is recorded in its aviation safety database, the Safety Investigation Information Management System (SIIMS). The occurrence data provided herein was extracted from the SIIMS database for the period 1 January 2001 to 31 December 2010 for Australian civil registered aircraft operating both within and outside Australian territory[3] and foreign registered aircraft operating within Australian territory only. Note that this report does not include occurrences relating to recreational aviation where the aircraft are registered with Recreational Aviation Australia, the Australian Sport Rotorcraft Association or the Hang Gliding Federation of Australia.

1.2.2 Activity data

The Bureau of Infrastructure, Transport and Regional Economics (BITRE) Aviation Statistics section routinely collects activity data for air transport and general aviation operations. This includes hours flown data and departures data collected through:

- The annual *General Aviation Activity Survey* (the Survey), which is distributed to operators or owners of aircraft listed on the Civil Aviation Safety Authority's civil aircraft register, with the exception of aircraft operated by the major domestic airlines (Qantas, Virgin Blue, Jetstar and Tiger Airways). The Survey estimates some data

[3] Australian territory refers to mainland Australia, and within the Tasmanian and Australian territories 12 nautical mile limit.

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where there is less than a 100 per cent return rate (see the Survey explanatory notes for 2009).

- Monthly performance data provided to the BITRE by airline operators.

The above activity data, available up to and including 2009 at the time of publishing, was used to calculate accident and fatal accident rates per million departures and per million hours flown. Note that activity data recently revised by BITRE for high capacity aircraft has risen from 2004 onwards. This relates to additional freight only activity, not previously available, being added to the figures.

For more aviation activity statistics, please visit the BITRE website at www.bitre.gov.au.

1.3 Disclaimer

Occurrence data used in this report is provided to the ATSB by responsible persons as defined in the Transport Safety Investigation Regulations 2003 Part 2.5. The ATSB accepts no liability for any loss or damage suffered by any person or corporation resulting from the use of this data.

The data contained in SIIMS is dynamic and subject to change pending the provision of new information to the ATSB.

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2 ACTIVITY DATA

The number of aviation occurrences alone does not represent a complete picture of safety within the industry. For meaningful comparisons to be made between different types of aircraft and operations they perform, data in this report is presented as a rate per million hours flown or departures. Activity data used to calculate rates in this report are found in Table 1 and Table 2. These data are rounded to the nearest thousand hours or departures to present the size or magnitude of the data in general terms. The Bureau of Infrastructure, Transport and Regional Economics (BITRE) compiles these data from reports submitted by airlines, and from other aircraft operators through the *General Aviation Activity Survey*. Activity data for sports aviation are not tabled in this report.

2.1 Departures

Aircraft departures are widely used as a measure of exposure, or the opportunity for an event to occur. This report uses these data as denominator figures for calculating accident and fatal accident rates for all air transport operation types[4] and general aviation. Departures are considered to be a more appropriate exposure measure than hours flown as most accidents occur either during the approach and landing or departure phases of flight.

Departures data are not available for individual operation types within general aviation. At the time of publication, departures were available up to the end of 2009.

Table 1 shows that in the period between 2001 and 2003, general aviation (GA) had about two times the number of aircraft departures in Australia than commercial air transport. Since about 2006, the GA to commercial air transport departures ratio has dropped to about 1.4. In general terms, GA departures have fallen since 2001. Since 2006, there have been about two million general aviation departures per year.

Domestic high capacity departures have increased between 2001 and 2008 in a linear fashion, but levelled off in 2009, while low capacity aircraft departures have decreased over the same time period. Charter departures have remained relatively static. A small, gradual increase in foreign registered aircraft departures has been observed over the reporting period.

Although there were a larger number of total general aviation departures than in air transport operations (Table 2), the departures in general aviation are dispersed across a much larger fleet. In 2009, there was a difference of about 600,000 departures.

---

[4] Charter departures are estimated because departures are not recorded separately for different types of operations in the BITRE *General Aviation Activity Survey*. The estimation model calculates the rate of departures per hour flown for aircraft that only perform charter operations. It then uses this ratio to estimate the number of charter-related departures for all aircraft based on the number of charter hours flown. Ratios are specific to aircraft type (aeroplane or helicopter) and number of engines (single or mulit-engine). The ratios used are shown in Appendix B.

As high capacity charter aircraft activity is not routinely separated from RPT operations, the real number of charter departures will be slightly different than those reported here. However, it is unlikely to significantly influence rate data.

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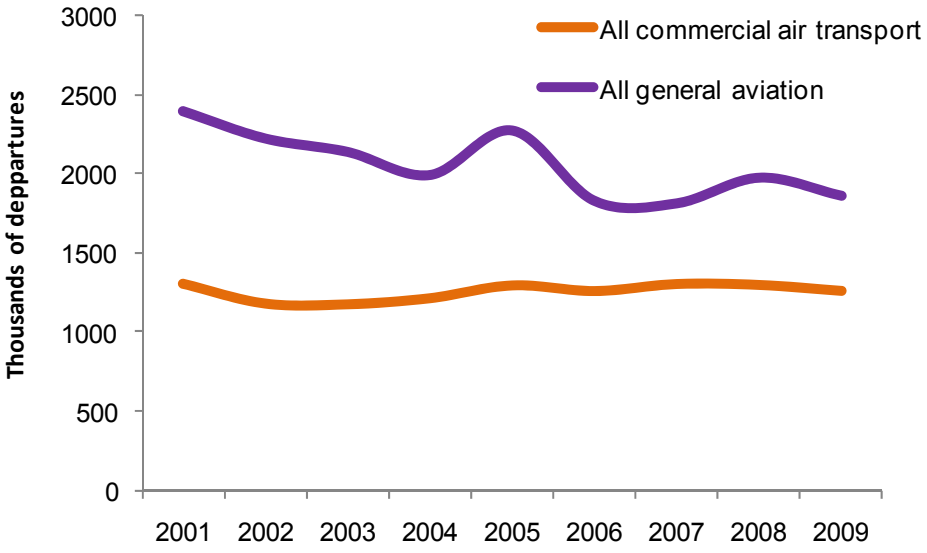
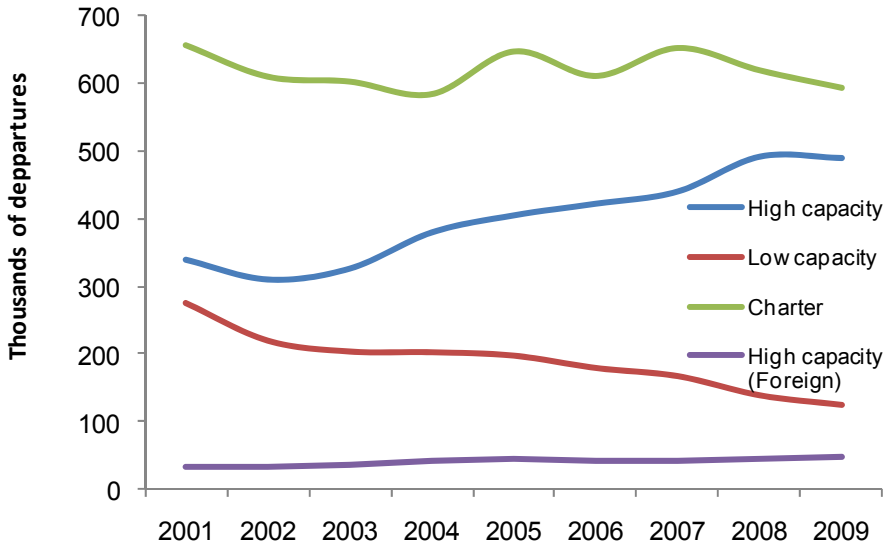
Table 1: Departures (thousands), 2001 to 2009

	2001	2002	2003	2004	2005	2006	2007	2008	2009
All commercial air transport	1,302	1,172	1,167	1,207	1,291	1,254	1,300	1,294	1,255
High capacity (*VH- registered)*	339	310	326	379	404	421	439	490	488
Low capacity	275	220	204	203	198	180	168	140	126
Charter (estimated)[5]	654	609	602	584	645	610	650	618	593
High capacity (*Foreign)*	34	33	35	41	44	43	43	46	48
All general aviation	2,398	2,223	2,137	1,989	2,274	1,823	1,808	1,972	1,856

Figure 1: Departures by operation type, 2001 to 2009





[5] Charter balloon departures are not included in this figure.

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2.2 Hours flown

Hours flown data, available up to the end of 2009 (and estimated for 2010), is used to calculate accident and fatal accident rates for different operation types. This data includes hours flown for both domestic/regional and international high capacity RPT operations for Australian airlines only, and general aviation (GA). Note that hours flown by foreign registered aircraft are not known. Hours flown is considered to be a more useful measure of exposure than departures for some operation types within general aviation because of the higher risk of an accident outside of the approach/landing and takeoff phases of flight; for example some aircraft may be required to perform low flying.

Table 2 records thousands of hours flown by operation type for VH- registered aircraft.[6] Following events in the United States in 2001, hours flown in Australia fell in both air transport and total GA, but steadily rose until 2008. In 2009, the rise in hours flown, for air transport and total GA stopped. Low capacity air transport hours flown have continued to decrease, while high capacity air transport hours continually increased until 2008 before levelling off. The change between high and low capacity air transport is, in part, due to a blurring of traditional regional and domestic airline capability, where larger aircraft are being flown into regional airports and mines.

Between 2001 and 2007, GA experienced a U-shaped hours-flown distribution, with a drop of about 50,000 hours. Since 2004, a general increase in GA hours has been observed. Flying training hours flown have increased since 2004. Survey and agricultural flying hours have displayed significant variability, most likely due to the changes in business markets and drought conditions. Other types of aerial work have displayed a relatively stable level trend in hours flown.[7]

In 2002, general aviation and air transport hours flown were similar, but since 2004, all air transport has continued to rise at a faster rate than all GA. Currently, this difference is about 360,000 hours per year.

---

[6] Activity figures for charter and aerial work in this edition have been revised from previous editions. The *General Aviation Activity Survey* collects test and ferry hours as a separate category, but this data is not associated with the type of operation (e.g. aerial work, charter).To take account of this condition, test and ferry hours are distributed across charter, aerial work, training and private/business operations, based on the expected proportion of test and ferry in those categories. Private/business is assigned 11 per cent, flying training 11 per cent charter 21 per cent and aerial work is assigned the remaining proportion.

[7] Hours flown by general aviation operation types are not recorded individually for all types of aerial work.

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Table 2: Hours flown (thousands), 2001 to 2009

	2001	2002	2003	2004	2005	2006	2007	2008	2009
All commercial air transport	1,506	1,367	1,378	1,562	1,623	1,633	1,732	1,767	1,700
High capacity	798	720	758	883	944	978	1,027	1,122	1,128
Low capacity	249	208	197	204	201	181	166	132	108
Charter	459	439	423	475	478	474	539	513	464
All general aviation	1,234	1,240	1,214	1,162	1,237	1,215	1,285	1,336	1,337
All Aerial work[7]	414	410	404	412	426	412	445	464	446
Aerial Agriculture	106	70	69	86	94	61	62	78	73
Aerial Mustering	96	110	99	103	113	102	112	112	105
Aerial EMS	62	67	68	69	68	78	74	81	81
Aerial Search & Rescue	5	5	4	4	6	7	9	9	7
Aerial Survey	46	39	52	33	32	44	54	64	38
Flying training	411	415	425	357	420	429	461	490	501
Private/Business	409	415	385	393	391	374	379	382	390

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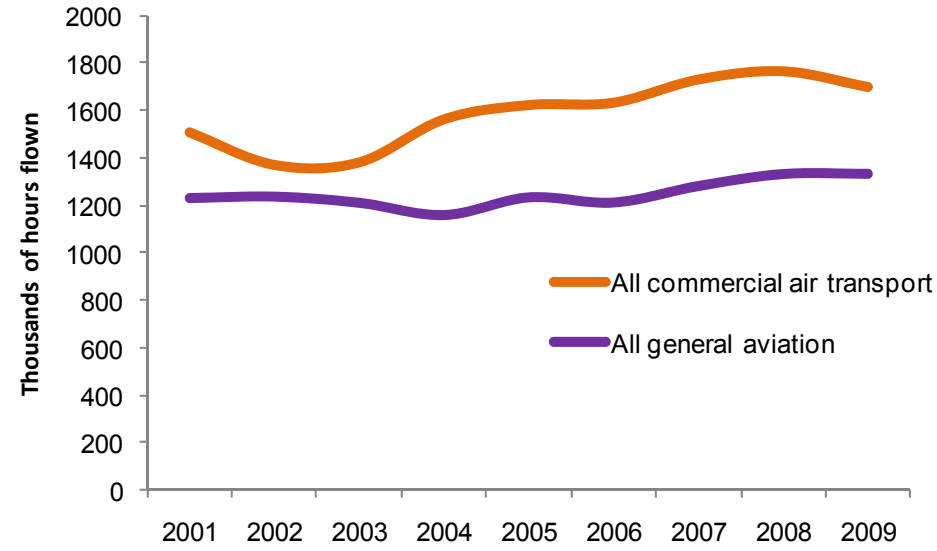
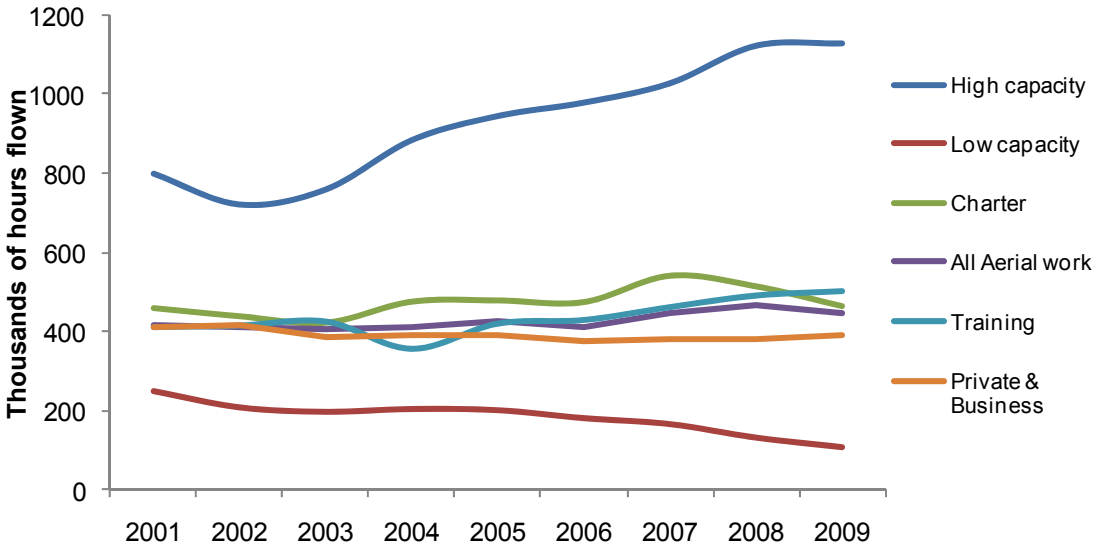
Figure 2: Hours flown by operation type, 2001 to 2009





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3 EXPLANATORY NOTES

Occurrence data represent a picture of aviation derived from information available at the time the report was generated. Data in this report are different from previous versions of *Aviation occurrence statistics* and are not directly comparable to those versions. In 2010, the ATSB has undertaken a quality review of occurrence data, upgrading a number of records to serious incident and accident, and downgrading occurrences not meeting the definitions contained in the *Transport Safety Investigation Act, 2003* and the International Civil Aviation Organisation (ICAO) Annex 13 definitions of serious incident. In addition, this report has expanded the aerial work operation type into sub-categories. For occurrence types (Chapter 7), the ATSB reviewed and altered the taxonomy used for coding occurrence types in 2010. Where more than one occurrence type has been associated with an occurrence, all occurrence types have been reported, rather than just the 'primary' occurrence type. Consequential events are tabled separately by operation type.

The following section contains a brief explanation of inclusions, exclusions, the structure of the report and other relevant factors to consider when reading this report.

Inclusions

Specifically, occurrence data in Chapters 4 to 7 include:

- the number of aircraft involved in incidents, serious incidents, serious injury accidents, fatal accidents and total accidents;
- the number of serious injuries and fatalities; and
- accident and fatal accident rates per million departures and million hours flown.

Exclusions

Fatalities do not include those resulting from:

- parachuting operations where aircraft safety was not a factor
- suicides
- criminal acts.

Structure of data in this report

In order to understand the structure of data in this report, a number of procedures are used in each chapter to distinguish occurrences from aircraft and injuries. An occurrence may involve one or more aircraft. The following points are of note:

- Occurrence data in Chapters 4 and 5 are presented based on aircraft involved in occurrences. Occurrences involving more than one aircraft are recorded once for each aircraft involved.
- Fatal accidents are counted based on what happens to the aircraft occupants. This means that each aircraft with an onboard fatality is counted separately as a fatal accident within the operation type of the aircraft. If two aircraft collide in mid-air and fatalities occur onboard both aircraft, two fatal accidents are counted. Using the same example, if two aircraft collide in mid-air and a fatality occurs on one aircraft only, one fatal accident is recorded, but in total, two accidents are recorded.

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- Injuries and fatalities are recorded against only the operation type of the aircraft in which the injury or fatality occurred.
- Tables in this report record aircraft where the registration or flight number is known and/or where the operation type can be reasonably ascertained. For example, aircraft operating in G class airspace without a transponder or flight plan can be reasonably expected to belong to general aviation, even though the operation subtype is not known.
- Where an occurrence has more than one level of injury, the highest injury level is recorded. For example, an accident involving an aircraft with four occupants may have one person with no injury, one person with minor injury, one person with serious injury, and one person with fatal injuries; this aircraft will be recorded as being involved in a fatal accident only.
- Serious injuries may be derived from either fatal accidents or serious injury accidents. Serious injury accidents represent occurrences where serious injury is the highest injury recorded.
- It is important not confuse serious injury and serious incident. A serious incident is an incident where an accident nearly occurred. In contrast, a serious injury involves an occurrence that requires, or would usually require, admission to hospital within 7 days after the day when the injury is suffered.
- The high-level categories of *all air transport* and *all general aviation* (GA) include occurrence data where the country of registration is not known, but the general type of operation is known. This means that the addition of sub-categories will be less than the total number at the higher level.

Further definitions of terminology used in this report can be found in the prefix.

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4 OCCURRENCES BY OPERATION TYPE

This chapter provides data on occurrence numbers and rates relating to the following operational types:

- **Commercial air transport:** high capacity regular public transport (RPT), low capacity RPT, and charter (VH-registered and foreign-registered aircraft).
- **General aviation:** aerial work, flying training, private, business and sports aviation (VH-registered and foreign-registered aircraft).

Table 3 compares the number of fatal accidents and fatalities for each operation type detailed in this chapter. Private aviation has by far the highest number of fatal accidents and fatalities. Fatal accidents in some aircraft operations are more likely to have a larger number of fatalities than other operation types. For example, over the period 2001 to 2010, there were 17 fatal accidents in charter operations, but 43 people killed as a result of these types of operations. This is because charter aircraft generally carry more passengers on each flight than agriculture. By comparison, there were 14 aircraft involved in fatal agricultural accidents over the same period, and 14 people killed. This shows that the seriousness of an occurrence is a function of the number of aircraft involved, the type of operation and the number of people on board these aircraft, who may potentially be at risk of injury or death.

Table 3: Fatal accidents and fatalities by operation type, 2001 to 2010

Operation type	Number of aircraft associated with a fatality	Number of fatalities
Commercial air transport	**19**	**60**
High capacity RPT	0	0
Low Capacity RPT	2	17
Charter	17	43
General Aviation	**147**	**236**
Aerial Work	42	58
Agriculture	*14*	*14*
Mustering	*9*	*10*
Emergency medical	*2*	*4*
Fire control	*2*	*2*
Survey and photography	*6*	*12*
Other/unknown	*8*	*14*
Flying training	14	18
Private/Business/sport	88	156
Private/Business	*70*	*135*
Sport aviation	*18*	*21*
Foreign registered general aviation	2	3

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4.1 Commercial air transport

An increase has been observed in the number of VH- and foreign registered commercial air transport aircraft incidents (Table 4) reported to the ATSB since 2003. This increase may be attributed to the introduction of the Transport Safety Investigation Regulations 2003 (TSI Regulations), which provides a prescriptive list of the types of occurrences that are required to be reported to the ATSB. This increase may also reflect a better reporting culture. More incidents were reported in 2010 than in any other year between 2001 and 2010.

Table 4: Commercial air transport occurrences, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	3,141	3,011	2,695	3,464	4,120	3,709	3,919	4,055	3,871	4,494
Serious incidents	9	10	15	30	31	16	45	47	24	33
Serious injury accidents	1	3	1	0	2	0	1	3	2	2
Fatal accidents	4	4	2	0	2	1	2	3	0	1
Total accidents	38	27	31	16	12	12	22	29	11	23
Number of people involved										
Serious injuries	4	8	4	0	2	0	1	15	3	2
Fatalities	10	12	8	0	18	2	2	6	0	2
Rate of aircraft involved										
Accidents per million departures	29.2	23	26.5	13.2	9.3	9.6	16.9	22.4	8.8	
Fatal accidents per million departures	3.1	3.4	1.7	0.0	1.5	0.8	1.5	2.3	0.0	

Most occurrences were incidents - about one per cent of all air transport occurrences were serious incidents or accidents. On average, there were about two fatal accidents every year involving these aircraft, and they belonged mainly to the category of charter operations. About one-in-ten accidents involved a fatality, and there are about three fatalities for each fatal accident. In 2010 there were two fatalities associated with one accident in the low capacity air transport category.

The fatal accident rate per million departures showed figures less than four fatal accidents per million departures to the end of 2009. No clear trend in fatal accident rates per million departures was observed, although some variability is observed between years. The fatal accident rate was at its highest in 2002 and lowest in 2004 and 2009.

The accident rate per million departures showed a U-shaped line (Figure 3) from 2003 until 2008. In 2009, the accident rate returned to the pre-2007 levels. Charter aircraft account for the majority of accidents in commercial air transport and have an accident rate per million departures that is about 3.5 times higher than low capacity RPT operations and seven times higher than high capacity RPT operations. The number of accidents in 2010 has increased over the 2009 figure. Accident rates were at about 26 per million departures prior to 2004, and between 2004 and 2006 the rate was less than half the pre-2004 rate. A spike in 2007 was followed by a decline in the accident rate to its lowest level in the reporting period.

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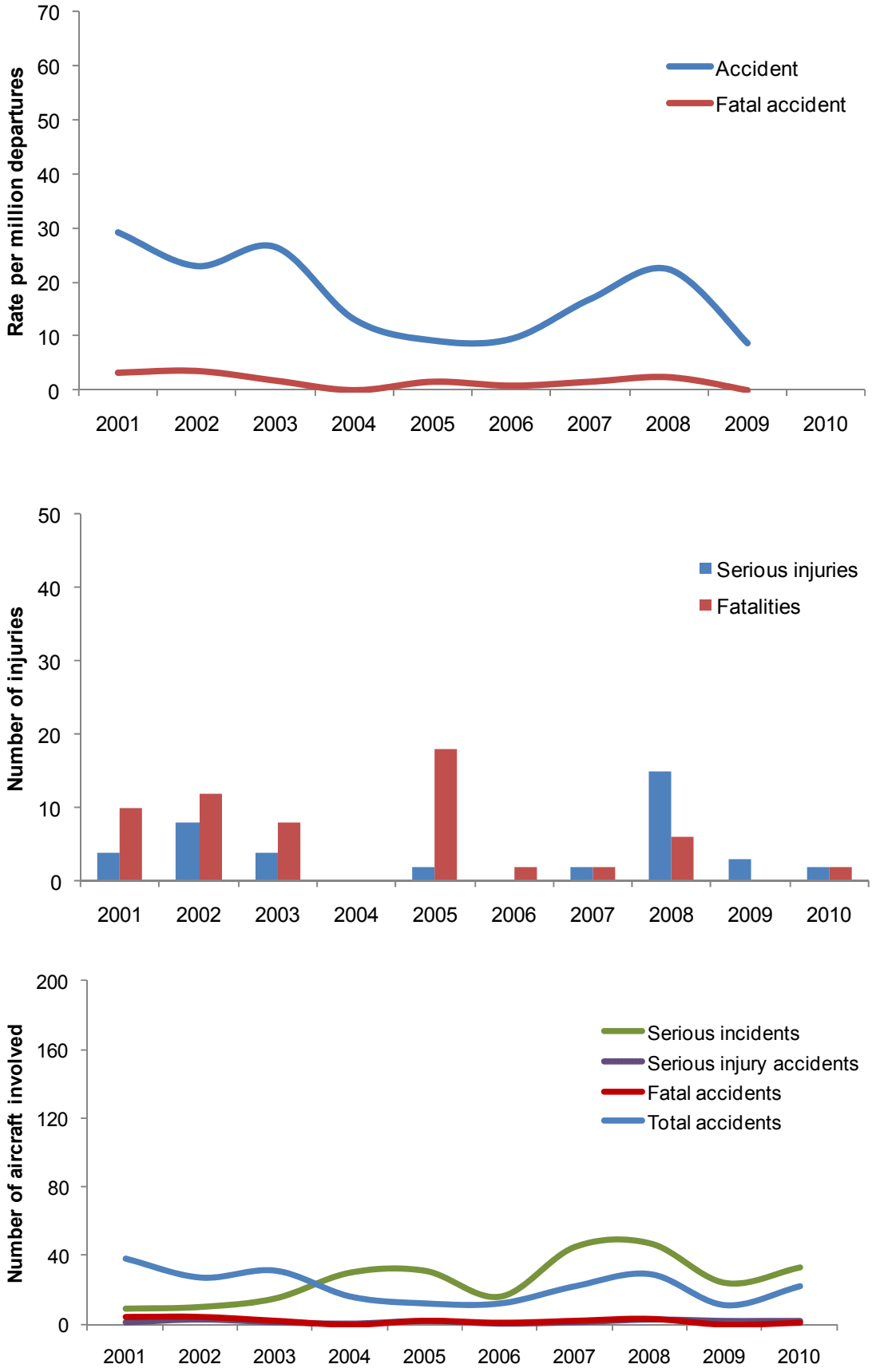
Figure 3: Commercial air transport occurrences and injuries, 2001 to 2010



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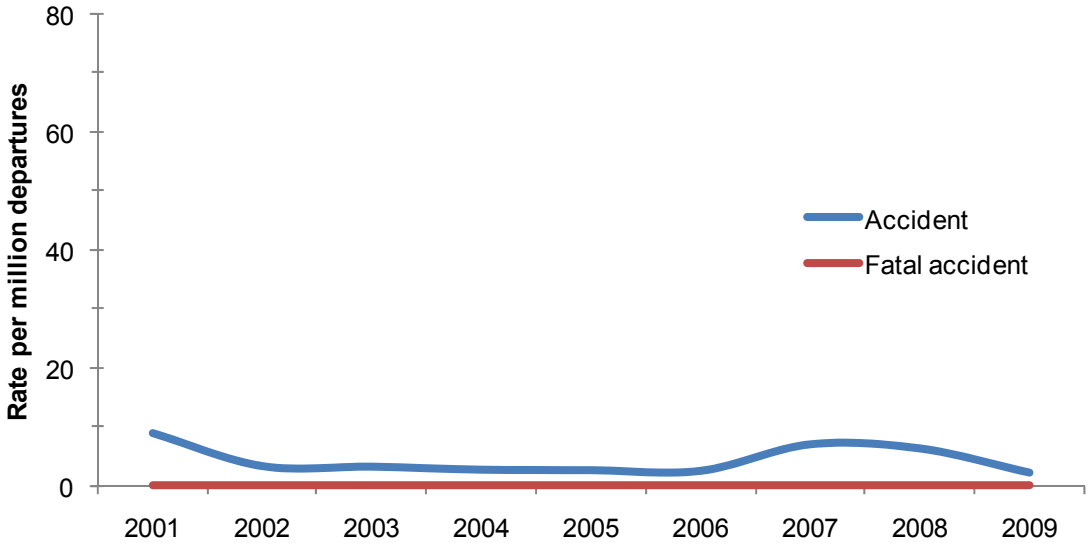
An increase in serious incidents was observed from about 2003 onwards[8]. However, the number of serious incidents dropped from about 45 (2007 and 2008) to 26 in 2009, but rose to 33 in 2010. Serious incidents are indicators of events that almost led to accidents. As such, they represent occurrences which could have had more serious consequences. In relation to serious injuries, there were generally less serious injuries than fatalities.

4.1.1 High capacity RPT (VH- registered)

A general increase has been observed in the total number of incidents reported to the ATSB by VH-registered high capacity aircraft (Table 5 and Figure 4). This equates roughly to a 60 per cent relative increase in reported incidents when 2001 and 2010 are compared. More incidents have been reported in 2010 than in any other year over the reporting period. Taking into account the increase in high capacity departures, the rate of incidents reported has actually been steadily reducing from 2006.

No fatalities were recorded among VH- registered high capacity RPT aircraft between 2001 and 2010. The last recorded fatal accident involving high capacity RPT in Australia was in 1975. This involved the collapse of a Boeing 707 nose gear during pushback. The nose of the aircraft fell onto the roof of the tug cabin crushing the driver. The total number of accidents has remained low, with about two accidents per year on average. The accident rate per million hours mirrors the accident rate per million departures. The number of serious incidents increased from 2004 onwards. This, in part, was due to a review of the ATSB's classification of immediately reportable matters (IRMs), which took effect in July 2003. The number of serious incidents declined in 2009, but has risen again in 2010.

Figure 4: High capacity (VH- registered) aircraft involved in accidents per million departures, 2001 to 2009



There have been two accidents in 2010 involving high capacity air transport aircraft and 13 serious incidents. The two accidents were:

[8] This is likely an artefact of a database recoding exercise undertaken by the ATSB that reviewed serious incident classification dating back to a baseline coincident with the introduction of the Transport Safety Investigation Act 2003 and associated Regulations.

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- On 4 November 2010, an Airbus A380 aircraft, registered VH-OQA, was operating between Changi, Singapore and Sydney when the No 2 engine sustained an uncontained engine failure. The aircraft was returned and landed at Singapore. A subsequent examination of the aircraft indicated that sections of the liberated turbine disc penetrated the left wing and the left wing-to-fuselage fairing, resulting in structural and systems damage to the aircraft (AO-2010-089).
- On 4 March 2010, a Boeing 717-200 aircraft, registered VH-NXM, was being prepared to depart from Ayers Rock, Northern Territory when the pilot in command instructed the cabin crew to close the aircraft doors. The cabin crew member allocated to the forward left door had difficulty unlatching the door, so the cabin crew member allocated to the forward right door came to assist. The assisting cabin crew member placed one foot outside the aircraft onto the portable stairs to assist with closing the door. At this point, ground personnel commenced moving the portable stairs and the assisting cabin crew member fell through the open door onto the apron. The cabin crew member sustained a fractured left arm, a sprained right wrist and other minor injuries (AO-2010-015)

The 13 serious incidents in 2010 involved incorrect aircraft configuration and missed approach (AO-2010-035), a ground handling belt loader contacting the side of an aircraft (AO-2010-038), medical incapacitation of flight crew and flight attendants, uncontained engine failure (AO-2010-066), airprox, breakdown of separation (AO-2010-104, AO-2010-014), turbulence, stall warning stick shaker activation and missed approach (AO-2010-081), cabin fumes and lightning strike.

Table 5: High capacity RPT (VH- registered), 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	1,732	1,776	1,478	1,976	2,392	2,184	2,244	2,457	2,408	2,854
Serious incidents	5	6	6	10	11	4	16	20	9	13
Serious injury accidents	1	1	1	0	1	0	1	1	1	2
Fatal accidents	0	0	0	0	0	0	0	0	0	0
Total accidents	3	1	1	1	1	1	3	3	1	2
Number of people involved										
Serious injuries	1	1	4	0	1	0	1	12	1	2
Fatalities	0	0	0	0	0	0	0	0	0	0
Rate of aircraft involved										
Accidents per million departures	8.8	3.2	3.1	2.6	2.5	2.4	6.8	6.1	2.0	
Fatal accidents per million departures	0	0	0	0	0	0	0	0	0	
Accidents per million hrs	3.8	1.4	1.3	1.1	1.1	1.0	2.9	2.7	0.9	
Fatal accidents per million hrs	0	0	0	0	0	0	0	0	0	

The number of serious injuries generally remained small. In 2010, two flight attendants were injured, with one slipping on a headset bag laying in the aisle and the other falling

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from the aircraft to the ground while closing a door. In 2003 and 2008, two accidents resulted in four and 12 injuries respectively:

- On 2 July 2003, a Boeing 747-438 aircraft, registered VH-OJU, operating from Singapore, arrived at Sydney during the airport's curfew period under a tailwind of around 12 kts. The pilot flying selected auto brake setting three and idle reverse thrust in accordance with the curfew requirement. However, during the landing roll, the reverse thrust was inadvertently de-selected. On arrival at the terminal, the pilot in command (PIC) observed a BRAKE TEMP advisory message and notified the ground engineers. At that point, a fire ignited on a right wing landing gear brake unit. The flight crew were advised and the PIC ordered an evacuation of the aircraft. On receiving the evacuation announcement, the cabin crew commenced the evacuation drill, deploying the aircraft's escape slides. As a result of the evacuation, one flight crew member and three passengers were seriously injured (200302980).
- On 7 October 2008, an Airbus A330-303 aircraft, registered VH-QPA, was operating from Singapore to Perth and cruising at 37,000 ft when the autopilot disconnected. From about the same time there were various aircraft system failure indications. While the crew was evaluating the situation, the aircraft abruptly pitched nose-down and descended 650 ft during the event. After returning the aircraft to 37,000 ft, the crew commenced actions to deal with multiple failure messages. Shortly after, the aircraft commenced a second uncommanded pitch-down event and descended about 400 ft during this second event. One flight attendant and 11 passengers were seriously injured and many others experienced less serious injuries. Most of the injuries involved passengers who were seated without their seatbelts fastened or were standing (AO-2008-070).

The ATSB investigated a serious injury accident involving a high capacity RPT aircraft in 2005. On 20 August 2005, smoke was detected in the forward cargo hold of an Airbus A330-303, registered VH-QPE, during cruise. It diverted to Kansai, Japan for a precautionary landing and during evacuation, one passenger sustained serious injuries and eight others sustained minor injuries (ATSB investigation 200504074).

In addition to these occurrences, several other notable serious incidents and accidents have occurred in the period between 2001 and 2010:

- On 21 July 2007, an Airbus Industrie A320-232 aircraft, registered VH-VQT, was attempting to land at Melbourne airport in fog but abandoned the landing due to low visibility. During the go-around, the aircraft was not in the correct flight mode, and it did not initially climb as expected by the crew. The aircraft descended to within 38 ft of the ground and this triggered an Enhanced Ground Proximity Warning System alert. A second missed approach was conducted and the aircraft diverted to Avalon, Victoria. The investigation found that the thrust levers were not in the take-off/go-around position during the first missed approach. It also found that the aircraft operator had changed the standard operating procedure for go-around, and this reduced the possibility of the flight crew detecting the incorrect flight mode (AO-2007-044).
- On 7 February 2008, a Boeing 717-200 aircraft, registered VH-NXE, operating to Darwin when the crew conducted a visual approach and elected to follow the instrument landing system to the runway. The aircraft was above the glideslope for the majority of its approach and shortly before landing, it temporarily exceeded the operator’s stabilised approach criteria. The aircraft landed heavily on the left main landing gear with a force of 3.6 g, and this led to creasing of the

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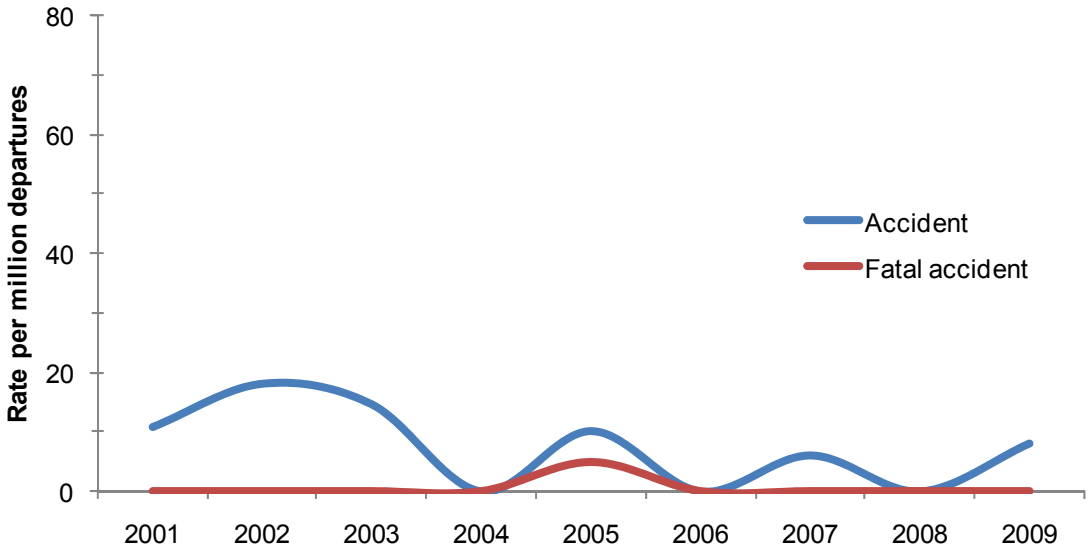
fuselage and damage to airframe longitudinal structural components, landing gear, and tyres. No passengers were injured in this accident (AO-2008-007).

- On 25 July 2008, a Boeing Company 747-438 aircraft, registered VH-OJK, was operating between Hong Kong and Melbourne when an oxygen cylinder, installed in the forward cargo hold, discharged its pressurised contents, propelling the cylinder upwards through the cabin floor. This led to an immediate and rapid depressurisation of the cabin. The cylinder struck a door frame, door handle and overhead panelling before falling to the cabin floor and exiting the aircraft through the ruptured fuselage. The aircraft made an emergency landing at Manila and all passengers safely disembarked from the aircraft (AO-2008-053).

4.1.2 Low capacity RPT (VH- registered)

Overall, there has been a decrease in the number of incidents reported to the ATSB involving low capacity RPT aircraft (Table 6 and Figure 5). This was influenced by a decline in the number of departures. The number of incidents per departure has steadily increased from 2003. Incidents and serious incidents were elevated in 2010, when compared with 2009. In low capacity RPT operations, the rate of accidents per million hours and million departures are very similar.

Figure 5: Low capacity aircraft (VH- registered) involved in accidents per million departures, 2001 to 2009



The total number of accidents has been relatively small in any given year. There were a total of 15 accidents recorded between 2001 and 2010, with the highest number recorded in 2002. There was one accident in 2010:

- On 22 March 2010, an Embraer - Empresa Brasileira de Aeronautica EMB-120ER Brasilia, with two flight crew onboard, departed from runway 29 at Darwin on a training flight. The training captain planned and carried out a simulated engine failure (asymmetric flight) after becoming airborne, but the aircraft rolled left and entered a steep nose-down attitude before impacting the ground. Both pilots were fatally injured (AO-2010-019).

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In addition, there were seven serious incidents in 2010. All occurrences related to airspace separation, including breakdown of separation (BOS) and airprox[9] events. The airspace separation events involved at least one air transport low capacity operations aircraft coming into conflict with high and low capacity, charter, and general aviation aircraft, including private and Recreational Aviation Australia registered aircraft.

Table 6: Low capacity RPT (VH- registered), 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	750	561	579	636	691	540	606	493	470	525
Serious incidents	1	1	6	10	7	5	8	11	4	6
Serious injury accidents	0	0	0	0	0	0	0	0	0	0
Fatal accidents	0	0	0	0	1	0	0	0	0	1
Total accidents	3	4	3	0	2	0	1	0	1	1
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	0	0
Fatalities	0	0	0	0	15	0	0	0	0	2
Rate of aircraft involved										
Accidents per million departures	10.9	18.2	14.7	0.0	10.1	0.0	6.0	0.0	7.9	
Fatal accidents per million departures	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	
Accidents per million hrs	12.0	19.2	15.2	0.0	9.9	0.0	6.0	0.0	9.2	
Fatal accidents per million hrs	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	

There have been two notable fatal accidents, one in 2005 and the other in 2010, resulting in a total of 17 fatalities. The fatalities occurring in 2010 are mentioned above, and the 2005 event is outlined below:

- On 7 May 2005, a Fairchild Aircraft Inc. SA227-DC Metro 23 aircraft, registered VH-TFU, with two pilots and 13 passengers, was being operated by Transair from Bamaga to Cairns, with an intermediate stop at Lockhart River, Queensland. On approach to Lockhart River, the aircraft impacted terrain in the Iron Range National Park on the north-western slope of South Pap, a heavily timbered ridge, approximately 11 km north-west of the Lockhart River aerodrome. The aircraft was destroyed and there were no survivors (200501977).

[9] An occurrence in which two or more aircraft come into such close proximity that a threat to the safety of the aircraft exists or may exist, in airspace where the aircraft are not subject to an air traffic separation standard or where separation is a pilot responsibility (Transport Safety Regulations, 2003).

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4.1.3 Charter (VH- registered)

Between 2001 and 2003, the number of aircraft involved in charter incidents was in the vicinity of 400 per year, but between 2004 and 2008, a significant rise in reported incidents was observed (Table 7 and Figure 6). This trend was reversed in 2009 and 2010.

Of all air transport operations, charter had the highest total number, and rate of accidents and fatal accidents per million hours and departures. The number of total accidents generally reduced from a maximum of 32 accidents in 2001 to nine in 2005, before climbing again to 2003 levels in 2008. In 2009, the total number of accidents sharply dropped again to eight, but rose to 20 in 2010.

The accident rate declined after 2001 until 2005, but then increased from 2006 to 2008 to levels similar to those found in 2003. Activity levels are not yet available for charter operations in 2010. The accident and fatal accident rate per million hours is higher than for departures.

The number of serious incidents also increased from 2003 onwards, but levelled out in 2006.

Table 7: Charter (VH- registered), 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	357	411	374	445	522	578	690	713	600	499
Serious incidents	0	1	3	9	6	6	16	13	10	14
Serious injury accidents	0	2	0	0	1	0	0	2	1	0
Fatal accidents	4	4	2	0	1	1	2	3	0	0
Total accidents	32	20	26	15	9	10	18	26	8	20
Number of people involved										
Serious injuries	3	7	0	0	1	0	0	3	2	0
Fatalities	10	12	8	0	3	2	2	6	0	0
Rate of aircraft involved										
Accidents per million departures	48.9	32.8	43.1	25.6	13.9	16.4	27.6	42.1	13.5	
Fatal accidents per million departures	6.1	6.6	3.3	0.0	1.5	1.6	3.1	4.9	0.0	
Accidents per million hrs	69.7	45.6	61.5	31.6	18.8	21.1	33.4	50.7	17.2	
Fatal accidents per million hrs	8.7	9.1	4.7	0.0	2.1	2.1	3.7	5.8	0.0	

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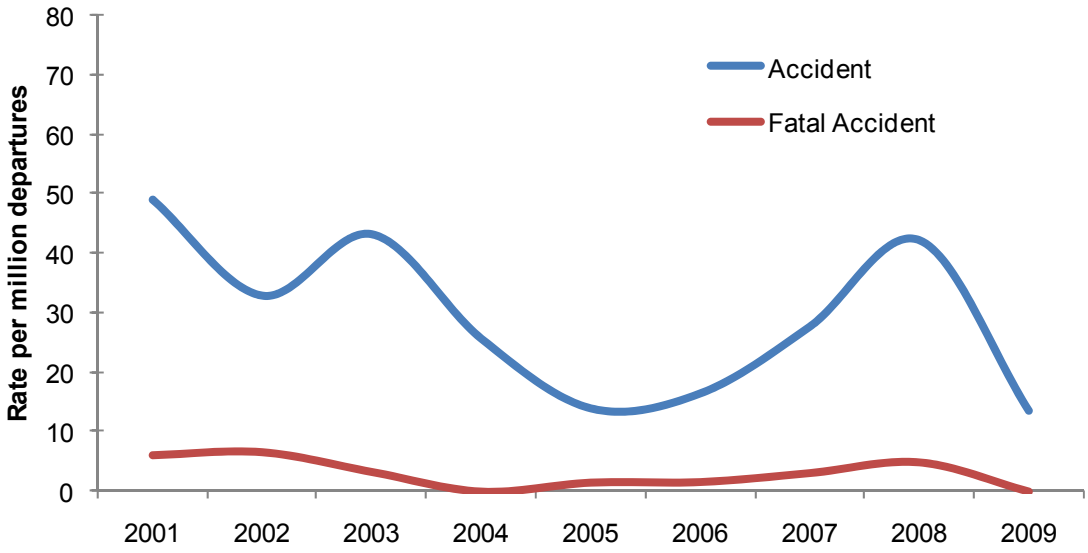
Figure 6: Charter aircraft (VH- registered) involved in accidents per million departures, 2001 to 2009



There were 20 accidents in 2010 involving charter aircraft – none involved fatalities. A brief overview of the 20 accidents shows:

- five accidents were associated with wheels-up landing – four were unintentional and one was due to a mechanical defect;
- four accidents were partial power loss / rough running engine accidents associated with a forced landing;
- one accident involved a box which shifted off the passenger seat and obstructed the aircraft controls;
- three other accidents involved landing gear collapse (rather than wheels up landing);
- two accidents involved floatplanes at takeoff or immediately after takeoff. In one accident a crab pot may have become entangled around the aircraft's water rudder (AO-2010-002). The other floatplane accident was a loss of control accident, where the takeoff was rejected due to directional control difficulties. During the attempt to place the aircraft back on the water at a level attitude for landing, the aircraft touched down heavily on the left float (AO-2010-082);
- one involved runway excursion
- one accident involved a hard landing
- three accidents involved entering cloud and fog and loss of visual reference to the ground.

The 12 serious incidents involved airprox, nose-wheel steering failure, runway excursion, and engine failure.

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There has not been a fatal accident in charter operations since 2008. For the 10-year period 2001 to 2010, both the number and rate of fatal accidents remained relatively low, while the corresponding fatality numbers were higher, particularly at the beginning of the reporting period. Some of the fatal accidents in charter include:

- On 10 April 2001, a Shrike Commander 500S aircraft, registered VH-UJB, departed Cairns on a charter flight. Shortly after takeoff, the pilot requested an amended altitude and indicated that he was able to continue flight with visual reference to the ground or water. Air Traffic Services recorded data indicated that approximately 13 minutes after departure, the aircraft disappeared from radar. A search located the wreckage on the north-western side of Thornton Peak. The pilot and three passengers were fatally injured (200101537).
- On 27 November 2001, a Raytheon Beech C90 King Air aircraft, registered VH-LQH, took off from runway 29 at Toowoomba aerodrome on a charter flight to Goondiwindi, Queensland. On-board were the pilot and three passengers. At about the time the aircraft became airborne, there was a loss of power on the left engine. Control of the aircraft was lost and it struck high-tension power lines before impacting the ground. All four occupants sustained fatal injuries (200105618).
- On 5 June 2002, the pilot of a Bell 206 (Jetranger) helicopter was tasked with conducting a survey operation with five persons on board. The Jetranger departed the Doijnji area for local operations and was later reported overdue at a scheduled refuelling. The wreckage of the helicopter was found the following day. Four of the occupants had not survived (200202656).
- On 26 September 2002, a Piper PA-32-300 aircraft, registered VH-MAR, departed Hamilton Island, Queensland. Shortly after the aircraft became airborne, the engine was heard 'coughing' and 'misfiring' before 'cutting out' and then 'starting again'. The aircraft was seen to commence a right turn, and the engine was again heard 'spluttering' and 'misfiring'. A number of witnesses reported that, when part way around the turn, the engine again 'cut out', and the aircraft descended and impacted the ground. The six occupants of the aircraft were fatally injured (200204328).
- On 14 March 2003, a Cessna 172G aircraft, registered VH-RPI, was undertaking consecutive charter flights to the Trefoil Island Aircraft Landing Area from Smithton, Tasmania. After takeoff, witnesses reported that the aircraft turned to the left on a southerly heading while climbing, followed by a turn to the east. They reported that following the turn to the east, the nose of the aircraft pitch abruptly upward. Following the nose-up pitching, the aircraft rolled abruptly to the left and it lost altitude and fell from line of sight. All four occupants received fatal injuries (200300929).
- On 8 November 2003, a Bell helicopter Company 206 (B206), registered VH-FHY, and a Robinson Helicopter Company R44, registered VH-YKL, were travelling in company returning to Kununurra from a fishing charter. Approximately 17 minutes into the journey, the pilot of the B206 received a broadcast from the pilot of the R44 stating that ‘I'm going in hard’. All four occupants of the R44 received fatal injuries (200304546).
- On 8 July 2005, a Piper Chieftain Navajo, PA31-350, registered VH-OAO, was approaching Mount Hotham aerodrome, Victoria, in weather conditions below the VFR and IFR minima. The pilot reported to air traffic control that the aircraft was overhead Mount Hotham, and requested a change from VFR to IFR in order to carry out an RNAV (GNSS) approach to Mount Hotham aerodrome. The pilot

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subsequently collided with terrain about 200 m below a ridge about 5 km south-east of the aerodrome, and all three occupants were fatality injured (200503265).

4.1.4 Foreign-registered air transport

As with VH- registered aircraft, foreign air transport did not record any fatal accidents, and the total number of accidents was low; however, the accidents involved potentially serious situations including engine failures, maintenance issues, a tail strike, collision on ground, and flap component corrosion. During 2010, more incidents have been reported than in any other year during the reporting period.

Table 8: Foreign registered air transport occurrences, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	298	261	250	389	504	403	366	379	382	564
Serious incidents	3	2	0	1	7	1	5	3	1	1
Serious injury accidents	0	0	0	0	0	0	0	0	0	0
Fatal accidents	0	0	0	0	0	0	0	0	0	0
Total accidents	0	2	1	0	0	1	0	0	1	0
Number of people involved										
Serious injuries	0	0	0	0	0	0	0	0	0	0
Fatalities	0	0	0	0	0	0	0	0	0	0

There was one serious incident in 2010 involving a foreign-registered high capacity aircraft. During an approach in instrument meteorological conditions (IMC), the aircraft went below the radar lowest safe altitude. On the previous day, a similar occurrence in visual meteorological conditions (VMC) occurred involving the same aircraft operator (AO-2010-027).

There was one tailstrike accident in 2009 involving an Airbus A340-500 aircraft, registered A6-ERG. It commenced the take-off roll on runway 16 at Melbourne. The aircraft failed to rotate as expected and sustained a tail strike, with the captain applying additional thrust to get the aircraft airborne. The tail strike damaged the aircraft, airport lighting and the instrument landing system. The aircraft subsequently returned and landed at Melbourne with no reported injuries. The take-off weight inadvertently used for take-off performance calculations was 100 tonnes below the actual take-off weight of the aircraft (ATSB investigation AO-2009-012).

One serious incident was recorded in 2009, associated with a breakdown of separation between a Boeing 737 and an Airbus A330. Some earlier accidents involving foreign-registered high capacity aircraft include:

- On 1 March 2002, the Boeing 747-436, registered G-BLND, departed from Sydney for an RPT flight to Bangkok, Thailand. While cruising at FL330 the crew experienced a sudden onset of airframe vibration, followed by alerts relating to the number-3 engine. Following problem solving, the engine was shut down and the aircraft jettisoned fuel, then returned to Sydney and landed using an over water approach. Technical investigation showed that a fan blade on the number-3 engine cracked due to fatigue, originating from a manufacturing bond-line defect.

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Blade fragments which escaped forward of the engine nacelle damaged the wing, control surfaces, fuselage and the number-4 engine. The engine blade had accrued 9,444 cycles of the 15,000-cycle design life before failing (200200646).

- On 8 December 2002, a Boeing 767-219ER aircraft, registered ZK-NBC sustained an uncontained failure of the left engine from a fatigue crack in the first stage high pressure turbine disk. The aircraft returned to Brisbane and landed safely. Parts ejected from the engine damaged wing leading edge flaps, and they could not be used during the subsequent landing. The investigation found that the damaged turbine disk had sustained microstructural damage during manufacturing or repair shot peening. The turbine disk had accumulated 42,069 hours and 12,485 cycles. It also found that there were emergency procedure-related misunderstandings between flight crew and cabin crew (200205780).
- On 22 August 2003, the Reims-Cessna F406 aircraft, registered ZK-VAF, was being operated on a passenger charter flight from Darwin to Tindal, NT. At approximately 85 to 90 kts during the take-off roll, the nose landing gear collapsed. The aircraft slid to a stop, the pilot shut down the engines and all occupants evacuated the aircraft uninjured. The actuator rod-end was noted to have an incorrect locking washer fitted. The incorrect locking washer did not conform to the locking device specified by the nose landing gear actuator manufacturer. Additionally, the nose landing gear actuator microswitch was found to be incorrectly adjusted (200303713).
- On 2 February 2006, a United States registered Boeing 747-422 (747) aircraft was taxiing for departure at Melbourne. At the same time, an Australian registered Boeing 767-338ER (767) aircraft was stationary on taxiway Echo and waiting in line to depart from runway 16. The tail section of the 767 was protruding into taxiway Alpha while it was stationery on taxiway Echo awaiting a clearance to enter the runway. The left wing tip of the 747 collided with the right horizontal stabiliser of the 767 as the 747 crew attempted to manoeuvre behind the 767. The pilot in command of the 747 misjudged the distance between the wingtip of the 747 and the right horizontal stabiliser of the 767 (200600524).

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4.2 General aviation

General aviation is all flying activities outside of scheduled (RPT) and non-scheduled (charter) passenger and freight operations. It includes aerial work (ambulance and emergency medical services, agriculture, mustering, search and rescue, fire control, and survey and photography), flying training, and private/business and sports aviation. In this report, general aviation (GA) does not include Australian non-VH registered aircraft.

Large air transport aircraft (35,000 kg or more) operated by major airlines only make up approximately 2.5 per cent of all aircraft on the Civil Aviation Safety Authority VH-register. A conservative estimate places at least 90 per cent of the VH-registered aircraft fleet into general aviation. General aviation accounts for the vast majority of aircraft movements across Australia (Table 1). For the size of the GA fleet and movements, there are comparatively few occurrence reports sent to the ATSB, using air transport operations as a reference group. The reasons for this difference in reporting between air transport and GA are not clear, but may relate to the fact that air transport and other IFR aircraft submit flight plans and commonly operate in airspace supervised by Airservices Australia. Operational errors and occurrences are more likely to be noted and reported; whereas, GA aircraft operate in both controlled and uncontrolled airspace. In uncontrolled airspace, operational errors and occurrences rely on visual sighting and identification of other aircraft; this is not always possible. Other possible reasons for the larger number of occurrence reports in air transport relate to the use of safety management systems by operators of larger aircraft, better reporting cultures, and airline system sophistication. In addition, the number of prescribed reportable matters detailed in the Transport Safety Investigation (TSI) Regulations 2003 is smaller for GA when compared with air transport. The TSI Regulations, currently under review, will align reporting requirements for any commercial operations - air transport or GA, in late 2011.

In 2010, the ATSB received occurrence reports relating to about 2,200 different GA aircraft. This represents about 20 per cent of all aircraft on the CASA VH- register. Only one occurrence report per aircraft registration was received in most circumstances, but several aircraft registrations were associated with multiple reports – up to nine different occurrences in 2010. Sub-sections of GA that appear to be reporting more occurrences, or are operating in categories associated with more occurrence reports, are in the aerial work category. This seems to suggest that either certain operations and/or aircraft are more likely to be associated with an occurrence report, or the reporting culture within these groups is stronger than in other areas of GA.

In 2009, the number of aircraft involved in general aviation accidents, serious incidents and incidents (Table 9) rose to about the same level as air transport (Table 4). In 2010, air transport reported almost 700 more occurrences than GA. The amount of flying performed, along with take-off and landing data when it becomes available, may be found to have influenced these results.

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Table 9: All general aviation (VH- and foreign registered), 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	2,381	2,653	2,409	2,673	3,057	3,501	3,542	3,526	3,684	3,558
Serious incidents	1	2	46	65	48	64	80	97	91	108
Serious injury accidents	16	10	11	14	4	8	7	16	10	15
Fatal accidents	18	6	13	12	16	19	12	22	16	13
Total accidents	151	130	117	143	118	92	118	126	119	126
Number of people involved										
Serious injuries	22	15	19	21	5	13	9	23	13	19
Fatalities	31	12	27	24	21	34	21	34	16	16
Rate of aircraft involved[10]										
Accidents per million departures	62.9	58.5	54.7	71.9	51.9	50.5	65.3	63.9	64.1	
Fatal accidents per million departures	7.5	2.7	6.1	6.0	7.0	10.4	6.6	11.2	8.6	
Accidents per million hours	122.4	104.8	96.4	123.2	95.3	75.8	91.9	94.2	89.1	
Fatal accidents per million hours	14.6	4.8	10.7	10.3	12.9	15.7	9.3	16.5	12.0	

Between 2001 and 2010, about 23,000 incidents were recorded as involving 'unknown' GA aircraft. This unknown GA number has increased from about 1,600 in 2001 to 2,900 in 2010; this is, in part, related to the abolition of mandatory flight plans for all aircraft. A steady increase in unknown GA aircraft occurrences has been observed since the mid-1990s, when this took effect. The ATSB was often notified about unknown GA occurrences by someone other than the pilot(s), and they were associated with three main types of occurrences (listed in order of frequency from highest to lowest):

- airspace incursion, aircraft separation, operational non-compliance, and regulations and standard operating procedures
- ground operations
- bird and animal strikes.

Table 9 shows that there has been a general increase in the number of aircraft involved in incidents, particularly since 2006. In contrast, although there have been some fluctuations, there was a slight reduction in total accidents until 2006, before a return to earlier levels, with a levelling off from 2007 at about 130 accidents a year (Figure 7). On average, for each fatal accident, there were nearly two people who received fatal injuries. This is different from air transport, where fatal accidents are associated with more deaths because of the size of the aircraft. For the 1,240 aircraft involved in accidents in GA between 2001 and 2010, 147 were fatal accidents, with 236 fatalities.

[10] Foreign registered GA departures and hours are not known. VH- registered aircraft hours are used as a proxy denominator. The real rate per departure or hour will be slightly smaller than the figures presented in this table. This equates to nine accidents, including two fatal accidents, over the period between 2001 and 2010, where aircraft hours are not known and not included in the denominator figures.

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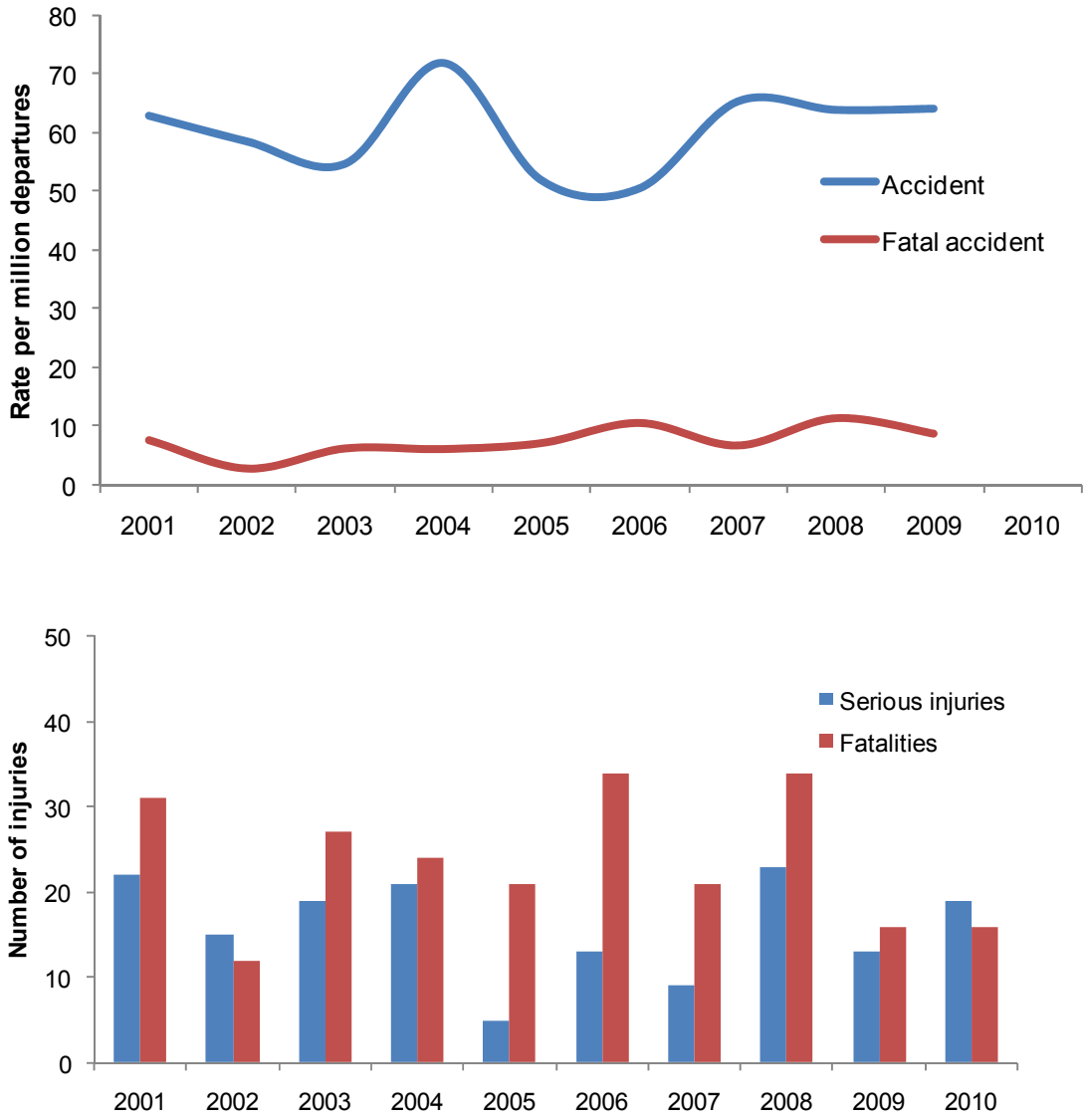
Overall, an increase in serious incidents was evident, with a jump in serious incidents following the introduction of the TSI Regulations in 2003 (Table 9). This has stabilised at about 100 incidents per year since 2008.

The GA accident rate per million departures is lower than for hours flown. In the most recent year where departures information is available (2009), the accident rate (per million departures) was about three times as large in GA as in commercial air transport, and the fatal accident rate was about 4.8 times as large.

Figure 7: General aviation (VH- and foreign registered) rates, injuries and occurrences, 2001 to 2010



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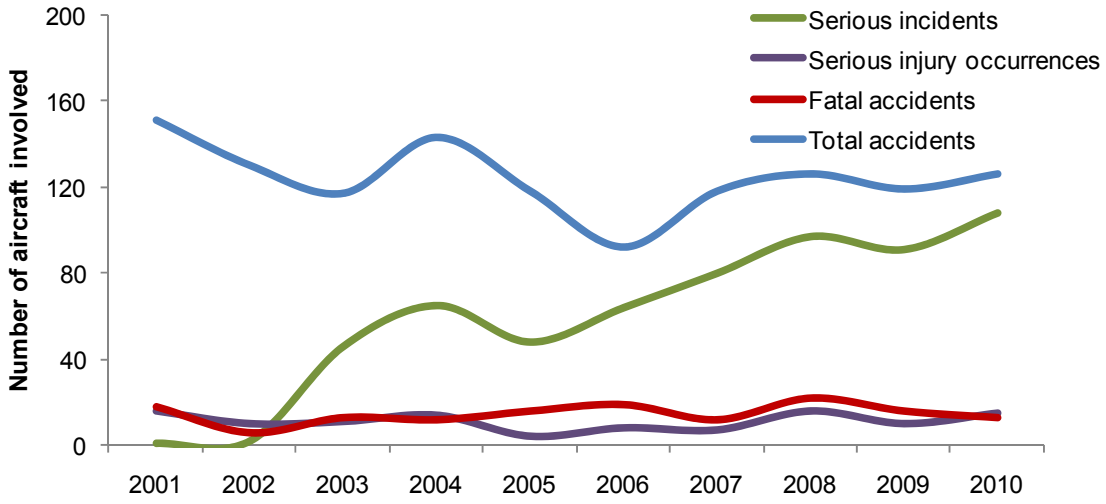

The accident and fatality rate varies in different parts of GA. When the data is pooled over the report period, certain features emerge. Compared with flying training, aerial work has an accident rate per million hours that is 1.4 times higher and private/business has an accident rate that is 3.6 times higher. In terms of fatal accidents per million hours, the fatal accident rate in private/business operation is the highest of all aircraft operations at about 18 per million hours, while agriculture is about 17 per million hours and survey and photography is about 13 per million hours. Aerial work has a fatal accident rate that is three times higher than flying training, and private/business is at least five times higher. These rates are explored in the following sub-sections. Note that accident rates are recorded per million hours flown, as departures in each subcategory are not known.

4.2.1 Aerial work

The number of incidents involving VH- registered aircraft conducting aerial work activities, including aerial agriculture, mustering, surveying and photography, emergency services, search and rescue, and fire control, increased from 192 incidents in 2001 to 283 in 2010. This represented about a 50 per cent relative increase over the report period.

Total accident numbers showed significant variability (Figure 9), with 23 accidents in 2002 and 2006, and 45 accidents in 2004 (and 42 accidents in 2010). This was also reflected in the total accident rate. Using pooled data, the accident rate over the report period was about 79 accidents per million hours, with more fatal accidents in aerial work during 2010 than in any other preceding year since 2001. Fatal accidents involved single pilot operations in agricultural work (4), mustering (3) and a ferry flight (1). The ferry flight was to be a transoceanic ferry flight with another GA aircraft from the United States to Australia, but the aircraft collided with terrain near Hollister Municipal Airport, California, US.[11]

[11] This accident is being investigated by the US National Transport Safety Board.

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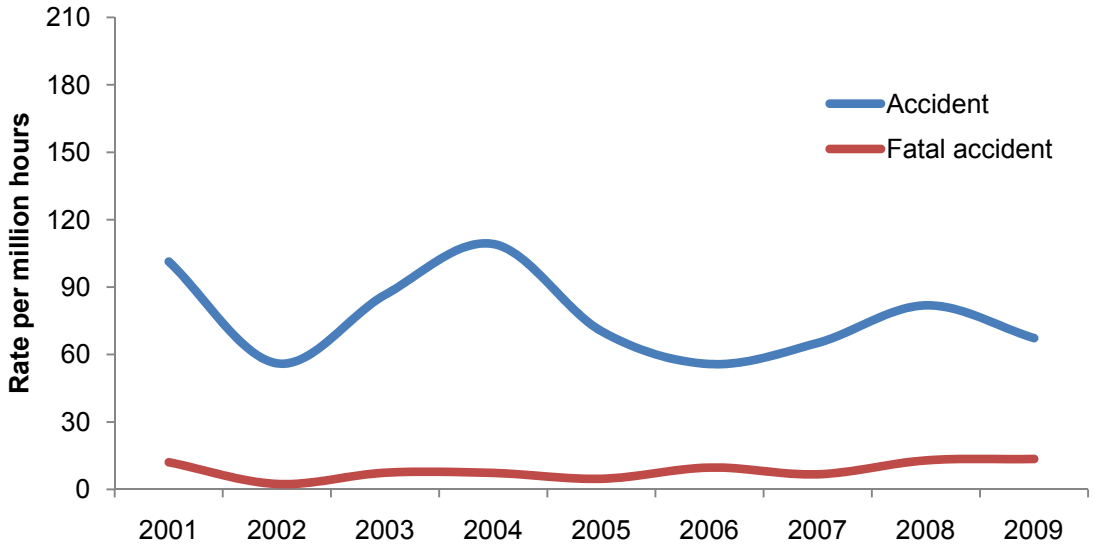
Table 10: Aerial work (VH- registered), 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	192	220	203	202	271	279	254	274	294	283
Serious incidents	0	1	15	15	15	9	14	18	16	27
Serious injury accidents	3	0	4	6	2	2	2	7	3	5
Fatal accidents	5	1	3	3	2	4	3	6	6	9
Total accidents	42	23	35	45	30	23	29	38	30	43
Number of people involved										
Serious injuries	5	1	9	9	2	2	2	9	5	6
Fatalities	9	1	7	4	2	9	3	7	6	10
Rate of aircraft involved										
Accidents per million hours	101.4	56.1	86.6	109.2	70.4	55.8	65.2	81.9	67.3	
Fatal accidents per million hours	12.1	2.4	7.4	7.3	4.7	9.7	6.7	12.9	13.5	

The range in accident rates seen in Figure 9 may in part reflect environmental factors affecting the growing cycles of crops, such as the long periods of drought in Australia. When analysing aerial work occurrence data, it also important to take into consideration that some of these activities operate within the low-level environment, which is inherently more hazardous than flying at higher altitudes.

Figure 8: Aircraft involved in aerial work accidents per million hours, 2001 to 2009



During the reporting period, there were a number of accidents that resulted in multiple fatalities. Some of these included:

- On 26 January 2001, a Cessna 310R aircraft, registered VH-HCP, departed Kiwirrkurra, Western Australia (WA), for Newman. The aircraft was operated by the Air Support Unit of the WA Police Service and had been used to transport police

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officers from Newman to Kiwirrkurra earlier that day. Witnesses at Newman aerodrome heard the engines start to 'cough and splutter'. Soon after, the aircraft collided with the ground. The four occupants sustained fatal injuries (200100348).

- On 11 August 2003, a Cessna 404 Titan aircraft, registered VH-ANV, impacted terrain within the Jandakot aerodrome perimeter during an attempt by the pilot to return for an emergency landing shortly after takeoff from runway 24 right. The aircraft was destroyed by the post-impact fire and one of the five passengers was fatally injured. The pilot and the other four passengers all received serious, life-threatening thermal injuries and one of those passengers died 85 days after the accident (200303579).
- On 21 February 2006, a Robinson R44 'Astro' helicopter, registered VH-HBS, was being operated on a series of aerial survey flights approximately 100 km to the north of Mt Isa. The pilot refuelled the helicopter and departed for a survey flight with three passengers on board. When the helicopter did not arrive at a pre-arranged rendezvous point, a search was initiated. Searchers found the burnt wreckage of the helicopter the next day. The four occupants were fatally injured (200600979).

Subcategories of aerial work are explored in the following sections.

Agriculture

There were 301 aircraft involved in agricultural occurrences over the reporting period. There were 14 fatalities over the reporting period and 13 serious injuries. The numbers are relatively small, and this introduces significant variability into the accident and fatality rates.

In 2010, there were 15 agricultural accidents; five related to wirestrikes, three related to total power loss, two involved runway excursions, two related to aircraft control, one was a hard landing, and the other two were collision with terrain occurrences. There were four fatal accidents in agricultural operations during 2010. Two of the five wirestrike accidents were fatal. One fatal wirestrike accident was an aeroplane aircraft that struck powerlines about 3.25 metres above the top of the crop being sprayed (AO-2010-026). The second wirestrike accident involved a helicopter that struck a powerline that was about 5.8 metres above the tree line during forestry spraying activities (AO-2010-033).

Two fatal accidents in agriculture involved collision with terrain. In the first fatal accident, the aircraft did not achieve the required take-off performance to allow the aircraft to become airborne and sustain flight (AO-2010-069), and the other aircraft collided with terrain while returning to the landing strip after spraying urea (AO-2010-110).When data is pooled for the period between 2001 and 2010, agriculture has the highest accident rate (177 per million hours) and the second highest fatal accident rate (17 per million hours) of any GA category.

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Table 11: Agricultural occurrences, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	14	13	11	6	7	2	4	5	6	3
Serious incidents	0	0	8	9	9	3	5	7	5	14
Serious injury accidents	1	0	1	4	1	1	1	4	0	0
Fatal accidents	1	0	0	1	1	1	0	3	3	4
Total accidents	17	10	15	22	18	8	10	18	10	15
Number of people involved										
Serious injuries	1	0	1	4	1	1	1	4	0	0
Fatalities	1	0	0	1	1	1	0	3	3	4
Rate of aircraft involved										
Accidents per million hours	158.9	140.8	214.3	255.8	189.5	129	161.3	230.8	137	
Fatal accidents per million hours	9.3	0.0	0.0	11.6	10.5	16.1	0.0	38.5	41.1	

The following three accidents illustrate the nature of some of the fatal occurrences since 2001.

- On 19 July 2004, a Bell 47G-3B-1 helicopter, registered VH-RTK was contracted to perform spraying operations on a property near Wodonga, Victoria. Preparations included an aerial survey and discussion with the land owner of known hazards, including powerlines. The pilot conducted a low-level return to the replenishment point outside the pre-planned safety transit route, severing a disused powerline about 34 m above the ground. The helicopter descended into a wooded area and was destroyed, and the pilot was fatally injured. The helicopter was not, nor could it have been, fitted with a wire-strike protection system (200402669).
- On 26 February 2008, two Air Tractor 502 aircraft, registered VH-ATB and VH-CJK, collided in mid-air. VH-ATB took off from an adjacent strip about 3 km from where VH-CJK was performing reciprocal spray runs utilising turn manoeuvres. VH-ATB entered a flight path just south of the field being sprayed by VH-CJK and the aircraft collided. The aircraft came to rest about 300 m apart, with the pilot of VH-CJK being fatally injured and the pilot of VH-ATB being seriously injured (AO-2008-014).
- On 20 May 2010, a Bell 206 helicopter struck a powerline and subsequently collided with terrain during forestry spraying operations. The pilot, the sole occupant, sustained fatal injuries and the helicopter was destroyed (AO-2010-033).

Mustering

As with agricultural work, mustering numbers are small and there was significant variability when year-on-year comparisons were made. Despite this, the total number of accidents appeared to be at about 7 per year over the reporting period. Almost all records sent to the ATSB were accidents, and this suggests that incidents are not generally being reported to the ATSB. There was also a rise in serious incidents in 2010.

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For mustering operations in 2010, there were 16 accidents, involving 14 helicopters and two aeroplanes. One accident involved a helicopter wirestrike; the pilot was aware of the wire, but was distracted by a passenger. The remaining 15 mustering accidents involved collision with terrain, including five where the tail rotor struck the ground or trees. These were related to pilot monitoring and checking of proximity to the ground and obstacles. Four collision with terrain accidents involved engine power loss, with fuel contamination, possible carburettor icing and foreign object debris ingestion (a plastic bag) into the air intake being cited as reasons for power loss by the pilots. The reason for power loss in the fourth accident was not established. Two collision with terrain accidents involved animals - a dog and a bird. In the first of these accidents, the pilot's helicopter was attacked by an eagle while herding cattle, and while performing an avoidance manoeuvre, collided with trees. In the second accident, the pilot observed a wild dog attacking a calf, and was chasing it away when the skid caught the ground and the aircraft collided with terrain.

There were three fatal accidents in mustering involving collision with terrain in 2010. In the first fatal accident, two helicopters had been performing mustering operations together. The pilot of one of the mustering helicopters observed a plume of smoke in the vicinity of where the other helicopter had been operating and found that the helicopter had impacted the ground, and that the wreckage was on fire (AO-2010-042). The second fatal accident involved a helicopter which collided heavily with the bank of a dry creek; there were no witnesses to the accident (AO-2010-073). The third fatal accident involved a collision with a tree (AO-2010-092).

Table 12: Mustering occurrences, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	3	2	0	0	1	4	1	0	3	0
Serious incidents	0	0	0	0	1	1	0	1	0	2
Serious injury accidents	2	0	1	1	0	0	1	1	0	4
Fatal accidents	1	1	1	0	0	0	1	0	2	3
Total accidents	11	6	8	7	5	4	8	3	5	16
Number of people involved										
Serious injuries	2	1	1	1	0	0	1	1	0	4
Fatalities	1	1	2	0	0	0	1	0	2	3
Rate of aircraft involved										
Accidents per million hours	114.6	54.1	80.0	68.0	44.2	39.2	70.8	26.5	47.2	
Fatal accidents per million hours	10.4	9.0	10.0	0.0	0.0	0.0	8.8	0.0	18.9	

Some examples of fatal mustering accidents over the 2001 to 2010 are provided below.

- On 28 September 2003, a Robinson R22 helicopter, registered VH-UXF, was engaged in aerial mustering operations south of Derby, Western Australia when the clutch drive shaft separated from the main rotor gearbox due to a fatigue crack that initiated from one of the shaft bolt holes. The investigation found that unapproved sealant was used when the shaft was last assembled. Although the pilot and passenger initially survived the crash, they succumbed to their injuries before medical help arrived.

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- On 24 July 2007, a Robinson R22 helicopter, registered VH-VHQ, departed from a helipad at Maryfield Station, Northern Territory to recommence cattle mustering activities. During the initial climb, at about the height of surrounding trees, the helicopter was struck by a gust of wind that resulted in a loss of height. During the recovery manoeuvre by the pilot, a person on the ground was struck in the head and fatally injured (AO-2007-026).
- On 17 June 2009, the pilot of a Robinson R22 helicopter, registered VH-RIT, left the cockpit of the helicopter, while it was positioned on the ground with the engine running, to perform a task. While walking back to the helicopter, the pilot was struck in the head by the main rotor blade and fatally injured.

Emergency medical

Emergency medical operations showed a general increase in the number of incidents over the reporting period. Of all aerial work categories with comparable rate data, accident rates per million hours for emergency medical operations were the lowest of any category. This is in spite of the sometimes higher risks and difficulty associated with approaching and landing at unusual places. In 2010, there were no accidents.

No fatal accidents have been recorded since 2003.

Table 13: Emergency medical occurrences, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	92	93	101	98	133	139	132	160	156	151
Serious incidents	0	1	2	1	1	0	2	5	3	3
Serious injury accidents	0	0	0	0	0	0	0	0	2	0
Fatal accidents	1	0	1	0	0	0	0	0	0	0
Total accidents	1	1	2	0	0	0	1	0	3	0
Number of people involved										
Serious injuries	1	0	0	0	0	0	0	0	3	0
Fatalities	1	0	3	0	0	0	0	0	0	0
Rate of aircraft involved										
Accidents per million hrs	15.9	14.9	29.4	0.0	0.0	0.0	13.3	0.0	37.0	
Fatal accidents per million hours	15.9	0.0	14.7	0.0	0.0	0.0	0.0	0.0	0.0	

Some examples of earlier fatal accidents follow.

- On 10 December 2001, a Raytheon Beech Super King Air 200C, registered VH-FMN, was being repositioned with a medical crewmember to Mount Gambier to transport a patient to Sydney. On approach to Mount Gambier aerodrome with the pilot activated lighting illuminated, the aircraft impacted the ground 3.1 NM from the runway threshold. The investigation concluded that it was likely the pilot was conducting a straight-in GPS approach, but could not ascertain why the aircraft collided with terrain. The pilot was fatally injured and the crewmember was seriously injured (200105769).
- On 17 October 2003, a Bell 407 helicopter, registered VH-HTD, was tasked with retrieving a patient from Hamilton Island, Queensland. It took off from Mackay, but

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did not arrive at Hamilton Island and the wreckage was found 3.2 NM from Cape Hillsborough, Queensland, in water. The investigation was unable to precisely determine what caused the accident, but considered it was consistent with spatial disorientation of the pilot (200304282).

Search and rescue

There are very few search and rescue related occurrences reported to the ATSB. There has been one accident in the last 10 years, and no fatalities. The following occurrence describes the single accident:

- On 27 April 2001, a VFR equipped Bell 407 helicopter, registered VH-WOQ, was engaged in a search and rescue operation involving occupants of a sinking yacht. The pilot agreed to drop a life raft to the yacht crew, but as the helicopter approached the drop site, it descended and collided with water at a speed of about 50 kts. The investigation found that the conditions above the water surface were conducive to visual illusions. The helicopter was not adequately equipped to perform a night over-water, search and rescue flight. Both the pilot and crewman survived the accident (200102083).

Fire control

Fire-bombing operations in Australia have been used since the early 1960s. There are few accidents associated with this type of operation, despite potential hazards associated with reduced visibility and high operating weight. There were no accidents in 2010. Hours flown data is not available for this type of operation.

- On 16 February 2006, a PZL-Warszawa-Okecie, Dromader M-18A, registered VH-FVF, collided with terrain while performing fire control operations. The aircraft made a left turn at an estimated height of 300 ft and banked left at nearly 90 degrees, consistent with a wing drop. There was insufficient height for the pilot to attempt recovery action. The investigation team could not conclusively determine what happened to the aircraft, but considered the possibility of an aircraft stall, in association with high operating weights and pilot distraction associated with fire-bombing operations. The pilot had limited experience on the turbine modified aircraft being flown (200600851).

Table 14: Fire control occurrences, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	8	8	4	3	2	11	4	2	8	3
Serious incidents	0	0	0	1	2	1	1	1	3	0
Serious injury accidents	0	0	1	0	0	0	0	0	1	0
Fatal accidents	0	0	0	0	0	1	0	0	1	0
Total accidents	2	1	3	1	0	3	1	0	4	0
Number of people involved										
Serious injuries	0	0	1	0	0	0	0	0	2	0
Fatalities	0	0	0	0	0	1	0	0	1	0

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Survey and photography

Very few survey and photography occurrences are reported to the ATSB. Table 15 shows that the number of incidents has increased from 2003 onwards. There were five non-fatal accidents in 2010; three involved helicopters, and two involved aeroplanes. The helicopter accidents involved a tail rotor separating in flight, a precautionary landing following a burning or smoky smell in the cabin, and revolutions per minute (RPM) decay and autorotation during powerline inspection. One aeroplane accident was related to controlled flight into terrain (AO-2010-053), and the other was fuel exhaustion and landing short of the runway (AO-2010-059). There were six fatal accidents between 2001 and 2010, resulting in 12 fatalities. Significant variability is seen in accident and fatal accidents rates per million hours.

Table 15: VH- registered survey and photography occurrences, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	7	8	4	8	14	17	18	24	38	38
Serious incidents	0	0	0	0	0	1	1	1	2	3
Serious injury accidents	0	0	0	0	1	1	0	1	0	1
Fatal accidents	0	0	1	0	0	2	1	2	0	0
Total accidents	2	0	2	0	2	3	2	7	3	5
Number of people involved										
Serious injuries	0	0	4	0	1	1	0	3	0	2
Fatalities	0	0	2	0	0	7	1	2	0	0
Rate of aircraft involved										
Accidents per million hours	43.5	0.0	37.7	0.0	60.6	66.7	37.0	109.4	78.9	
Fatal accidents per million hours	0.0	0.0	18.9	0.0	0.0	44.4	18.5	31.3	0.0	

Some examples of survey and photography accidents over the reporting period follow.

- On 2 February 2006, a Bell 206B (III) helicopter, registered VH-MFI, struck powerlines about 37 m above ground level while on a noxious weeds survey near Parkes, New South Wales. The helicopter continued a further 88 m before striking the ground. The pilot and two passengers received fatal injuries (200600523).
- On 19 November 2008, a pilot and two linesmen were operating a McDonnell Douglas 369D helicopter, registered VH-PLJ, to test a high-voltage power line between Mannum and Mobilong, South Australia. While manoeuvring to test a conductor joint, the helicopter's main rotors struck a conductor and the helicopter impacted the ground. One linesman was fatally injured and the other sustained minor injuries, while the pilot sustained serious injuries (AO-2008-078).
- On 15 May 2008, a Cessna, 210L, registered VH-IDM, on a low-level geophysical flight, 83 km north-east of Georgetown, Queensland, lost altitude during a left turn, impacting the ground in a steep left-wing-down attitude, consistent with loss of control. The investigation found that the loss of control was most likely due to pilot loss of consciousness as a result of a heart arrhythmia associated with focal scaring or chronic heart muscle inflammation (AO-2008-035).

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4.2.2 Flying training

During the period 2001 to 2010, there were 3,289 aircraft involved in flying training occurrences. The number of flying training aircraft involved in incidents increased from 2003, but declined from 2006 to 2008, remaining stable since then at a level lower than a decade ago.

There were no fatal accidents in flying training during 2010, but two serious injury accidents. The 16 flying training accidents involved three helicopters and 13 aeroplanes. Six of the 16 flying training accidents involved aircraft control in the landing phase. This was often associated with either unstable approach, flaring too high and aircraft stall and hard landing –the aircraft bounced and / or ended up off the side of the runway (runway excursion). Two accidents involved power loss after takeoff – one was a helicopter and the other was an aeroplane. The aeroplane performed a turnback to the runway at between 50 and 100 feet. Shortly before landing, the aircraft pitched nose-up and stalled, before colliding with the ground (AO-2010-032). The helicopter accident involved engine power loss, autorotation and a hard landing. This resulted in the main rotor striking the tail boom and severing it. Two accidents involved unintentional wheels-up landing and two accidents involved landing gear. In relation to landing gear, one accident involved an aircraft making a 180 degree turn during taxi, resulting in the collapse of the landing gear. In the other landing gear accident, the pilot made the decision to land with an unsafe landing gear indication. The nose gear collapsed on landing. Finally, there were four accidents involving collision with terrain. They included two aeroplanes –one was performing asymmetric flight training, and was associated with loss of control and collision with terrain (AO-2010-111). The other accident was where the pilot attempted to out-climb rising terrain and collided with terrain. The remaining two helicopter training accidents involved RPM decay, rotor droop and inability to maintain height. One helicopter accident was associated with dynamic rollover, and in the other, the helicopter's main rotor severed the tail boom.

Table 16: Flying training, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	285	281	277	294	365	353	338	248	255	237
Serious incidents	0	0	13	11	12	22	18	18	23	27
Serious injury accidents	2	1	1	1	0	1	0	0	1	2
Fatal accidents	2	1	5	1	1	0	0	3	1	0
Total accidents	18	25	19	14	23	12	19	22	21	16
Number of people involved										
Serious injuries	2	1	2	2	0	1	0	0	1	3
Fatalities	2	1	7	2	1	0	0	4	1	0
Rate of aircraft involved										
Accidents per million hours	43.8	60.2	44.7	39.2	54.8	28.0	41.2	44.9	41.9	
Fatal accidents per million hours	4.9	2.4	11.8	2.8	2.4	0.0	0.0	6.1	2.0	

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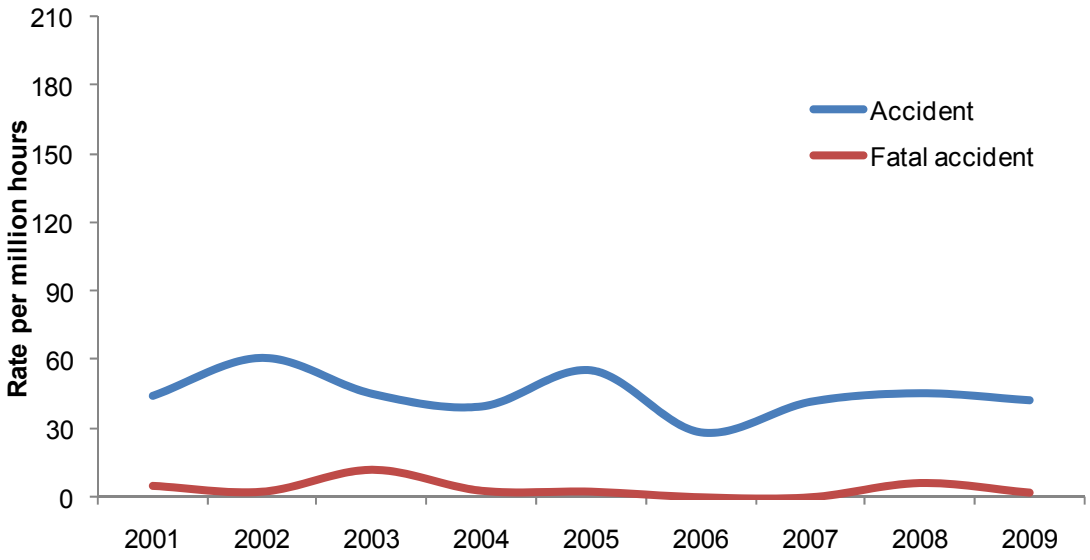
Both the number and rate of total accidents has remained fairly constant since 2001, at about 20 per year. Fatal accidents have remained low, with the exception of 2003, where five fatal accidents were recorded, resulting in seven fatalities. There were no fatal accidents in 2010.

Figure 9: Aircraft involved in flying training accidents per million hours, 2001 to 2009



Some notable flying training fatal accidents since 2001 include:

- On 29 July 2002, two Cessna 172R aircraft, registered VH-CNW and VH-EUH, collided while on short final approach to runway 17 left at Moorabbin, Victoria. The two aeroplanes were entangled when they impacted the runway. The student pilot and instructor of VH-EUH were able to exit their aircraft before fire engulfed both aeroplanes. The solo pilot of VH-CNW sustained fatal injuries (200203449).
- On 20 June 2003, a Robinson R22 helicopter, registered VH-OHA, was being used to conduct flying training in the Bankstown training area with an experienced flight instructor and student pilot on board. The helicopter was observed and heard flying in a normal manner. Witnesses reported subsequently hearing a number of loud bangs and one witness observed what appeared to be a main rotor blade separating from the helicopter. The helicopter descended to the ground in an inverted attitude and both occupants were fatally injured (200302820).
- On 11 November 2003, a qualified pilot, with a flight instructor, was undertaking multi-engine aircraft training in a Piper PA-34-200 Seneca aircraft, registered VH-CTT. The aircraft departed Bankstown and turned right to operate in the southern training circuit. They completed three circuits and were on final approach for a fourth touch and go. Witnesses reported that when the aircraft was almost over the threshold, it started to diverge right, while maintaining a low height. They reported that when the aircraft was abeam the mid length of the runway, its nose lifted and the aircraft banked steeply to the right before impacting the ground in a near vertical nose-down attitude. The pilot was fatally

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injured. The instructor received severe burns and was treated in hospital for three and a half weeks before succumbing to those injuries (200304589).

- On 18 December 2008, a Cessna 152 aircraft and a Liberty XL2 aircraft collided in midair over Casula, NSW, in the proximity of the 2RN reporting point, south-west of Bankstown. The Liberty remained flyable and landed at Bankstown approximately 6 minutes later, while the Cessna descended to the ground and was destroyed. Both occupants of the Cessna were fatally injured (AO-2008-081).

4.2.3 Private/business and sports aviation

Private/business and sports aviation generally involves aircraft that are operated for pleasure, or to meet a business or professional need. From data held by the ATSB, it is difficult to distinguish between business and private operations; therefore, these data are aggregated in this report.

Incidents for private/business and sports aviation increased from 2005 to 2007, but have continued to decline since then, reaching their lowest level in the reporting period in 2010. The number of aircraft involved in serious incidents has risen as a result of the introduction of the TSI Regulations in 2003. Although there is some variability in total accident figures, a general decrease is observed. Fatal accidents have declined from 15 in 2006 to only 3 in 2010.

As hours flown for sports aviation is not comprehensively known, rate data is not available for the combined private/business and sports aviation operation type.

Table 17: Private/business and sports aviation occurrences, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	266	264	222	215	240	288	317	277	285	196
Serious incidents	1	1	3	22	13	14	24	17	22	20
Serious injury accidents	11	8	6	7	2	5	5	9	6	8
Fatal accidents	11	4	5	7	13	15	9	13	9	3
Total accidents	91	79	63	83	64	56	66	65	66	62
Number of people involved										
Serious injuries	15	12	8	10	3	10	7	14	7	10
Fatalities	20	10	13	16	18	25	18	23	9	5

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Private/Business

There were 2,927 aircraft involving private/business occurrences over the period 2001 to 2010. Incidents reported to the ATSB increased between 2004 and 2007, but in 2010, they reduced to their lowest level in 10 years. Serious incidents have increased since the introduction of the TSI Regulations in 2003. There have been a total of 135 fatalities from 70 aircraft involved in fatal accidents, equating to about two fatalities per fatal accident. Sixty-two serious injuries were recorded over the report period.

Table 18: Private/business occurrences, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	218	217	178	171	208	274	292	236	259	156
Serious incidents	1	1	2	19	12	13	19	14	18	14
Serious injury accidents	7	5	2	3	0	4	4	7	3	5
Fatal accidents	9	4	3	6	9	12	7	11	6	3
Total accidents	81	70	52	72	53	49	58	58	57	55
Number of people involved										
Serious injuries	9	8	2	6	1	9	6	12	3	6
Fatalities	18	10	11	15	14	21	15	20	6	5
Rate of aircraft involved										
Accidents per million hours	198.0	168.7	135.1	183.2	135.5	131.0	153.0	151.8	146.2	
Fatal accidents per million hours	22.0	9.6	7.8	15.3	23.0	32.1	18.5	28.8	15.4	

Assuming a linear trend, the accident rate for private/business aircraft showed a general decrease from a high of almost 200 accidents per million hours to about 150 per million hours in 2009. The fatal accident rate dipped in 2002 and 2003, but rose to a higher level after 2004.

Private/business operations recorded the highest accident rate of any Australian aviation operation type at about 156 accidents per million hours. In terms of fatal accidents, there are about 19 fatal accidents per million hours. This is significantly higher than any other operation type.

There were 55 accidents, including three fatal accidents in 2010. All fatal accidents involved collision with terrain in different ways. The first fatal accident involved a twin-engine aircraft which was observed on radar to commence a rapid descent from 3,500 feet. Search and rescue personnel located the wreckage of the aircraft in the vicinity of where it was last observed to be operating (AO-2010-023). The second fatal accident involved an aircraft which contacted the surface of a lake and was found submerged in water (AO-2010-045). The third fatal accident involved ground impact with a pilot performing mustering in the private operations category[12] (AO-2010-079).

Of the 55 accidents in private operations, about 50 per cent occurred during approach and landing, 30 per cent were manoeuvring, in the climb, cruise, or in descent, about 15 per cent were during takeoff or in the initial climb, and 5 per cent were during an unknown

[12] The property owner performs mustering, rather than hiring a commercial operator.

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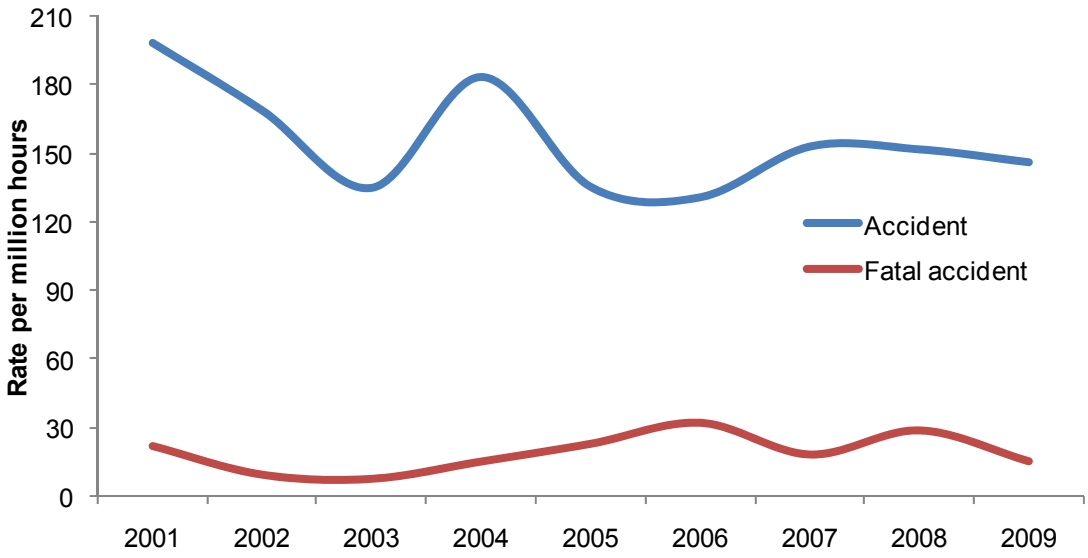
phase of flight. There were a large number of occurrence types associated with private operations accidents; therefore, a high-level summary is provided here. About 30 per cent of accidents in private operations related to malfunctioning engines, with most being total or partial powerless. About 20 per cent were runway excursions (mostly on landing), about 10 per cent were landing gear indication problems and or wheels-up landing, and about 20 per cent were collisions with terrain. The remaining 20 per cent were a miscellaneous group of occurrences including ground collisions, hard landings, fuel starvation, animal and birdstrike and wirestrike.

Figure 10: Aircraft involved in private/business accidents per million hours, 2001 to 2009



Some examples of private/business accidents resulting in fatalities include:

- On 22 June 2003, a Cessna 172M, registered VH-TUR, entered a spin during a right turn after takeoff from runway 35 at Wedderburn aerodrome in New South Wales. It impacted the ground to the north-east of the airfield and the four occupants were fatally injured. The investigation team considered the reduction in climb performance and collision with terrain to be related to an overweight aircraft, with 10 degrees of flaps, which climbed into an increasing and gusting tailwind (200302847).
- On 7 February 2004, a Piper PA-28R-200 Arrow, registered VH-TRZ, was conducting a private sightseeing flight over Lake Eildon in Victoria. It struck a high voltage power line about 133 ft above the water level of the lake. This dislodged the left wing of the aircraft, and the aircraft impacted water 165 m beyond the cable. The four aircraft occupants were fatally injured when the aircraft impacted the water (200400437).
- On 17 November 2007, the owner-pilot of a Cessna Aircraft Company C337G (Skymaster), registered VH-CHU, was conducting a private flight in accordance with the visual flight rules (VFR) from Moorabbin, Victoria to Merimbula, New South Wales. The aircraft wreckage and three of the deceased occupants were found on a beach between Venus Bay and Cape Liptrap, Victoria. The investigation found that while manoeuvring over water at low level in conditions of reduced visibility, the pilot probably became spatially disorientated and inadvertently descended into the water (AO-2007-061).

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- On 31 October 2006, a Piper PA-31-350 Chieftain, registered VH-ZGZ, was operating on an instrument flight rules (IFR) flight from Emerald to Gladstone, Queensland. The aircraft impacted the ground in a very steep nose-down attitude at high speed. Three people on board the aircraft sustained fatal injuries. The investigation team could not conclusively establish why the aircraft experienced a loss of control, but considered malfunction of the autopilot or flight controls (such as jammed control), and fuel starvation possible. Adverse weather, pilot incapacitation, and structural failure were considered unlikely factors that might have lead to the loss of control. The pilot's experience on the aircraft was low, and night and instrument flying experience was also low (AO-2006-001).

Sports aviation

Sports aviation includes gliding, parachute operations, and aerobatics in VH-registered aircraft. Accident numbers in sports aviation are low and have reduced since 2005. There were no fatal accidents in 2010. The seven accidents in 2010 involving sports aviation involved two balloons, three gliders, and two aeroplanes. The first aeroplane involved birdstrike and precautionary landing and the second aircraft involved runway excursion. For balloons, one accident involved collision with terrain associated with a downdraft, and the other accident involved a fall while exiting the basket. The three glider accidents were associated with out-landing, headwinds, and collision with the ground at low level while turning onto base for the runway.

Table 19: Sports aviation (VH- registered), 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	48	47	44	44	32	14	25	41	26	40
Serious incidents	0	0	1	3	1	1	5	3	4	6
Serious injury accidents	4	3	4	4	2	1	1	2	3	3
Fatal accidents	2	0	2	1	4	3	2	2	3	0
Total accidents	10	9	11	11	11	7	8	7	9	7
Number of people involved										
Serious injuries	6	4	6	4	2	1	1	2	4	4
Fatalities	2	0	2	1	4	4	3	3	3	0

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4.2.4 Foreign general aviation

There have been very few accidents involving foreign registered general aviation aircraft. In 2010, there were two accidents, one of which involved a fatality. The fatal accident involved a powered glider which struck powerlines and impacted the ground at Corowa, New South Wales. The other accident involved a MXR Technologies MXS-R aircraft which crashed into the Swan River near Perth during a practise run for an air race. The aircraft was seriously damaged and the pilot sustained minor injuries.

Table 20: Foreign registered general aviation, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of aircraft involved										
Incidents	18	34	19	12	31	43	47	56	50	67
Serious incidents	0	0	0	1	1	0	1	0	0	1
Serious injury accidents	0	1	0	0	0	0	0	0	0	0
Fatal accidents	0	0	0	1	0	0	0	0	0	1
Total accidents	0	3	0	1	0	1	1	1	0	2
Number of people involved										
Serious injuries	0	1	0	0	0	0	0	0	0	0
Fatalities	0	0	0	2	0	0	0	0	0	1

Other significant accidents involving foreign-registered general aviation aircraft since 2001 included the following.

- On 30 August 2004, the owner-pilot of a Cessna 421C Golden Eagle, registered HB-LRW, commenced his takeoff from El Questro Aircraft Landing Area, Northern Territory, for a private flight to Broome, where the pilot intended resuming the aircraft delivery flight from Switzerland to Perth. Witnesses to the takeoff stated that, shortly after lift-off from the runway, the aircraft commenced a slight left bank and drift before striking the trees to the side of the runway and impacting the ground. The aircraft was destroyed by the impact forces and post-impact fire. The pilot and passenger were fatally injured (200403202).

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5 OCCURRENCES BY AIRCRAFT TYPE

This chapter examines occurrences by type of aircraft and operation group. It primarily considers the number of occurrences in relation to the number of hours flown by the type of aircraft within an operation category. Fixed-wing aircraft (aeroplanes) accounted for about 85 per cent of all aircraft on the Civil Aviation Safety Authority's civil aircraft register (VH- register) in December 2010. This was followed by rotary-wing aircraft (helicopters), accounting for 13 per cent (the other 2 per cent were balloons).

5.1 Differences between operation groups

The accident rate in helicopters performing any type of operation (about 98 accidents per million hours) is about 2.3 times the accident rate in aeroplanes performing any type of operation (about 45 per accidents per million hours). When GA aeroplanes and GA helicopters were compared using pooled data between 2001 and 2010, GA helicopters had an accident rate of about 117 per million hours (307 accidents for about 2.6 million hours flown) and GA aeroplanes had about 85 accidents per million hours (845 VH- registered accidents for about 10 million hours flown). This represents an accident rate in GA helicopters that is about 1.3 times higher than GA aeroplanes. This accident rate combines single and multi-engine aircraft. The disparity between aeroplane and helicopter accident rates does not apply universally across all operation types. Different operation types are explored in Section 5.1.1.

Table 21: Number of VH- registered powered aeroplanes and helicopters involved in accidents, 2001 to 2010

Aeroplanes	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Air transport	35	25	28	12	12	11	17	23	10	20
General aviation	103	100	81	99	78	60	85	84	79	84
Helicopters										
Air transport[13]	3	2	3	4	0	1	5	6	1	3
General aviation	40	21	27	34	31	25	26	35	34	36

For aeroplanes, there were about four GA accidents for every air transport accident. Pooled data between 2001 and 2010 demonstrated that there were about 13 accidents per million hours in aeroplanes performing air transport versus about 85 accidents per million hours in GA aeroplanes. Both the GA and air transport accident rates appear to have decreased between 2001 and 2009. Based on the relative change in hours flown over time for air transport and GA, it is predicted that the accident rate for air transport will be higher in 2010 than in 2009, and slightly higher for GA in 2010 when compared with 2009.[14]

[13] There was no high capacity or low capacity RPT helicopter aircraft operations in Australia during the period 2001 to 2010. All air transport operations for helicopters are charter operations.

[14] General aviation and charter hours-flown data, derived from BITRE, is not yet available for 2010. In this report, 2010 hours-flown data is estimated using linear trend for point and preliminary BITRE data. The linear trend for point technique uses regression to predict hours flown data using the existing data series between 2001 and 2009.

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For helicopters, there were about 11 GA accidents for every air transport accident (with air transport equating to charter helicopter flying[13]). Helicopters make up about 25 per cent of all accidents (Table 21) and fatal accidents (Table 22) in general aviation for the reporting period, even though in total numbers on the VH- register, they account for 13 per cent of all aircraft. In terms of the amount of flying performed, helicopters fly far fewer hours than aeroplanes. For the 307 GA accidents involving helicopters, the accident rate was about 117 per million hours using pooled data between 2001 and 2010. This compares to 28 charter helicopter accidents over the same period which yields a pooled accident rate of 36 per million hours – about a third of the GA helicopter accident rate.

Table 22: Number of VH- registered powered aeroplanes and helicopters involved in fatal accidents, 2001 to 2010

Aeroplanes	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Air transport	4	3	1	0	2	1	1	2	0	1
General aviation	13	5	8	7	10	12	9	18	7	8
Helicopters										
Air transport	0	1	1	0	0	0	1	1	0	0
General aviation	5	1	5	4	3	4	2	2	8	4

5.1.1 Aircraft type by operation type comparison

As can be seen in Table 23, differences were found in accident rates by type of aircraft operation, and by type of aircraft. There were no high or low capacity RPT helicopter aircraft operations in Australia during the period 2001 to 2010.

Table 23: Accident, fatal accident, fatalities by operation and aircraft type, 2001 to 2010

Operation	**Aircraft type**	**Accidents per million hours**	**Fatal accidents per million hours**	**Number of fatalities**
Charter	Helicopters	35.9	5.1	13
	Aeroplanes	39.7	3.2	30
Aerial work	Helicopters	93.9	11.8	32
	Aeroplanes	65.9	8.0	26
Flying training	Helicopters	102.9	14.8	6
	Aeroplanes	38.4	2.2	12
Private/Business	Helicopters	224.2	25.1	13
	Aeroplanes	147.2	17.1	122

Charter

Charter aeroplanes and helicopters have similar accident rates. For charter helicopter and aeroplane operations, the rate is similar at about 40 per million hours pooled over the period of this report. Year-on-year comparisons between charter aeroplane and helicopter accidents show greater fluctuations in the helicopter accidents rates; the total number of charter helicopter accidents is small. Based on the number of accidents recorded in 2010, and using estimated hours flown data for charter, the ATSB predicts that the actual 2010 charter helicopter accident rate will be about 39 per million and the aeroplane accident

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rate will be 43 per million hours. In relation to the fatal accident rate in charter helicopter operations, helicopters have a higher fatal accident rate per million hours (about 5.1 per million hours) than aeroplanes (3.2 fatal accidents per million hours). In terms of the total number of people killed in charter, there were 13 people killed in helicopter accidents; this equates to about 17 fatalities per million hours using pooled data between 2001 and 2010. This was compared with 30 people killed in aeroplanes performing charter operations yielding about 7.6 fatalities per million hours.

Aerial work

When the accident rate in aeroplanes and helicopters performing any type of aerial work was compared, the helicopter accident rate (about 94 per million hours) was higher than the aeroplane rate (about 66 per million hours). About 75 per cent of agricultural hours are flown by fixed-wing aircraft; agriculture operations, as a sub category of aerial work, act as an effect modifier on the aerial work total. Using estimated hours flown data for 2010, the predicted accident rate for 2010 aerial work figures will be higher than for 2009 for helicopters (about 106 accidents per million hours) but about the same for aeroplanes (about 68 per million hours).

The fatal accident rate in aerial work for helicopters (about 12 per million hours) is similar to the aeroplane fatal accident rate (8 per million hours). Aeroplanes and helicopters perform a similar number of hours in aerial work. Less people are killed in aeroplanes performing aerial work (26 between 2001 and 2010) than in helicopter fatal accidents; there were 32 people killed in helicopter aerial work operations.

These data show that the aerial work accident rate for helicopters is higher than the aeroplane accident rate, but that the fatal accident rates across aerial work are similar, taking into account the type of aircraft.

Flying training

Helicopters performing flying training have an accident rate that is about 103 per million hours flown, more than double the rate of aeroplanes, which is at about 38 accidents per million hours. The predicted accident rate for 2010, using estimated hours flown for flying training will be lower than the 2009 rate for both helicopters (about 86 per million hours) and aeroplanes (about 31 per million hours).

The fatal accident rate in helicopters performing flying training was six-times higher than the aeroplanes in flying training. There were five fatal accidents and six people killed in helicopters between 2001 and 2010, giving a total of about 15 fatal helicopter accidents per million hours in flying training. For aeroplanes, there were nine fatal accidents and 12 people killed in flying training, yielding a fatal accident rate of about two per million hours.

Private/Business

Helicopters performing private or business flying have a higher accident rate than aeroplanes. Using pooled data between 2001 and 2010, the private or business helicopter accident rate was about 224 per million hours, while aeroplanes have an accident rate of about 149 per million hours. This represents about 1.5 times the number of accidents in helicopters compared with aeroplanes. The estimated accident rate for aeroplanes will be slightly higher for 2010 than it was in 2009, and the estimated 2010 helicopter accident rate will be lower than for 2009.

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For fatal accidents in private/business, helicopters had a higher fatal accident rate (about 25 fatal accidents per million hours) than aeroplanes (about 17 fatal accidents per million hours); however, for the 11 fatal helicopter accidents in private/business operations between 2001 and 2009, there were 13 fatalities. In comparison with this figure, aeroplanes had 56 fatal accidents, but 122 fatalities. In other words, more people, in total, were killed in private fatal aeroplane accidents than in fatal helicopter accidents.

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6 OCCURRENCES BY STATE/TERRITORY

As aviation is a regional, national and international activity, the location of an occurrence may not have any bearing on causal factors. This means that the assessment and interpretation of occurrence numbers by state/territory must be treated cautiously because comprehensive activity data for a specific state or territory cannot be reliably generated. Consequently, rate data was not calculated for the following table.

The number of accidents, fatal accidents and fatalities provided below reflects what happened in a particular state or territory and not the level of aviation safety.

The data below (Table 27) is based on the number of occurrences and includes occurrences involving Australian VH- registered aircraft.

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Table 24: All aircraft accidents, fatal accidents and fatalities (including non-VH Australian aircraft) by state/territory, 2001 to 2010

State	Category	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ACT	Total accidents	2	0	4	0	0	1	0	0	1	0
	Fatal accidents	1	0	0	0	0	0	0	0	0	0
	Fatalities	4	0	0	0	0	0	0	0	0	0
NSW	Total accidents	41	51	45	38	45	30	42	54	47	42
	Fatal accidents	3	6	8	5	8	12	7	10	6	5
	Fatalities	6	11	15	7	12	16	8	16	6	7
NT	Total accidents	18	10	12	11	7	10	14	12	10	15
	Fatal accidents	1	2	0	1	1	2	2	3	0	2
	Fatalities	1	5	0	1	1	3	4	4	0	3
Qld	Total accidents	57	42	37	55	37	27	40	47	45	58
	Fatal accidents	10	6	6	8	9	5	6	7	5	5
	Fatalities	18	11	13	10	23	14	9	11	5	6
SA	Total accidents	15	9	8	11	10	3	10	12	6	17
	Fatal accidents	2	0	1	0	1	0	0	1	1	1
	Fatalities	2	0	2	0	2	0	0	1	1	1
Tas.	Total accidents	4	6	5	5	0	5	5	4	6	4
	Fatal accidents	2	0	1	1	0	0	3	0	0	0
	Fatalities	2	0	4	1	0	0	3	0	0	0
Vic.	Total accidents	24	21	22	26	17	15	28	27	26	32
	Fatal accidents	4	5	0	5	4	4	7	3	6	2
	Fatalities	5	7	0	13	6	5	12	3	7	2
WA	Total accidents	35	25	21	17	17	15	22	32	24	31
	Fatal accidents	4	0	4	1	1	1	5	3	5	3
	Fatalities	8	0	9	2	1	2	8	8	6	4
Other [15]	Total accidents	3	0	0	4	2	1	4	2	2	7
	Fatal accidents	1	0	0	0	0	0	0	0	0	1
	Fatalities	1	0	0	0	0	0	0	0	0	1

[15] 'Other' refers to occurrences involving Australian-registered aircraft operating outside mainland Australia, and Tasmanian and Australian territories 12 nautical mile limit.

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7 OCCURRENCE TYPES: WHAT HAPPENED

Accidents and incidents are usually the result of a complex set of circumstances, often involving a chain or sequence of events. The ATSB codes one or more occurrence type for each accident or incident to identify what happened and how an occurrence developed. This can serve as a useful springboard to understanding what types of occurrences have taken place, and where potential areas for improvement may be made.

There are five different occurrence type categories currently used by the ATSB (detailed in Appendix A):

- airspace
- aerodrome and airways facility
- environment
- mechanical
- operational.

The ATSB records one or more occurrence types for all aircraft involved in all occurrences. Accidents and serious incidents generally have more occurrence types than incidents as they are more likely to be investigated and there is a greater amount of information to draw upon for analysis and coding. For occurrences involving multiple aircraft, aircraft with the same operation type are recorded twice; aircraft with different operation types are recorded against the corresponding operation type.

The tables below show that the one of the most frequently reported occurrence types is a consequential event. Consequential events are secondary events such as rejected takeoff, precautionary landing, go-around, or aircraft evacuation. In other words, some other type of event has led to the consequential event. These consequential events are related to many different primary events; for example, an engine failure on takeoff may lead to a rejected takeoff, or a runway incursion might lead to a go-around. The relationships between different types of occurrences are summarised in this report because there are a significant number of occurrence type permutations and combinations.

Occurrence types are not the why of an occurrence per se, but generally are a description of what occurred. There is no description of individual actions, local conditions, risk controls, or organisational influences in these tables. The count of occurrence types does not necessarily reflect their importance. Fuel-related events may be relatively rare, by comparison with aircraft control, but fuel starvation can be very serious, and result in an attempt at an emergency landing, and potential aircraft damage and injury to people on board, or outside the aircraft.

7.1 Commercial air transport

During 2010, the top five occurrence type events for air transport relating to accidents and serious incidents (Table 25) were aircraft separation, aircraft control, powerplant and propulsion, miscellaneous operational events and a combination of terrain collisions, runway events and ground operations events. For incidents (Table 26), the top five occurrence types were wildlife strikes, failure to comply (FTC) with air traffic services instructions, mechanical systems and airframe events, and miscellaneous operational events.

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7.1.1 Accidents and Serious Incidents

Table 25: Air transport Accident and Serious Incidents by Occurrence Type, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Aerodrome and airways facility											
Aerodrome related	0	0	0	0	1	0	0	0	0	0	1
Airspace											
Aircraft separation	1	4	16	14	9	5	21	11	10	18	109
FTC (Operational Non-compliance)	1	0	1	2	3	0	5	4	3	2	21
ATC Procedural Error	1	2	1	2	4	1	3	1	0	0	15
VCA (Airspace incursion)	0	0	0	0	0	0	1	1	1	0	3
Breakdown of co-ordination	1	0	0	0	0	0	0	0	0	1	2
Other	0	0	0	0	0	0	1	0	0	0	1
Environment											
Weather	2	1	2	3	1	0	5	6	1	2	23
Wildlife	4	1	0	0	0	0	2	0	0	1	8
Mechanical											
Powerplant / propulsion	5	8	6	9	6	7	10	17	8	10	86
Airframe	7	12	9	8	7	2	9	7	8	3	72
Systems	8	3	1	4	6	3	5	8	5	1	44
Operational											
Aircraft control	26	14	13	8	6	6	17	20	13	11	134
Miscellaneous	3	2	2	9	6	5	10	26	10	8	81
Terrain Collisions	7	3	3	4	5	4	5	8	2	5	46
Runway events	0	6	6	1	2	5	6	9	1	5	41
Ground operations	7	2	6	2	0	2	5	4	1	5	34
Fuel related	3	3	4	5	2	0	4	5	2	0	28
Fumes, Smoke, Fire	1	1	2	4	4	1	1	7	3	1	25
Communications	0	2	3	3	1	2	2	6	1	4	24
Cabin Safety	1	2	0	0	3	0	4	1	0	2	13
Flight preparation / Navigation	1	1	0	1	4	0	4	0	0	1	12
Regulations and SOPs	3	2	1	0	1	1	0	1	0	0	9
GPWS / TAWS	0	1	0	1	1	0	2	0	1	0	6
Aircraft loading	1	1	1	1	0	0	0	0	0	1	5
Consequential events	18	14	13	12	17	12	18	29	16	17	166

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Aircraft separation

In 2010, aircraft separation events involved airprox and breakdown of separation[16] (BOS). Five per cent of airprox[17] serious incidents involved high capacity operations, 45 per cent were charter operations, and the remaining 50 per cent were low capacity RPT operations. In terms of relative aircraft tracks, 45 per cent were on a reciprocal track, about 25 per cent were on converging tracks, and the remainder were crossing or on the same track. Avoidance manoeuvres were taken in 45 per cent of all airprox serious incidents in 2010. In relation to the distance between aircraft, the closest that two aircraft came from colliding was 40 metres horizontally; both aircraft were converging head on at the same height when the airprox took place (see break-out box).

Too close for comfort
Two aircraft were travelling in opposite directions head-to-head. Aircraft one was a low capacity air transport aircraft in cruise, using visual flight rules and aircraft two was a charter aircraft, descending from above aircraft one, using instrument flight rules (IFR). Aircraft two did not, however, have an operating transponder, and aircraft one did not hear radio calls from aircraft one at top of descent on the common traffic advisory frequency (CTAF) or area frequencies. Neither pilot was aware of the other aircraft; this situation may have been compounded by the combination of high-wing aircraft in cruise and low-wing aircraft in descent. Neither aircraft had time to take evasive action. The two aircraft came within 40 metres of each other horizontally at the same height.

In all BOS occurrences for air transport in 2010, the separation conflict was with another aircraft (rather than a vehicle on the runway). A radar standard was being used in 50 per cent of BOS events, a procedural standard in about 35 per cent and a runway standard in 15 per cent of BOS events. Fifty per cent were on reciprocal tracks, 35 per cent were on the same track and 15 per cent were on crossing tracks.

Aircraft control

Aircraft control-related serious incidents and accidents in air transport were in two main categories - wheels-up landing (45 per cent) and hard landing (25 per cent). All wheels-up landings in 2010 were in charter operations. Two of the three hard landing occurrences in 2010 were related to helicopter operations, and the third was an aeroplane.

Powerplant / propulsion

About 40 per cent of powerplant / propulsion serious incidents and accidents during 2010 were total engine failure events. Thirty per cent were partial power loss and 30 per cent were abnormal engine indications. This category includes the uncontained in-flight engine failure involving an Airbus A380 overhead Batam Island Indonesia (AO-2010-089), the in-flight engine failure involving a Boeing 747 near Singapore Changi International (AO-

[16] A breakdown of separation as defined by the TSI Regulations is an occurrence where there is a failure to maintain a recognised separation standard (vertical, lateral or longitudinal) between aircraft that are being provided with an air traffic service separation service.

[17] An airprox as defined by the TSI Regulations is an occurrence in which two or more aircraft come into such close proximity that a threat to the safety of the aircraft exists or may exist, in airspace where the aircraft are not subject to an air traffic separation standard or where separation is a pilot responsibility.

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2010-090) and the uncontained in-flight engine failure involving a Boeing 747 near San Francisco (AO-2010-066).

The partial power loss events in 2010 were all in charter operations. One aircraft diverted to an alternate aerodrome, and the other two conducted forced landings. Abnormal engine indications were received by pilots in three events, two involving charter and the third high capacity air transport. The abnormal engine indications were related to lightning strike for the high capacity aircraft, and low oil pressure and suspected carburettor icing for the charter aircraft

Miscellaneous events

Miscellaneous serious incidents and accidents for air transport in 2010 involved warning devices, crew incapacitation and airframe overspeed. Warnings were the most frequently occurring event, and these related to abnormal engine indications and stick shaker activation during turbulence. Crew incapacitation involved a captain in one occurrence, and the copilot in the other. In the occurrence involving the captain, a check captain took the incapacitated captain's place. For the copilot incapacitation, the aircraft returned to the departure location. The airframe overspeed related to the pilot exceeding the flap speed during a manoeuvre to ensure safe separation with another aircraft displayed on the terrain collision and awareness system (TCAS).

Terrain collisions

There were five collision with terrain accidents and serious incidents in air transport in 2010, one in the low capacity RPT operations, and four in charter operations. The low capacity RPT event involved a simulated engine failure during asymmetric training resulting in the fatal injuries to the two pilots on board (AO-2010-019). The remaining four occurrences were from charter operations. Three involved entering fog or cloud, resulting in a loss of visual reference and awareness of the aircraft's position in relation to the ground (AO-2010-080, AO-2010-076, third event not investigated), and the fourth event involved a long landing associated with a tail wind and attempted go-around (AO-2010-109).

Ground operations

The five serious incidents and accidents involving ground operations in 2010 included a ground handler driving a belt loader into the side of a high capacity aircraft. An inspection by the operator found that the throttle pedal became caught on the throttle stop as a result of a missing striker plate.

Runway events

There were five runway events in 2010 for air transport which resulted in a serious incident or accident. Four involved runway excursion and the fifth involved runway incursion. All the runway excursion events were associated with charter operations. The first runway excursion event was an overrun associated with a precautionary landing, the second and third events were veer-offs associated with directional control difficulties during landing, the fourth was a veer-off associated with a failure of the nosewheel steering. The runway incursion involved the pilot of a low capacity RPT aircraft crossing the holding point while two military aircraft were taking off.

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7.1.2 Incidents

The top five incidents for air transport in 2010 were wildlife strike, failure to comply with air traffic services instructions, mechanical systems and airframe events, and miscellaneous events.

Table 26: Air transport Incidents by Occurrence Type, 2001 to 2010

Occurrence Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Aerodrome and airways facility											
Airways facility	37	28	38	27	52	16	17	13	12	22	262
Aerodrome related	22	17	18	21	16	20	20	24	28	18	204
Airspace											
FTC (Operational Non-compliance)	353	410	426	543	761	633	770	813	727	1,006	6,442
Aircraft separation	486	306	266	305	320	204	180	255	238	233	2,793
ATC Procedural Error	180	156	205	200	285	285	206	188	146	97	1,948
Breakdown of co-ordination	140	112	110	176	207	150	180	163	195	252	1,685
VCA (Airspace incursion)	74	47	55	72	58	50	93	73	52	51	625
Other	19	23	22	7	15	17	6	7	7	2	125
Environment											
Wildlife	602	614	645	855	951	921	960	1052	1164	1330	9,094
Weather	138	122	101	172	171	174	206	225	180	232	1,721
Mechanical											
Systems	291	288	204	278	316	323	324	388	325	415	3,152
Airframe	199	228	170	174	235	198	270	325	289	260	2,348
Powerplant / propulsion	238	214	159	162	170	163	210	216	221	196	1,949
Operational											
Miscellaneous	228	191	127	145	190	258	299	385	361	324	2,508
Fumes, Smoke, Fire	95	102	72	74	105	101	131	154	139	272	1,245
Communications	96	85	92	165	146	117	93	150	103	70	1,117
GPWS / TAWS	137	69	67	163	242	149	83	36	22	18	986
Aircraft loading	49	33	16	36	41	79	130	108	71	125	688
Flight preparation / Navigation	61	76	42	65	74	60	74	56	29	38	575
Ground operations	42	59	53	55	45	55	67	72	56	50	554
Cabin Safety	82	76	29	35	39	42	55	54	40	58	510
Aircraft control	36	40	23	46	55	66	66	52	37	26	447
Runway events	44	35	46	46	34	40	41	57	40	48	431
Fuel related	29	40	21	31	23	32	55	52	35	30	348
Loading related	28	8	6	23	21	19	63	45	30	0	243
Regulations and SOPs	6	12	3	7	7	10	28	22	6	0	101
Terrain Collisions	8	10	8	9	11	10	6	13	8	8	91
Consequential events	580	483	348	410	446	602	594	685	674	623	5,445

Wildlife

Most wildlife strikes in air transport were birdstrikes, with a small number of animal strikes reported. The number of birdstrikes has doubled over the period 2001 to 2010, driven by the large increase in aircraft movements (departures and landings) in high

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capacity RPT over the same period, resulting in a modest increase in the rate of birdstrikes per aircraft movement.

In air transport during 2010, there were 11 bird and bat species that accounted for seventy-five per cent of the known species. In order of frequency these were Bat/Flying Fox, Kite, Galah, Swallow/Martin, Lapwing/Plover, Nankeen Kestrel, Magpie, Pipit, Hawk, Magpie-lark, and Curlew/Sandpiper. About 7 per cent of bird strikes resulted in minor damage. In relation to animal strikes, most animal strikes either involved rabbits or hares.

Failure to comply

There has been a continual increase in the number of reported failure to comply (FTC) with air traffic services instructions incidents involving air transport aircraft from 2001 (353 incidents per year) to 2010 (1006 incidents). About 80 per cent of FTC incidents related to high capacity RPT aircraft, and the increasing trend partially reflects the growth in high capacity traffic; however, all three operation types (high capacity RPT, low capacity RPT and charter) showed an increase in the rate of FTC incidents per aircraft departure over the 10 years.

During 2010, about 66 per cent of FTC events were related to verbal instructions and the remainder were related to published information. In relation to phase of flight, about 20 per cent of FTC incidents occurred on the ground, mainly during taxiing, and 80 per cent took place in flight. Of the FTC incidents in flight, about 25 percent occurred on the initial climb, or climb to cruise, 50 per cent occurred during cruise, and 25 per cent occurred during descent and approach.

For FTC incidents relating to verbal instructions, they were most commonly related to aircraft route and altitude while in the air, and failure to comply with a taxi or pushback clearance while on the ground. For FTC incidents relating to published information, about 33 per cent related to standard instrument departures (SIDs) and standard arrival routes (STARs) and the remainder were related to FTC with other Aeronautical Information Service (AIS) publications. Common examples in other AIS categories included pilots operating instrument flight rules (IFR) aircraft without serviceable radio equipment, failure to update waypoint estimates, turning away from the direction specified in a SID or STAR and failure to make radio calls.

Mechanical Systems

The number of mechanical systems incidents reported for air transport operations increased between 2003 and 2008, but they have now stabilised. In 2010, mechanical systems events were chiefly related to avionics/flight instruments, hydraulic systems, air/pressurisation, flight controls, and electrical systems. Avionics/flight instruments events were related to error messages associated with primary flight controls in 35 per cent of events, communication systems in 30 per cent of events, navigational systems in about 15 per cent of events, and the remainder were a mixed group of auto flight control and secondary flight systems. During 2010, hydraulics systems events were mostly of the primary system, where the type of hydraulic system was identified. Air/pressurisation events were related to pressurisation (45 per cent), bleed air (35 per cent) and air conditioning (10 per cent). In relation to flight controls during 2010, about 60 per cent of events related to flaps or slats, 15 per cent were related to the rudder, about 15 per cent to the elevator and 10 per cent a mixed group of tail rotor, aileron, and spoilers. Electrical events during 2010 featured mainly alternator or generator failures; four electrical events related to chafed or burnt wiring.

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Mechanical Airframe

For air transport during 2010, the most common airframe event related to landing gear and landing gear unsafe indications (70 per cent). This was followed by windows (about 10 per cent), doors / exits (about 5 per cent), and a range of other airframe events. About 40 per cent of landing gear / indication events are in high capacity air transport, about 20 per cent are in low capacity and 40 per cent are charter. About 25 per cent of landing gear events are false indications of problems, and 75 per cent have a mechanical problem. The mechanical problems include individual components such as burst tyres and brake failures, as well as actuator arms and hydraulics that activate the entire landing gear.

Miscellaneous

The miscellaneous incidents category in air transport covers airframe overspeed, crew incapacitation, depressurisation, stall warnings and other warning devices, along with a mixed group of other types of events. General warnings were the most common, followed by stall warnings, airframe overspeed and crew incapacitation. The largest group of warning devices covered anti-skid, bleed system, aircraft door, cowl heat, elevator asymmetry, fire and smoke, flaps and slats, engine and hydraulic systems.

In relation to crew incapacitation, most people were incapacitated due to illness, rather than injury. The first officer was more likely to be affected (about 65 per cent) than the captain (15 per cent) or second officer (15 per cent). In one incident, a crew member was injured due to turbulence. Two incidents involved the pilot being temporarily blinded by lasers pointed from the ground. About half the pilots were removed from duties for the remainder of the flight.

For stall warnings during 2010, most were due to weather turbulence, but two were related to aircraft turning onto the final approach. All but one was a stick shaker alert. Where the duration of a stick shaker was known, the alert was most commonly for about 1 second.

Airframe overspeeds were associated with windshear and turbulence. Where the speed was recorded, the highest airframe overspeed recorded was 20 kts. There were six depressurisation incidents in 2010 relating to air transport; one involved failure of the right cockpit side window and rapid cabin decompression at about 20,000 feet above the ground. Several cockpit items, including the quick reference handbook, were lost overboard in the event, oxygen masks were donned by the pilot and passengers, and the aircraft descended and landed safely (AO-2010-063). The remaining five depressurisation events were more gradual in nature, and flight crew or passengers donned oxygen masks in four of the six events.

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7.2 General Aviation

7.2.1 Accidents and Serious incidents

Table 27 shows occurrence type accidents and serious incidents recorded for general aviation (GA) aircraft. The five most frequently coded occurrence types were terrain collisions, aircraft control, powerplant/propulsion, aircraft separation and runway events.

Table 27: General Aviation Accident and Serious Incidents by Occurrence Type, 2001 to 2010

Occurrence Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Aerodrome and airways facility											
Aerodrome related	0	0	1	0	0	1	0	0	1	0	3
Airspace											
Aircraft separation	0	8	37	38	25	40	34	65	52	58	357
FTC (Operational Non-compliance)	1	0	2	8	8	12	5	23	14	3	76
ATC Procedural Error	0	0	1	2	2	3	0	7	4	2	21
VCA (Airspace incursion)	0	0	0	0	2	1	1	3	4	1	12
Breakdown of co-ordination	0	2	0	0	0	0	0	0	0	0	2
Environment											
Weather	2	3	0	1	1	4	14	3	10	9	47
Wildlife	5	4	2	2	5	0	2	2	3	3	28
Mechanical											
Powerplant / propulsion	28	16	18	46	27	36	68	43	56	45	383
Airframe	17	16	23	12	11	12	11	12	12	10	136
Systems	3	4	6	6	4	2	4	6	7	9	51
Operational											
Terrain Collisions	84	44	63	72	72	65	70	103	69	103	745
Aircraft control	55	65	38	53	46	33	51	52	48	36	477
Runway events	14	16	16	14	9	11	22	26	24	22	174
Ground operations	7	14	9	10	7	2	22	16	23	21	131
Miscellaneous	16	6	8	15	13	6	9	18	19	7	117
Fuel related	8	4	5	3	7	4	5	8	6	11	61
Communications	0	0	7	12	2	2	1	17	9	8	58
Fumes, Smoke, Fire	3	2	4	4	3	4	5	6	4	8	43
Flight preparation / Navigation	2	1	3	4	2	2	4	3	4	0	25
Cabin Safety	2	0	4	1	1	2	1	1	0	1	13
Regulations and SOPs	1	0	1	1	3	1	1	1	0	0	9
Aircraft loading	1	0	2	0	0	0	1	1	1	0	6
Consequential events	45	36	33	60	48	43	63	53	61	70	512

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Terrain collisions

For terrain collisions accidents and serious incidents in general aviation during 2010, about 66 per cent were collisions with the ground and about a 30 per cent were wirestrike occurrences.

For collision with terrain events, half were performing aerial work and half were in the private/business/sport category. In relation to phase of flight, about 40 per cent took place while manoeuvring, about 20 per cent during landing and 15 per cent during takeoff or initial climb, and the remainder occurred during an unknown phase of flight.

For GA accidents and serious incidents involving wirestrike events in 2010, 66 per cent were aeroplanes and about 33 per cent were helicopters. About 66 per cent of wirestrikes involved aircraft being operated in the agricultural category, and the remainder were conducting mustering, survey or private operations. The pilot was aware of the wire in at least 50 per cent of wirestrike occurrences. The type of wire was mostly standard powerlines.

There were two controlled flight into terrain (CFIT) accidents in 2010, both involving aircraft operating in the survey work category. The first involved an aeroplane which collided with the ground at between 140 and 150 knots; this was associated with loss of situational awareness. The second CFIT involved a helicopter operating just above the tree canopy in low cloud and inclement weather; during a turn to go back the same way the aircraft had come from, the helicopter struck a tree branch.

Aircraft control

During 2010, hard landing, loss of control and wheels-up landing featured commonly in GA aircraft control occurrence types involving accident or serious incident.

About 33 per cent of hard landings involved solo flying training operations, 33 per cent involved private operations and 33 per cent involved sport aviation, aerial work or unknown operation types.

Loss of control occurrence type events were roughly an even split between operations in the air, and those on the ground (during taxi, takeoff or landing). Principally, they occurred among fixed-wing aircraft.

Most wheels-up occurrence type events were unintentional, involving a variety of certified and homebuilt single and twin-engine aircraft.

Powerplant / propulsion

The majority of GA powerplant / propulsion related accidents and serious incidents in 2010 involved total or partial power loss. These involved forced or precautionary landing in 50 per cent of occurrences, collision with terrain in 40 per cent, and hard landing in 10 per cent. Sixty-six per cent first occurred during manoeuvring or cruise, and the other 33 per cent in climb after take-off.

For accidents and serious incidents concerning total power loss / engine failure, most resulted in a forced landing / diversion; some of these events resulted in collision with terrain, hard landing, ground strike and runway excursion or undershoot. Sixty per cent were performing private/sports/business operations, about 25 per cent were performing aerial work and about 15 per cent were performing flying training.

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Aircraft separation

About 95 per cent of aircraft separation serious incidents in 2010 were related to airprox. In 40 per cent of airprox events, neither aircraft was aware of the other aircraft, while one aircraft was aware of the other aircraft in 30 percent of events. In 15 per cent of occurrences, both aircraft were aware of each other, but still came in close proximity to each other; the remaining 15 per cent were unknown.

For about 70 per cent of airprox occurrences, there was no alert of a potential collision, and in the remainder, the alert came from air traffic control, traffic collision avoidance system resolution advisory (TCAS RA) or other sources. Most aircraft were either converging, on reciprocal tracks, or on the same track. Avoidance manoeuvres were taken by at least one aircraft in 70 per cent of airprox occurrences. Where operation type was known, the majority were performing flying training, followed by aerial work.

Runway events

In 2010, most accidents and serious incidents in GA involving runway events were runway excursions. About 75 per cent of these were veer-offs, and the remainder were overruns.

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7.2.2 Incidents

The top five occurrence type events involving incidents between 2001 and 2010 were airspace incursion, failure to comply, wildlife, runway events and aircraft separation (Table 28).

Table 28: General Aviation Incidents by Occurrence Type, 2001 to 2010

Occurrence Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Aerodrome and airways facility											
Aerodrome related	6	7	12	3	10	10	8	5	4	10	75
Airways facility	13	7	16	2	4	10	1	5	2	4	64
Airspace											
VCA (Airspace incursion)	941	1,017	892	1,161	1,167	1,286	1,265	1,141	1,225	1,215	11,310
FTC (Operational Non-compliance)	330	374	257	172	338	646	820	1129	910	988	5,964
Aircraft separation	251	192	147	176	182	198	195	269	309	241	2,160
ATC Procedural Error	53	58	54	63	68	91	74	77	59	35	632
Breakdown of co-ordination	35	51	64	50	45	51	61	57	43	66	523
Other	37	80	42	6	11	6	1	4	1	2	190
Environment											
Wildlife	177	217	256	294	387	386	382	361	404	409	3,273
Weather	6	11	6	7	9	12	19	20	12	21	123
Mechanical											
Powerplant / propulsion	162	155	168	134	148	129	174	174	153	134	1,531
Systems	117	99	108	198	187	179	151	151	158	176	1,524
Airframe	131	127	101	127	112	164	171	184	168	128	1,413
Operational											
Runway events	125	147	148	166	244	274	238	315	481	318	2,456
Communications	145	119	94	105	85	191	138	222	163	156	1,418
Flight preparation / Navigation	97	114	101	72	106	115	115	70	70	66	926
Aircraft control	46	33	34	45	66	48	67	52	55	32	478
Miscellaneous	32	45	33	45	51	49	46	49	57	53	460
Fumes, Smoke, Fire	32	23	35	38	29	37	41	37	36	44	352
Ground operations	25	28	29	37	42	28	34	36	42	44	345
Terrain Collisions	36	34	25	35	35	25	35	37	41	24	327
Fuel related	24	25	27	16	20	13	18	19	13	20	195
Regulations and SOPs	5	3	3	7	3	3	9	15	4	0	52
Cabin Safety	1	6	2	2	5	5	8	2	1	0	32
Aircraft loading	1	2	0	1	2	2	4	4	1	3	20
GPWS / TAWS	0	0	0	1	4	0	0	0	1	2	8
Consequential events	319	258	261	233	265	359	331	355	358	317	3,056

Airspace incursion

Airspace incursions by GA aircraft are by far the most commonly reported incident across 2001 to 2010, and remained the most common in 2010. Although the rate of airspace incursion incidents increased between 2003 and 2006, it has reduced slightly and remained stable since then, at about 1,200 incidents per year.

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In 2010, 66 per cent of airspace incursions related to controlled airspace and 33 per cent were incursions of prohibited, restricted or danger (PRD) areas.[18] About 75 per cent of incursions involved the pilot flying from G class airspace to C class airspace. About 10 per cent involved the pilot going from G class airspace to D class airspace and the remaining 15 per cent were mixture of incursion into C, D, E, G and GAAP control areas and zones. In both G to C and G to D class airspace incursions, the incursion was more likely to be into a control area (lower limit level) rather than a control zone (from the ground up). In about 60 per cent of incursions, the pilot flew the aircraft horizontally into controlled airspace, and about 25 per cent entered vertically from above or below the airspace; the incursion type was unknown in the remaining events.

Most airspace incursion incidents relating to PRD areas involved incursions of restricted military airspace by civilian aircraft. In 2010, the most frequently reported civilian events were at R564A and R564B, both at Singleton Army Base, NSW, R156 at the Royal Australian Air Force (RAAF) base, Pearce, WA, R633A at Greenbank, QLD, R295A at Port Wakefield Army Base, SA, and R555C at Holsworthy Army Base, NSW. These bases are used for live firing exercises. It does not follow that live fire exercises were taking place during all PRD incursions, but potential safety risks may have existed as a result of these incursions.

Failure to comply (Operational Non-Compliance)

The number of GA failure of comply (FTC) with air traffic services instructions incidents rose markedly between 2004 (172 incidents per year) and 2008 (1,129 incidents), but in 2010, fell to 988 incidents.

About 60 per cent of FTC incidents in 2010 were failures to comply with verbal instructions of air traffic control, and the remaining 40 per cent were failures to comply with published information. About 20 per cent of FTC incidents occurred on the ground during taxiing or pushback, about 10 per cent during the takeoff or landing roll, and the remainder occurred in the air, most commonly during the cruise, or approach to an aerodrome.

Wildlife

Reports of wildlife strikes have remained fairly stable since 2006. Bird and Flying-Fox strikes dominated wildlife strikes in 2010. Bat/Flying-Fox, Galah, Kite, Magpie, Lapwing/Plover, Nankeen Kestrel, Magpie-lark and Silver gull species accounted for about 60 per cent of known species struck in general aviation. About 10 per cent of bird and flying-fox strikes in GA resulted in aircraft damage. In relation to animal strikes, kangaroo and wallaby species were most frequently struck.

Runway events

The number of runway events recorded for GA aircraft has doubled since 2001. Runway incursion incidents dominated runway incidents in GA, accounting for about 75 per cent of all runway events during 2010.

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[18] PRD areas are defined dimensions above the land, or water, within which flight is restricted at specified times. They are designed to separate civil aircraft from such things as military or industrial activities. They can also be used to separate aircraft from specific aviation activities such as aerobatics.

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Almost all runway incursions in GA during 2010 were by aircraft (rather than people or vehicles) and involved the actions of the pilot. About 13 per cent led to go-around by another aircraft on final approach to the runway.

Other runway events mostly involved landing or takeoff from the wrong runway (about 20 per cent). The remainder were runway excursion or undershoot events.

Aircraft separation

The most common aircraft separation event in GA related to aircraft proximity in the circuit. These situations involved the pilot manoeuvring the aircraft to avoid other traffic, visually separated in the circuit (about 50 per cent). About 30 per cent of events were related to breakdown of separation (BOS), and the remainder were loss of separation assurance and TCAS alerts. All BOS events were conflicts with other aircraft and these occurred mainly in C and D class airspace. About 20 per cent of BOS events occurred on the ground. Air traffic services were using radar separation standards in about 50 per cent of BOS events, procedural standards in about 20 per cent and runway standards in 20 per cent of events. The remaining 10 per cent of events were related to breakdown of visual and wake turbulence standards.

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APPENDIX A: ATSB OCCURRENCE TYPE TAXONOMY

Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
Operational	Aircraft control	Hard landing
		Incorrect configuration
		Loss of control
		Unstable approach
		Wheels up landing
		Other
	Aircraft loading	Dangerous goods
		Loading related
		Other
	Cabin Safety	Cabin communications
		Cabin preparations
		Passenger related
		Unrestrained occupants / objects
		Other
	Communications	Air-ground-air
		Callsign confusion
		Transponder related
		Other
	Consequential events	Ditching
		Diversion / return
		Emergency / Precautionary descent
		Evacuation / disembarkation
		Fly-by inspection
		Forced / Precautionary landing
		Fuel dump / burn off
		Missed approach / go-around
		Overweight landing
		Rejected take-off
		Other
	Flight preparation / Navigation	Lost / unsure of position
		Pre-flight / Planning
		Unsecured door / panel
		VFR into IMC
		Other
	Fuel related	Contamination
		Exhaustion
		Leaking or venting
		Starvation
		Other
	Fumes, Smoke, Fire	Explosion
		Fire
		Fumes

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Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
		Smoke
	GPWS / TAWS	
	Ground operations	Collision on ground
		Foreign object damage / debris
		Ground handling
		Ground prox
		Jet blast / Prop / Rotor wash
		Other
	Miscellaneous	Airframe overspeed
		Crew incapacitation
		Depressurisation
		Missing aircraft
		Security related
		Stall warnings
		Unauthorised low flying
		Warning Device Other
		Laser Related
		Other
	Regulations and SOPs	
	Runway events	Depart / App / Land Wrong Runway
		Runway Excursion
		Runway Incursion
		Runway undershoot
		Other
	Terrain Collisions	Collision with terrain
		Controlled flight into terrain
		Ground strike
		Wirestrike
Mechanical	Airframe	In-flight break-up
		Doors / Exits
		Furnishings and fittings
		Fuselage / Wings / Empennage
		Landing gear / Indication
		Windows
		Other
	Powerplant / propulsion	Abnormal engine indications
		Partial power loss / rough running
		Propellers
		Total power loss / engine failure
		Transmission and gearboxes
		Other
	Systems	Air / Pressurisation
		Avionics / Flight Instruments
		Electrical

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Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
		Fire protection
		Flight controls
		Fuel
		Hydraulic
		Other
Airspace	Aircraft separation	Airprox
		Breakdown of separation
		Loss of separation assurance
		Mid-air collision
		TCAS / ACAS
		Other
	ATC Procedural Error	Information error
		Failure to pass traffic
	Breakdown of co-ordination	
	FTC (Operational Non-compliance)	Published information
		Verbal instruction
	VCA (Airspace incursion)	Controlled airspace
		PRD
Aerodrome and airways facility	Aerodrome related	Lighting
		Markings and signs
		Other
	Airways facility	ATM
		Navaids
		Radar
		Other
Environment	Wildlife	Animal strike
		Birdstrike
		Other
	Weather	Icing
		Lightning strike
		Turbulence
		Windshear / microburst
		Other

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APPENDIX B: DEPARTURES PER HOUR

The following table shows that departures per hours flown ratio used to estimate the number of departures for each operation type.

Aircraft type	Operation Type	Departures per hour
Balloons and airships	Agriculture	1.0
Balloons and airships	Business	1.6
Balloons and airships	Charter	1.2
Balloons and airships	Other aerial work	2.5
Balloons and airships	Private	1.2
Balloons and airships	Test Ferry	1.6
Balloons and airships	Training	1.4
Aeroplane multi engine	Agriculture	2.7
Aeroplane multi engine	Ambulance	1.2
Aeroplane multi engine	Business	1.1
Aeroplane multi engine	Charter	1.2
Aeroplane multi engine	Other aerial work	0.8
Aeroplane multi engine	Pipe Powerline	0.9
Aeroplane multi engine	Private	1.4
Aeroplane multi engine	Regional	1.2
Aeroplane multi engine	Search Rescue	0.9
Aeroplane multi engine	Survey Photography	0.8
Aeroplane multi engine	Test Ferry	4.8
Aeroplane multi engine	Towing	0.8
Aeroplane multi engine	Training	1.7
Aeroplane single engine	Agriculture	2.6
Aeroplane single engine	Ambulance	1.1
Aeroplane single engine	Business	1.2
Aeroplane single engine	Charter	1.6
Aeroplane single engine	Mustering	1.2
Aeroplane single engine	Other aerial work	1.2
Aeroplane single engine	Pipe Powerline	2.4
Aeroplane single engine	Private	2.0
Aeroplane single engine	Regional	1.6
Aeroplane single engine	Search Rescue	0.6
Aeroplane single engine	Survey Photography	0.7
Aeroplane single engine	Test Ferry	1.7
Aeroplane single engine	Towing	7.4
Aeroplane single engine	Training	2.1

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Aircraft type	Operation Type	Departures per hour
Helicopter multi engine	Ambulance	1.7
Helicopter multi engine	Business	4.4
Helicopter multi engine	Charter	1.6
Helicopter multi engine	Other aerial work	1.6
Helicopter multi engine	Private	3.4
Helicopter multi engine	Search Rescue	1.1
Helicopter multi engine	Survey Photography	1.0
Helicopter multi engine	Test Ferry	2.1
Helicopter multi engine	Training	1.8
Helicopter single engine	Agriculture	2.7
Helicopter single engine	Ambulance	1.9
Helicopter single engine	Business	1.7
Helicopter single engine	Charter	1.7
Helicopter single engine	Mustering	1.8
Helicopter single engine	Other aerial work	1.2
Helicopter single engine	Pipe Powerline	0.8
Helicopter single engine	Private	1.7
Helicopter single engine	Survey Photography	1.5
Helicopter single engine	Test Ferry	2.0
Helicopter single engine	Towing	7.0
Helicopter single engine	Training	2.3
Helicopter single engine	Search Rescue	1.0

Aviation Occurrence Statistics
2001 to 2010

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