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2008 to 2017



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Addendum

Page	Change	Date

Safety summary

The purpose of this report

Each year, thousands of safety occurrences involving Australian and foreign-registered aircraft are reported to the Australian Transport Safety Bureau (ATSB) by individuals and organisations in Australia's aviation industry and by members of the public.

This report is part of a series that aims to provide information to the aviation industry, manufacturers and policy makers, as well as to the travelling and general public, about these aviation safety occurrences. In particular, what can be learned to improve transport safety in the aviation sector.

The study uses information over the ten-year period from 2008-2017 to provide an insight into the current and possible future trends in aviation safety.

What the ATSB found

The majority of air transport operations in Australia each year proceed without incident.

In 2017, nearly 200 aircraft were involved in accidents in Australia, with 203 involved in a serious incident (an incident with a high probability of an accident). There were 40 fatalities in the aviation sector in 2017, which was a significant increase from the 21 fatalities in 2016. There were no fatalities in either high or low capacity regular public transport (RPT) operations, which has been the case since 1975 and 2010 respectively.

Almost half of all fatalities that occurred in commercial air transport operations during the study period occurred in 2017. During 2017, there were 14 fatalities from 21 accidents in commercial air transport operations, 21 fatalities from 93 accidents in general aviation operations, and five fatalities from 53 accidents in recreational aviation operations.

Terrain collisions were the most common accidents or serious incidents for aircraft involved in general aviation, recreational aviation and remotely piloted aircraft in 2017. Aircraft control, followed by terrain collisions, were the most common occurrence type associated with an accident or serious incident for aircraft involved in air transport operations.

Wildlife strikes, including birdstrikes, were again the most common type of incident involving both commercial air transport and general aviation operations. Runway events and aircraft control incidents were the most common types of incident reported for recreational aviation.

The accident and fatal accident rates for general and recreational aviation reflect their higher-risk operational activity when compared to commercial air transport operations. They also reflect the significant growth in recreational aviation activity over the last ten years and this sector's increased reporting culture.

General aviation accounts for one-third of the total hours flown by Australian-registered aircraft and over half of all aircraft movements across Australia.

The total accident rate, per hours flown, indicates general aviation operations are nine times more likely to have an accident than commercial air transport operations, with recreational operations around twice as likely to experience an accident than general aviation operations.

The fatal accident rate, per hours flown, indicates general aviation operations are around fifteen times more likely to experience a fatal accident than commercial air transport operations, and recreational operations are almost 30 times more likely to experience a fatal accident than commercial air transport operations.

Private/business helicopters followed closely by recreational gyrocopters had the highest fatal accident rate for any aircraft or operation type, whereas recreational aeroplanes had the highest

total accident rate. There were no fatal accidents involving general aviation balloons reported during the study period.

Aeroplanes remain the most common aircraft type flown, which is reflected in the proportion of accidents they are involved in. In 2017, 15 of the 22 fatal accidents involved aeroplanes—three gliders, two helicopters, and two weight shift aircraft were also involved in fatal accidents.

Since 2016, the increased availability and use of remotely piloted aircraft (RPA) saw them match helicopters as the second highest aircraft type for reported accidents. However, there were no collisions with other aircraft, fatalities or serious injuries relating to RPA reported to the ATSB. While the consequences of an accident involving an RPA have been low to date, their increased use, and possible interactions with traditional aviation, is an emerging trend in transport safety that will continue to be monitored closely by the ATSB.

Note: Previous editions of *Aviation Occurrence Statistics* reports contained an error regarding the number of occurrences and subsequently rates for balloons conducting general aviation operations and air transport - charter operations. This error was communicated to the ATSB by the Australian Ballooning Federation. A systemic error was identified and rectified within the reporting system. This report has a decrease in the number of occurrences, and rates, for balloons conducting private operations, and a corresponding increase for balloons conducting charter operations compared to previous editions.

Safety message

This report highlights the importance of effective and timely reporting of all aviation safety occurrences, not just for the potential of initiating an investigation, but also for further study and analysis of aviation transport safety.

While there has been an increase in accident and incident reporting, the limited detail provided for most occurrences, especially by recreational flyers, remains a challenge for the industry and ATSB. This report also highlights the need for improvements in the reporting rates for some areas in general aviation.

By comparing accident and occurrence data across aviation operation types, the ATSB is able to develop a complete picture of the aviation industry to identify emerging trends in aviation transport safety, identify further areas for research and recommend pre-emptive safety actions.

Contents

Context.....	4
Data sources and submissions.....	5
Sources of information	5
Activity data.....	6
Occurrences by operation type.....	9
Occurrence by aircraft type	13
Occurrence types: what happened	16
Appendices	19
Appendix A – Explanatory notes	19
Analysis methodology	19
Operation types	20
Occurrence types and events	21
Appendix B – ATSB occurrence type taxonomy	23
Australian Transport Safety Bureau	26
Purpose of safety investigations	26
Developing safety action	26
Glossary.....	27

Context

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

The types of occurrences that are required to be reported to the ATSB are detailed in the [Transport Safety Investigation Regulation 2003](#). Depending on the seriousness of the event (in terms of the potential to cause injury or damage) and the category of operation, these occurrences are categorised as either immediately reportable matters (IRMs) or routine reportable matters (RRMs). For the full list of IRMs and RRM, visit the [ATSB's website](#).¹

Aviation occurrence statistics are updated and published annually by the ATSB, and can be subject to change pending the provision of new information. When using these statistics, it is important to remember that responsible persons, as defined in Part 2.5 of the Regulations, provide occurrence data to the ATSB. The ATSB accepts no liability for any loss or damage suffered by any person or corporation resulting from the use of these statistics.

See *Appendix A – Explanatory notes* for definitions of aircraft operation types and a general explanation of the analysis approach. Definitions of occurrence categories appear in the *Glossary*.

NOTE 1:

Consistent with the 2017 edition, in this edition of *Aviation occurrence statistics*, *medical transport* operations are grouped with *commercial air transport* operations. Previous editions grouped *emergency medical services* under *general aviation – aerial work*. This change is consistent with the Civil Aviation Safety Authority's Notice of Proposed Rule Making (NPRM) 1304OS, July 2013. The NPRM outlined that medical transport flights will operate under the requirements of an air transport air operator's certificate (issued under CASR Part 119) and the applicable operational rule set (CASR Part 133 for helicopter operations and either Part 121 or 135 for aeroplane operations).

Consistent with the 2015, 2016 and 2017 editions, this edition also combines occurrences involving mustering activities classified within *private* operations with *aerial work – mustering*.

NOTE 2:

Although comparable with the previous edition of *Aviation Occurrence Statistics*, fewer incidents are reported in this edition than earlier (pre-2014) editions due to a change of ATSB policy. Events involving operational non-compliance with air traffic control verbal or published instructions, airspace infringement, and breakdowns of co-ordination between air navigation service providers, when they occur without any other occurrence event, have not been included as incidents in these statistics since the 2014 edition. See *Appendix A – Explanatory notes* for more detail.

¹ www.atsb.gov.au/about_atSB/legislation.aspx

Data sources and submissions

Sources of information

The sources of information used included:

- the ATSB occurrence database
- ATSB investigation reports
- aircraft and operator activity data from the Bureau of Infrastructure, Transport and Regional Economics (BITRE).

Activity data

The overall number of safety occurrences alone does not represent a complete picture of aviation safety. For meaningful comparisons to be made between different types of aircraft and the operations they perform, aviation occurrence statistics are often presented as a rate per million hours flown or per million departures.

The Bureau of Infrastructure, Transport and Regional Economics (BITRE) collects and compiles this activity data from reports submitted by airlines, and from other aircraft operators through its *General Aviation Activity Survey*.

Figure 1 displays activity data used to calculate rates in this report. The data is rounded to the nearest thousand hours (or thousand departures) to present the size or magnitude of the data in general terms. Specific activity data for movements of non-Australian (foreign) registered aircraft is limited, but tabulated where available.

Aviation activity is grouped into the following operational types:

- **Commercial air transport.** High capacity regular public transport (RPT) flights, low capacity RPT flights, charter flights and medical transport flights.
- **General aviation.** Aerial work operations (including aerial agriculture, aerial mustering, search and rescue, and aerial survey), flying training, private, business and sports (including gliding) aviation (VH or foreign-registered).
- **Recreational aviation.** Aircraft used for recreational flying registered by a recreational aviation administration organisation (RAAO).

In this study, there are two types of activity data used, aircraft **departures** and **hours flown**.

Aircraft departures are widely used as a measure of exposure, that is, the opportunity for an event to occur within a certain amount of flying activity. This report uses departure data for calculating accident and fatal accident rates for all commercial air transport operations and general aviation (as a whole). Where figures are available, departures are a more appropriate measure than hours flown as most accidents occur either during the approach and landing or departure phases of flight.

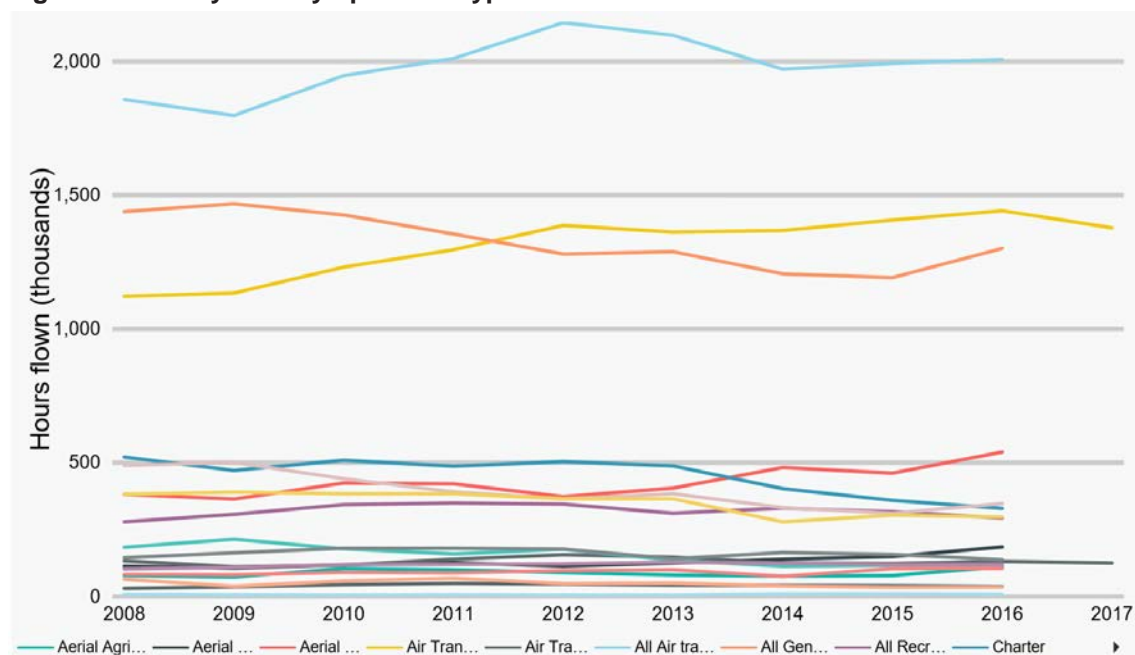
Departure data is not available for individual operation types within general aviation (GA) prior to 2016 and for any recreational aviation operational type. The combined totals also do not include medical transport (commercial air transport) or gliding (general aviation). At the time of publication, departures were only available to 2016 for most operation types, and to 2017 for some types of commercial air transport (high and low capacity RPT, charter and foreign RPT).

While departures are generally used as a measure of exposure for commercial air transport operations, flying hours are a more useful measure of exposure for general aviation because of the higher risk of an accident outside of approach and landing and take-off phases of flight. For

example, agricultural and search and rescue aircraft performing low flying as part of normal operations.

Figure 1 presents a selection of the data available in a web based [interactive tool](#) that displays the number of departures or hours flown for operation types with available data. Data can be filtered for different operation types and the display can be altered between a chart and table.

Figure 1: Activity data by operation type 2008 to 2017²



Data source: Bureau of Infrastructure, Transport and Regional Economics. [Link to interactive tool](#)

Activity for commercial air transport operations remained relatively constant over the last 10 years.

The majority of commercial air transport flight hours in Australia are operated by high capacity RPT. Its proportion of total air transport hours flown increased from 60 per cent to 72 per cent between 2008 and 2016. Further, high capacity RPT had increased to around 50 per cent of the total departures in commercial air transport by 2016.

Within commercial air transport, high capacity RPT³ activity steadily increased most years from 2008 to 2016, however departures and flight hours both decreased in 2017. Low capacity RPT activity remained relatively constant throughout the study period. Charter flight hours decreased significantly, especially in the three years⁴ leading up to 2016. The charter departures closely followed the flight hours apart from a small increase in 2016. Further, medical transport hours flown increased by approximately 30 per cent from 2008 to 2016.

General aviation departures remained relatively steady over the study period, however flight hours steadily decreased, indicating that the average flight time decreased.

² Activity data is not available for all years and operation types. Most operation types only have data encompassing 2008 to 2016.

³ Within this report, when high capacity RPT operations is referenced it also includes the small number of high capacity charter operation departures or hours.

⁴ In 2014, BITRE started a major reclassification of operation types in their General Aviation Activity Survey, including the specific collection of charter departures (which were previously estimated), and the specific collection of new operation types that previously would have been counted within charter. However, the current publication corrected for the latter change and used 2014 and 2015 charter departures that were the equivalent of what of their pre-2014 estimate.

Flying training hours fell by around 30 per cent from its peak in 2009 and private/business and sport activity also steadily reduced over the eight years until 2016. All aerial work increased significantly over the study period. Within aerial work, aerial mustering increased significantly. Aerial survey hours reduced by almost one half, possibly due to an increase in remotely piloted aircraft use.

Flying activity for Australian (non-VH) recreational aviation, across different types of RAAO, as reported by each RAAO to the BITRE, remained steady across the study period. This was consistent with the different aircraft types (gyrocopters, recreational aeroplanes and weight shift) within recreational aviation, which also remained steady.

Occurrences by operation type

Occurrence numbers and rates presented through the statistics in this section relate to the following operational types:

- **Commercial air transport.** High capacity regular public transport (RPT) flights, low capacity RPT flights, charter and medical transport flights.
- **General aviation.** Aerial work operations, flying training, and private, business and sports (including gliding) aviation (VH or foreign-registered).
- **Recreational aviation.** Aircraft used for recreational flying registered by a recreational aviation administration organisation (RAAO).
- **Remotely piloted aircraft operations.** All operations using remotely piloted aircraft (RPA) approved by the Civil Aviation Safety Authority.

Aircraft involved in these occurrences include both Australian civil registered aircraft (both VH aircraft, and aircraft registered by RAAOs) operating within or outside Australian territory,⁵ and foreign registered aircraft operating within Australian territory. For further information on how the statistics in this report were treated, and how these operational types are defined by the ATSB, see *Appendix A – Explanatory notes*.

Table 1 compares the number of fatal accidents and fatalities for commercial air transport, general aviation, recreational aviation, and each of their subtypes. Fatal accidents in some aircraft operations are more likely to have a greater number of associated fatalities than in other operation types. For example, aircraft used for agricultural operations usually have a single pilot on board and, as a result, the number of fatal accidents was the same as the number of fatalities over the last 10 years. In contrast, survey or photography aircraft generally have a pilot, in addition to a camera operator or navigator on board, resulting in more fatalities than fatal accidents, in the same period.

⁵ Australian territory refers to mainland Australia, the land areas of Tasmania and Australia's offshore territories. It also includes territorial waters, and coastal waters to the 12 NM limit.

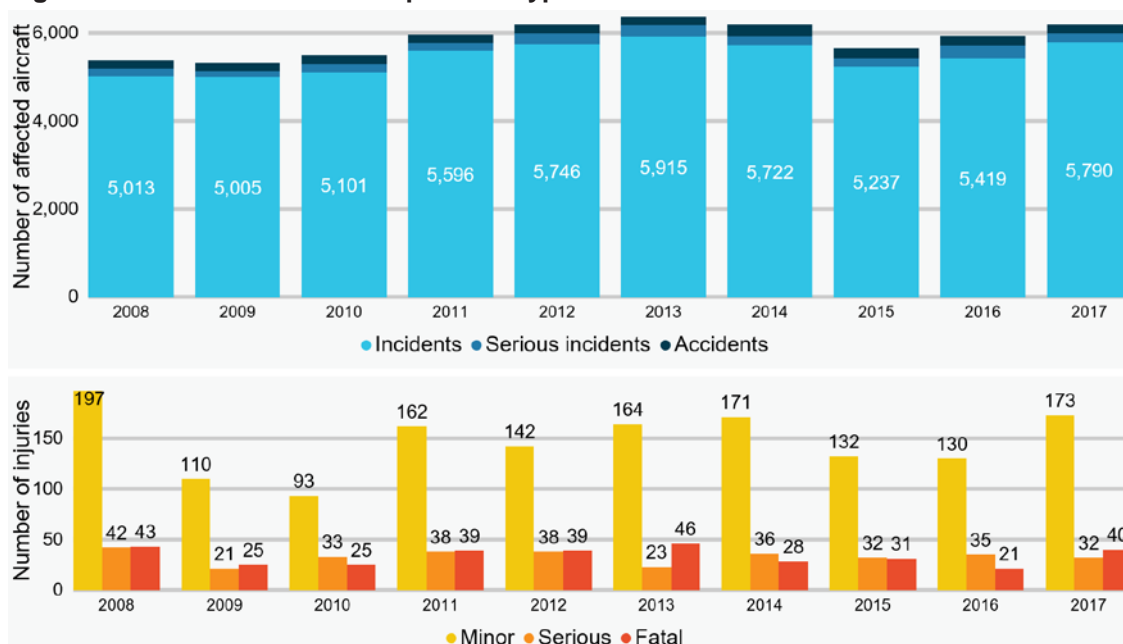
Table 1: Fatal accidents and fatalities by operation type (Australian-registered unless specified) 2008 to 2017⁶

Operation type	Number of aircraft associated with a fatality	Number of fatalities
Commercial air transport	15	30
High capacity RPT	0	0
Low capacity RPT	1	2
Charter	14	28
Medical transport	0	0
Foreign registered air transport	0	0
General aviation	142	206
Aerial work	47	54
<i>Agriculture</i>	19	19
<i>Aerial Mustering</i>	14	15
<i>Search & rescue</i>	2	2
<i>Fire control</i>	2	2
<i>Survey and photography</i>	5	8
<i>Other</i>	3	5
Flying training	11	17
Private/Business/Sport	83	134
<i>Private/Business</i>	68	116
<i>Sport aviation (excluding gliding)</i>	4	4
<i>Gliders⁷</i>	10	12
Foreign registered general aviation	1	1
Recreational aviation	83	100
Gyrocopters	11	13
Aeroplanes	41	50
Weight Shift	30	36
Remotely Piloted Aircraft	0	0
Total	241	337

Figure 2 presents a selection of the data available in a web based [interactive tool](#) that gives detailed information regarding the number of occurrences per operation type (including locations, number of injuries, aircraft types and occurrence summaries) displayed as charts, tables and an occurrence map. Also included are links to ATSB websites for investigated occurrences.

⁶ Totals (bold values) also contain occurrences where the operation subtype was unknown. Hence, totals can contain more aircraft or fatalities than the sum of the operation type and operation subtype values.

⁷ Includes two motorised gliders.

Figure 2: Occurrence data for operation types

Data sources: ATSB's aviation occurrence database. [Link to interactive tool](#)

There was a greater than average number of fatalities in 2017 compared to the previous nine years. Further, 2017 had almost double the number of fatalities as 2016 (which had the lowest number for any year recorded by the ATSB).

Two fatal accidents involving aircraft conducting charter operations, one at Essendon Fields Airport, Victoria ([AO-2017-024](#)) and one at Jerusalem Bay, New South Wales ([AO-2017-118](#)), accounted for 11 of the 40 fatalities in 2017.

The number of fatalities in general and recreational aviation during 2017 were consistent with the previous nine years.

Overall, the number of occurrences increased over the 10 years but there was a small decrease from the peak in 2013. Around 70 per cent of all reported incidents involved aircraft conducting commercial air transport operations (three quarters of which are high capacity RPT). Alternatively, general and recreational aviation made up 83 per cent of the more serious occurrences (accidents and serious incidents). This is explained in part by the different reporting requirements for these operation types.

Recreational aviation, medical transport, remotely piloted aircraft systems, aerial work, flying training, recreational aeroplanes, survey and photography, sports aviation, and search and rescue all showed an increase in the number of occurrences which were reported to the ATSB over the study period. Whereas, despite 2017 being the worst for fatalities, the number of occurrences involving aircraft in charter operations decreased from 2008 to 2017. The total number of general aviation occurrences also decreased.

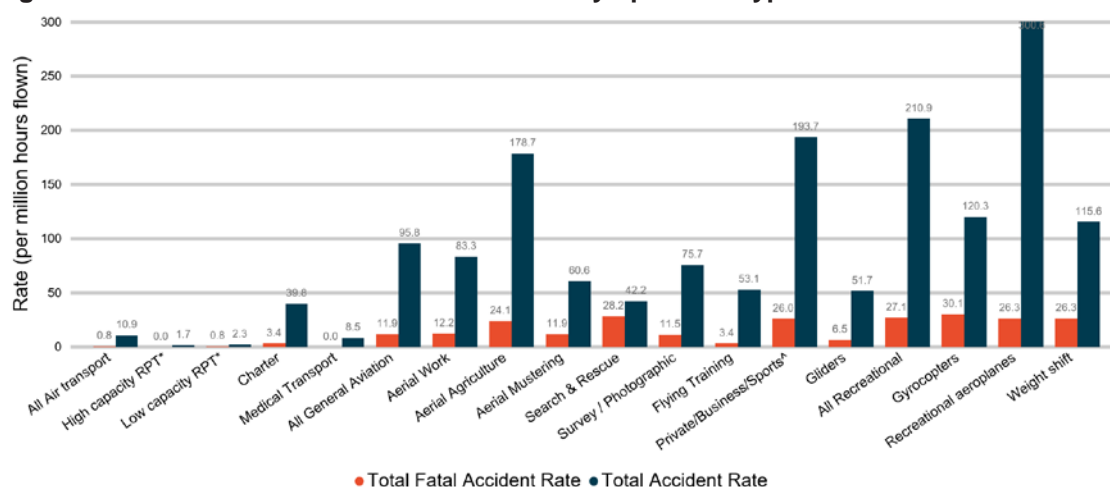
Figure 3 presents a selection of the data available in a web based [interactive tool](#) that shows the rate of accidents and fatal accidents for each of the specific operation types⁸ over this period per million hours flown. Generally, recreational aviation operation types had higher accident rates when compared to general aviation or commercial air transport operations. While Recreational

⁸ Activity data for each operation type was provided by BITRE, except for the following: fire control, other/unknown general aviation, foreign-registered general aviation. Except where indicated, accident and fatal accident rates are based on those accidents from 2008 to 2016 only, as 2017 activity data for all operation types was not available at the time of writing. Private/business/sport excludes gliding.

Aviation Australia (RAA)-registered aeroplanes had the highest accident rate, general aviation, aerial agriculture and private/business and sport flights had higher accident rates than recreational gyrocopters and weight shift aircraft.

Recreational aircraft, private/business and sport, search and rescue, and aerial agriculture operation types were among the most likely to result in a fatal accident when considering the amount of flying activity. Two of the three search and rescue accidents were fatal accidents. Gyrocopters had the greatest fatal accident rate per million hours flown. More information on accident and fatal accident rates (including per million departures) for selected operation types is provided in the interactive tool.

Figure 3: Rate of accident and fatal accidents by operation type 2008 to 2017⁸



*Only High capacity RPT and Low capacity RPT include 2017 data, other operation types end at 2016. *Excludes gliders

Data sources: Bureau of Infrastructure, Transport and Regional Economics and ATSB's aviation occurrence database. [Link to interactive tool](#)

The rates (per million hour flown) of accidents involving gliders and recreation aircraft significantly increased over the study period. No operation type had a statistically significant decrease in their accident rate.

Overall, general aviation had a significant decrease in the rate (per million departures or hours flown) of fatal accidents. This was probably driven by the decrease in the fatal accident rate of aerial work, which accounts for around one-third of all general aviation hours flown.

Occurrence by aircraft type

This section explores trends in occurrences by the type of aircraft involved, and the type of operation conducted. It looks primarily at the rate of accidents within each type of operation, in relation to the number of hours flown by the type of aircraft within that category. See *Appendix A* for definitions.

There are over 15,000 aircraft on the Australian civil aircraft (VH-) register.⁹ Of these, fixed-wing aircraft (aeroplanes and gliders) accounted for 83 per cent, rotary-wing aircraft (helicopters) for 14 per cent and the remaining 3 per cent were balloons, (including one airship). At the time of writing, the number of remotely piloted aircraft (RPA) in Australia is unknown. Australian-registered recreational aircraft are additional to these figures. There were over 5,000 aircraft registered with Recreational Aviation Australia (RAA) in late 2016 (around 4,400 aeroplanes and 940 weight shift aircraft). Gyrocopters are registered with the Australian Sport Rotorcraft Association (ASRA). Weight-shift aircraft are registered with both the Hang Gliding Federation of Australia (HGFA) and RAA.

As flying activity data is only available for some of these types of aircraft, accident rates are only provided for aeroplanes, helicopters, gliders and recreational aircraft types including recreational aeroplanes, gyrocopters, and weight-shift aircraft.

Figure 4 presents a selection of the data available in a web based [interactive tool](#) that displays the number of accidents, fatal accidents and injuries by aircraft type per operation group (air transport, general aviation, recreational aviation and remotely piloted aircraft).

There are considerably more accidents in Australia involving aeroplanes than other aircraft; around 70 per cent of all accidents over the study period.

Helicopters were involved in around one quarter of all general aviation accidents and fatal accidents in the 10-year period, even though they accounted for 14 per cent of the Australian VH-registered fleet and flew less hours than aeroplanes.

Recreational aircraft contributed to around one-third of the fatal accidents. Between 2008 and 2017, 31 per cent of all accidents and 34 per cent of all fatal accidents in Australian aviation involved recreational aircraft. They contribute to nine per cent of the recorded hours flown by aircraft in Australia between 2008 and 2016 (Figure 1). In the last four years of the study period, recreational aircraft were involved in around 45 per cent of all fatal accidents.

Since 2013, the number of accidents involving remotely piloted aircraft has significantly increased, from zero in 2012 to around 15 per cent of all accidents by 2016 and 2017. This is equivalent to the contribution from helicopters and is an increase from five per cent in 2015.

⁹ CASA registered aircraft numbers are until the end of 2016. These data were obtained from the CASA website: www.casa.gov.au/standard-page/data-files

Figure 4: Number of accidents involving Australian-registered aircraft, by aircraft type 2008 to 2017

Aircraft Type	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Aeroplanes										
Air transport	23	11	20	16	9	9	22	6	11	16
General Aviation	84	78	84	73	60	58	106	88	84	53
Recreational	36	34	40	44	50	59	76	52	43	38
Balloons										
Air transport	3	3	2	2	0	1	2	0	3	2
General Aviation	0	0	0	1	1	0	1	0	0	0
Glider										
General Aviation	4	3	3	12	12	8	10	6	9	10
Gyrocopters										
Recreational	2	4	6	4	6	7	5	4	6	7
Helicopters										
Air transport	5	2	3	5	4	5	3	1	2	3
General Aviation	36	33	36	25	27	24	28	35	25	28
Remotely Piloted Aircraft										
General Aviation	0	0	0	0	0	2	3	12	31	29
Weight Shift										
Recreational	3	4	10	13	31	15	17	18	12	8

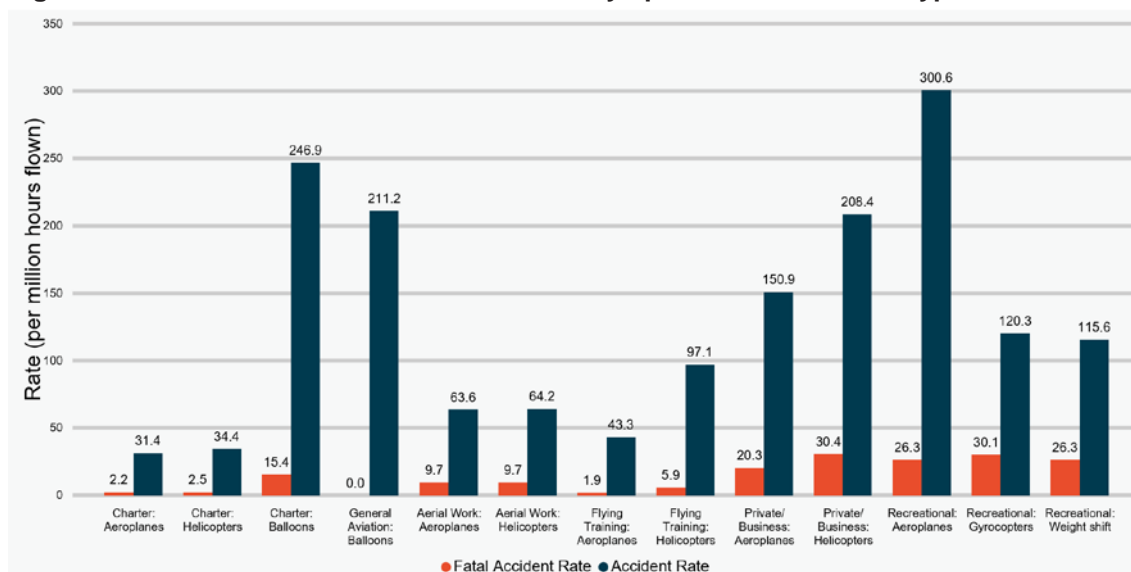
Data sources: ATSB's aviation occurrence database. [Link to interactive tool](#)

Note: Occasionally the detailed information regarding the operation subtype or operation type of an aircraft involved in an accident is unknown but the operation group is known. This may lead to small differences between operational and aircraft type data.

Figure 5 presents a selection of the data available in a web based [interactive tool](#) that displays the rate (per million hours flown) for aircraft types and selected operation types. The data is displayed as a chart or table, more yearly break downs can be viewed by clicking the 'Yearly Totals' button.

Note: Balloons operating within general aviation (including private/business/sports aviation, flying training operations and aerial work) were combined due to the low number of accidents (three reported in 10 years) and fatal accidents (zero reported), and the accuracy in the hours flown.

Figure 5: Rate of accidents and fatal accident by operation and aircraft type



Data sources: Bureau of Infrastructure, Transport and Regional Economics and ATSB's aviation occurrence database. [Link to interactive tool](#)

Considering flying activity, recreational aeroplanes had the highest accident rate. The accident rate involving helicopters is higher than for aeroplanes conducting the same operation type. The accident rate for recreational aeroplanes was higher than for aeroplanes in all operation types.

When comparing the accident rate of aircraft types¹⁰ by operation type, there is significant difference between air transport (charter), general aviation, and recreational aviation.

The fatal accident rate over the 2008 to 2016 period was highest for helicopters used for private/business operations followed by recreational gyrocopters.

There were no fatal accidents for general aviation balloons.

Where fatalities occurred, the rate was lowest for aeroplanes conducting flying training followed by aeroplanes and helicopters conducting charter operations.

Over the nine-year study period (2008 to 2016), the accident rate for recreational aeroplanes and weight shift aircraft increased significantly. No operation types, with available activity data, recorded a statistically significant decrease in their accident rate.

The fatal accident rate for helicopters conducting aerial work decreased significantly over the study period. No operation types, with available activity data, recorded a statistically significant increase in their fatal accident rate between 2008 and 2016.

¹⁰ Activity data was only available for aeroplanes, helicopters, balloons, gyrocopters, recreational aeroplanes, and weight-shift aircraft.

Occurrence types: what happened

Accidents and incidents are often the result of a complex set of circumstances, involving a chain, or sequence of events. The ATSB categorises each reported accident, serious incident and incident into one or more occurrence types to identify what happened, and how the sequence of events developed to lead to an accident or incident. Classifying occurrences in this way helps to understand what types of occurrences have taken place, and identify potential areas for safety improvement and communication.

Occurrence types do not explain why an accident or incident happened; they are generally a description of what occurred. This report does not examine the safety factors, such as individual actions, local conditions, risk controls, organisational influences, or technical failure mechanisms that explain what led to an occurrence. An analysis of safety factors is more valuable when considering a cluster of occurrences that have a similar occurrence type, such as in the ATSB's [Avoidable Accidents](#) series, or through detailed ATSB investigations of particular accidents or serious incidents.

There are broad occurrence type categories used by the ATSB to classify occurrences. These are:

- airspace-related
- infrastructure-related
- environment-related
- operational-related
- technical-related.

Consequential events that happen as the result of an occurrence, for example; forced and precautionary landings, emergency descents, rejected take-offs, evacuations and fuel dumps to reduce landing weight, are also recorded.

The five categories of occurrences are broken down further into different occurrence types, which are detailed in *Appendix B*. The ATSB records one or more occurrence types for all aircraft involved in each occurrence. Accidents and serious incidents generally have more occurrence types coded than incidents, as they are more likely to be investigated, and their severity usually means that there is a greater amount of information to draw upon for analysis and coding. In occurrences involving multiple aircraft, aircraft with the same operation type are recorded once, whereas aircraft with different operation types are recorded against the corresponding operation type.

The frequency of a particular occurrence type does not necessarily reflect its importance or safety risk. For example, fuel-related events may be relatively rare, when compared with fumes events, but fuel starvation is always a serious incident. Many fuel starvation events result in an attempt at an emergency landing, and potential aircraft damage and injury to people on board or outside the aircraft. In comparison, most fumes-related events are minor in nature, and do not affect the safety of flight, or result in any injuries.

Figure 6 presents a selection of the data available in a web based [interactive tool](#) that displays the number of occurrences (accidents, serious incidents and incidents) for each year over the study period. The data can be filtered for different operation groups (air transport, general aviation, recreational aviation and remotely piloted aircraft systems) and injury levels.

Figure 6: Number of occurrences in air transport operation, by occurrence type 2008 to 2017 (other operation groups¹¹ can also be viewed interactively)

Occurrence Types	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Airspace											
Aircraft separation	240	228	228	258	326	328	348	267	355	334	2,912
Airspace infringement	27	19	10	13	20	17	17	8	10	16	157
ANSP* Operational error	184	140	83	58	71	107	137	30	70	77	957
Breakdown of co-ordination	28	20	18	4	15	18	24	7	10	16	160
Encounter with RPA	0	0	0	0	0	1	9	14	60	109	193
Operational Non-compliance	131	86	114	105	123	132	135	88	126	182	1,222
Other	6	4	1	1	5	7	2	7	1	2	36
Consequential events											
All	745	721	681	765	887	859	832	812	779	740	7,821
Environment											
Interference with aircraft from ground	2	3	5	6	8	10	13	16	58	61	182
Weather	187	152	219	255	313	478	572	485	411	354	3,426
Wildlife	1,093	1,207	1,373	1,453	1,371	1,437	1,423	1,415	1,584	1,624	13,980
Infrastructure											
ATM	5	1	6	0	2	1	4	3	3	8	33
Nav aids	3	4	7	5	2	2	8	19	3	2	55
Other	11	8	6	4	7	11	5	6	5	5	68
Radar / Surveillance	3	3	6	3	9	3	0	1	2	1	31
Runway lighting	18	26	22	13	22	14	15	13	18	11	172
Operational											
Aircraft control	129	101	117	155	238	248	256	203	179	219	1,845
Aircraft loading	91	65	129	234	231	213	200	88	102	61	1,414
Communications	150	105	79	81	92	103	103	77	89	114	993
Crew and cabin safety	103	85	99	143	124	173	153	99	111	150	1,240
Flight preparation / Navigation	60	35	45	54	57	54	45	43	48	56	497
Fuel related	58	39	31	39	34	42	32	34	14	29	352
Fumes, Smoke, Fire	165	147	283	314	329	312	324	283	261	280	2,698
Ground operations	71	55	50	86	77	67	68	48	67	63	652
Ground proximity alerts / warnings	37	23	20	38	71	173	222	250	194	278	1,306
Miscellaneous	337	305	279	282	398	274	282	208	43	123	2,531
Runway events	69	48	57	77	77	74	82	60	79	76	699
Terrain Collisions	34	26	24	22	16	20	15	12	20	20	209
Technical											
Airframe	259	231	266	328	283	276	245	221	191	229	2,529
Powerplant / propulsion	246	241	219	273	301	233	206	167	202	192	2,280
Systems	382	320	441	494	531	510	516	531	534	450	4,709

Data sources: ATSB's aviation occurrence database. [Link to interactive tool](#)

The most common occurrence type associated with an accident or fatal accident for all operation groups was terrain collision followed by aircraft control occurrences.

The most common higher-level occurrence type reported (for accidents, serious incidents and incidents) was 'operational' for general aviation (33%), recreational aviation (51%) and remotely piloted aircraft (63%). Whereas for commercial air transport, operational occurrences made up around one-quarter of occurrences and environmental-related occurrences (32%) were the most commonly reported.

The number of airspace-related occurrences for aircraft conducting commercial air transport operations increased significantly over the study period. This was driven primarily by the increase in the number of RPA encounters. In addition, for commercial air transport the number of weather, wildlife, ground proximity alerts/warnings, and interference with aircraft from ground (usually laser strikes) also increased. Fuel-related occurrences and terrain collisions decreased.

For general aviation, the number of reported RPA encounters, interference with aircraft from ground, aircraft control and technical systems all increased over the 10 years. While communication related occurrences, airspace infringements, operational non-compliance, flight preparation/navigation, fumes, smoke and fire occurrence, and runway events all decreased.

Within recreational aviation, the number of airspace related occurrences increased significantly. This was driven primarily by the increase in aircraft separation and operational non-compliance occurrences, and to a lesser extent the number of encounters with an RPA. Further, wildlife occurrence, aircraft control, communications related, flight preparation/navigation, runway events,

¹¹ General Aviation, Recreational Aviation and Remotely Piloted Aircraft Systems

airframe, and technical system occurrences all increased. There were no occurrence types involving a recreational aircraft that had a statistically significant decreased over the study period.

For remotely piloted aircraft, the number of occurrences reported associated with wildlife, aircraft control, terrain collision, powerplant/propulsion, and technical systems all increased. There were no statistically significant decreases. This is not surprising for an emerging aviation industry.

Appendices

Appendix A – Explanatory notes

Occurrence data represent a picture of aviation derived from information available at the time these statistics were prepared.

This appendix explains what data was included or excluded to produce these statistics, how operation types are defined, and other important points to consider when interpreting these statistics.

Analysis methodology

Inclusions

Specifically, occurrence data includes:

- the number of aircraft involved in incidents, serious incidents, serious injury accidents, fatal accidents and total accidents
- the number of serious injuries and fatalities
- 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.

Important points to consider

A number of procedures are used in different sections of this report to distinguish occurrences from aircraft and injuries.

- An occurrence may involve one or more aircraft.
- Where occurrence data is presented by operation type or occurrence type (as in the occurrences by operation type and occurrence types: what happened sections of this report), tabulated figures refer to the number of aircraft involved in occurrences. Occurrences involving more than one aircraft are recorded once for each aircraft involved.
- *Occurrence types: what happened* sections of this report, tabulated figures refer to the number of aircraft involved in occurrences. Occurrences involving more than one aircraft are recorded once for each aircraft involved except where the aircraft are of the same operation type where they are recorded once.
- Aircraft involved in fatal accidents are counted based on what happens to the aircraft occupants. This means that each aircraft with an on-board fatality is counted separately as being involved in a fatal accident within the operation type of the aircraft. If two aircraft collide in mid-air and fatalities occur on-board both aircraft, two aircraft involved in fatal accidents are counted. Using the same example, if two aircraft collide in mid-air and a fatality occurs on one aircraft only, one aircraft is recorded as being involved in a fatal accident, but in total, two aircraft are recorded as being involved in accidents.
- 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

Class G¹² 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.
- The number of serious injuries are derived from both fatal accidents that involve some serious injuries, and from serious injury accidents (serious injury accidents represent occurrences where serious injury is the highest injury recorded.)
- It is important not confuse serious injury accidents and serious incidents. A serious incident is an incident where an accident nearly occurred. In contrast, a serious injury accident involves an occurrence resulting in the highest injury 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 commercial air transport, all general aviation and all recreational aviation 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.

Operation types

This report provides data pertaining to a number of operational types, which are utilised across a wide range of ATSB statistical and research reports.

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) and charter* - regular public transport operations¹³ and charter operations 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 having a maximum payload capability that exceeds 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 having a maximum payload capability of 4,200 kg or below.
- *Charter* - operations involving the carriage of passengers and/or cargo on non-scheduled flights by the aircraft operator, or by the operator's employees, for trade or commerce (excluding RPT operations). In this report, charter operations (for both occurrences and departures/hours flown) mostly refer to charter operations in low capacity aircraft.¹⁴
- *Medical transport* - operations involving flights facilitating emergency medical assistance in and/or transport by carrying ill or injured persons as medical passengers, other persons directly involved with the medical passenger, and/or medical personnel.

General aviation is considered to be all flying activities that do not involve scheduled (RPT) and non-scheduled (charter) passenger and freight operations. It may involve Australian civil (VH-) registered aircraft, or aircraft registered outside of Australia. General aviation includes:

- Aerial work. This includes flying for the purposes of agriculture (spraying and spreading), mustering, search and rescue, fire control, or survey and photography
- Flying training

¹² Class G airspace is all airspace not promulgated as Class A, C, D, or E.

¹³ RPT operations are conducted in accordance with fixed schedules to and from fixed terminals over specific routes.

¹⁴ In the ATSB online aviation occurrence database, closed charter operations are generally coded as 'low capacity' operation type with 'charter' as an operation sub-type. Other charter occurrences in low capacity aircraft is coded as an operation type of 'charter'.

- Private, business and sports aviation. Sports aviation includes gliding, parachute operations, ballooning, warbird operations, and aerobatics.

In these statistics, general aviation does not include operations involving Australian non-VH registered aircraft (such as military aircraft, or aircraft registered by recreational aviation administration organisations (RAAOs)).

Recreational aviation refers to all flying conducted for pleasure involving aircraft registered in Australia by RAAOs. These organisations have been authorised by the Civil Aviation Safety Authority (CASA) to maintain registers of aircraft and conduct administration of recreational flying. Recreational aviation aircraft include those registered with:

- Australian Sports Rotorcraft Association (ASRA) (gyrocopters with a G– registration)
- Hang Gliding Federation of Australia (HGFA) (weight shift aircraft, such as hang gliders, paragliders, powered parachutes, weight shift trikes and microlights with a T1– or T2– registration)
- Recreational Aviation Australia (RAA) (registrations in the 10-, 19-, 24-, 25-, 28-, 32-, and 55-series). These encompass a wide range of aircraft types, sizes, and performance levels, and may include fixed-wing aeroplanes or sport aircraft, amateur-built or experimental aircraft, weight-shift microlights, powered gliders and powered parachutes.

Remotely piloted aircraft (RPA) refer to occurrences involving unmanned fixed-wing, rotary-wing or lighter-than-air craft that are controlled by a ground-based operator conducting commercial, government or research activities and not flown for sport or recreation.

Reports of safety incidents involving military aircraft that have been reported to the ATSB are excluded from these statistics, unless the military aircraft has affected the safety of a civil aircraft.

Aircraft types

- Aeroplanes refer to all manned, VH- registered powered fixed-wing aircraft, and to recreational powered aeroplanes registered by RAA.
- Balloons refer to all manned, VH- registered hot air balloons and lighter-than-air craft, including dirigibles.
- Helicopters refer to all manned, VH- registered rotary-wing aircraft
- Gliders refer to all manned, VH- registered non-powered fixed-wing aircraft, and manned, VH- registered powered gliders.
- Gyrocopters refer to rotary-wing aircraft registered with ASRA, marked with a G- registration
- Remotely piloted aircraft refers to unmanned fixed-wing, rotary-wing, and lighter-than-air craft that are controlled by a ground-based operator.
- Weight shift refers to manned aircraft controlled by human movement. They include hang gliders, paragliders, powered parachutes, and weight-shift trikes. These aircraft may be registered with HGFA, marked with a T1- or T2- registration, or with RAA marked with a 32- registration.

Occurrence types and events

Not all notifications reported to the ATSB are classified as incidents, serious incidents or accidents. Those deemed not to be a transport safety matter are classified as ‘events’. Events are not included in this report.

Notifications of the following occurrence type events *when they occur without any other occurrence type event* are coded as events:

- consequential events (diversion/return, fuel dump/burn off, missed approach/go-around)
- operational non-compliance with air traffic control verbal or published instruction

- airspace infringement
- breakdown of co-ordination between air navigation service providers (ANSP).

Note that previous (pre-2014) editions of *Aviation occurrence statistics* did include operational non-compliance, airspace infringement and breakdown of co-ordination as incidents.

In addition, infrastructure related events (air traffic management, navigation aids, radar/surveillance, runway lighting) are coded as events when no aircraft was affected.

Appendix B – ATSB occurrence type taxonomy

Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
Airspace	Aircraft separation	Airborne collision alert system warning
		Collision
		Loss of separation
		Loss of separation assurance
		Near collision
		Issues
	Airspace infringement	
	ANSP operational error	Information / procedural error
		Failure to pass traffic
		Other
	Encounter with RPA	Collision with RPA
		Near encounter with RPA
		Sighting
	Breakdown of co-ordination	
	Operational non-compliance	
	Other	
Consequential events	Ditching Diversion / return Emergency evacuation Emergency / precautionary descent Forced / precautionary landing Fuel dump / burn off Missed approach / go-around Rejected take-off Other	
Environment	Interference with aircraft from ground	
	Weather	Icing
		Lightning strike
		Turbulence / windshear / microburst
		Unforecast weather
		Other
	Wildlife	Animal strike
		Birdstrike
		Other
	Other	
Infrastructure	ATM Nav aids Radar / surveillance Runway lighting Other	
Operational	Aircraft control	Airframe overspeed
		Control issues
		Hard landing

Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
		Incorrect configuration
		In-flight break-up
		Loss of control
		Stall warnings
		Unstable approach
		Wheels up landing
		Other
	Aircraft loading	Dangerous goods
		Loading related
		Other
	Communications	Air-ground-air
		Call sign confusion
		Transponder related
		Other
	Crew and cabin safety	Inter-crew communications
		Cabin injuries
		Cabin preparations
		Depressurisation
		Flight crew incapacitation
		Passenger related
		Unrestrained occupants / objects
		Other
	Fire, fumes and smoke	Fire
		Fumes
		Smoke
	Flight preparation / navigation	Aircraft preparation
		Flight below minimum altitude
		Lost / unsure of position
		VFR into IMC
		Other
	Fuel related	Contamination
		Exhaustion
		Leaking or venting
		Low fuel
		Starvation
		Other
	Ground operations	Foreign object damage / debris
		Ground handling
		Jet blast / prop / rotor wash
		Taxiing collision / near collision
		Other
	Ground proximity alerts / warnings	
	Miscellaneous	Missing aircraft
		Security related
		Warning devices

Occurrence Type Level 1	Occurrence Type Level 2	Occurrence Type Level 3
	Runway events	Other Depart / approach / land wrong runway Runway excursion Runway incursion Runway undershoot
	Terrain collisions	Other Collision with terrain Controlled flight into terrain Ground strike Wire strike
Technical	Airframe	Doors / exits Furnishings and fittings Fuselage / wings / empennage Landing gear / indication Objects falling from aircraft Windows Other
	Power plant/propulsion	Abnormal engine indications Auxiliary power unit Engine failure or malfunction Propeller / rotor malfunction Transmission and gearboxes
	Systems	Other Air/pressurisation Anti-ice protection Avionics / flight instruments Datalink (RPA) Electrical Fire protection Flight controls Fuel Hydraulic Other

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB 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 operations involving the travelling public.

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.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Glossary

Occurrence - an accident, incident or serious incident.

Accident - an occurrence involving an aircraft where:

- a person dies or suffers serious injury
- the aircraft is destroyed, or is seriously damaged
- any property is destroyed or seriously damaged (Transport Safety Investigation Act 2003).

Incident - an occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operation (International Civil Aviation Organisation Annex 13).

Serious incident - an incident involving circumstances indicating that an accident nearly occurred (International Civil Aviation Organisation Annex 13).

Serious injury - an injury that requires, or would usually require, admission to hospital within seven days after the day when the injury was suffered (Transport Safety Investigation Regulations 2003).

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