

NEW ZEALAND FIXED WING AVIATION ACCIDENTS

**A review of all reported New Zealand registered
aeroplane accidents from 1995 to 2004**

(Prepared by Anthony Wackrow: 2005)

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This study used the Australian Transport Safety Bureau's (ATSB) Paper B2004/0010 (General Aviation Fatal Accidents: How do they happen?) as a template. The author acknowledges the ATSB's paper B2004/0010 as an important guide for grouping and preparation of this data.

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EXECUTIVE SUMMARY

This report aims to identify what caused New Zealand fixed wing aviation accidents over the ten year period from 1995 to 2004. The report did not identify any causes that were common to all fixed wing accidents. However, several trends and factors have been identified.

For the purposes of this report fixed wing aircraft means a “power-driven heavier-than-air aircraft deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight”. The sample does not include microlight aircraft, amateur built aircraft, gliders or any sports category aircraft.

There were 461 fixed wing accidents (80 involving fatalities and/or serious injuries) involving New Zealand registered aircraft between 1995 and 2004. These accidents resulted in 123 fatalities. The data indicated a very low chance of any person escaping an aircraft accident involving fatalities.

Since the year 2001 there has been a downward trend in the rate of fixed wing accidents. However, the fatal fixed wing accident rate has shown a strong upward trend since 2002.

Private flights recorded the highest number of accidents and the highest rate of accidents. Agricultural aviation accidents also scored high numbers, but a lower rate. Transport passenger accidents were among the highest count of accidents, but scored the lowest rate of any operational group. Solo and dual training operations have close actual numbers of accidents, yet their rates (one of the lowest compared with other groups) differ significantly, with the solo training accident rate nearly double that of dual training operations.

The average age of accident aircraft was 26 years. Single engine aircraft recorded a higher rate of accidents than multi engine aircraft but had a similar fatal accident rate. Single crew pilots were 42 times more likely to have an accident than multi crew pilots and 13 times more likely to have a fatal accident.

Saturday was the most frequent day for fixed wing accidents while Friday was most common for fatal accidents. Midday to mid afternoon was the most common time for accidents, with most fatal accidents occurring between 1400 and 1500 local time. No clear explanation can be given for these results, although end of week fatigue and increased private flying during weekends may have played a part.

The data showed that the risk of a pilot being involved in an accident increased with age, with the highest risk occurring in the 55 to 64 age bracket. Those pilots who gained their licence at an older age were more likely to be involved in an accident than those who gained their licence at a younger age. The longer the pilot had held their licence the less chance they had of having an accident (the most common licence

held by accident pilots was a Commercial Pilots Licence [CPL]). This agrees with the findings of a study conducted by the National Transportation Safety Board (NTSB)¹.

Pilots who had between 200 and 2000 flight hours were more likely to have an accident than other pilots. The data showed that time on type of aircraft was a good safety indicator with greater time equating to less risk of an accident. The greater the 90 day currency of the pilot the less risk they had of being involved in an accident. The data indicated that total flight time was not a good indicator of safety risk.

Pilot gender did not seem to play a significant part in reducing the risk of an accident, although slightly less female pilots were involved in fatal accidents than were represented in the whole pilot population.

Nearly half of all fixed wing accidents occurred during the landing stage of flight. However, there were no fatalities and few serious injuries as the result of these accidents. The majority of fatal accidents occurred during the cruise and after takeoff.

The majority of accidents involved aircraft operating to Visual Flight Rules (VFR). There was a slight increase in Instrument Flight Rules (IFR) fatal accidents when compared to the percentage of IFR accidents for the total population.

The most common type of fatal or serious injury fixed wing accident was Uncontrolled Flight into Terrain (UFIT) followed by Controlled Flight into Terrain (CFIT) and Managed Flight into Terrain (MFIT) accidents (see Appendix A for definitions).

UFIT accidents happened for a variety of reasons but it is worth noting that inappropriate control inputs featured strongly as a contributing cause in most of these accidents. It is also worth noting that a high number of these accidents involved stalls (resulting in spins) while the aircraft was turning. Icing was a common cause for loss of control by IFR aircraft.

Agricultural operations featured strongly among the CFIT low level accidents with a majority hitting trees or hills. This is consistent with New Zealand terrain. Most of the CFIT accidents during 'normal' operations involved VFR aircraft with limited or zero external visibility. All the IFR CFIT accidents occurred during instrument approaches.

The MFIT accidents resulted in more serious injuries than fatalities. Most of the fatalities for MFIT accidents were the result of ditching. All these fatalities resulted from drowning rather than impact forces. All those who drowned were not wearing lifejackets.

All the MFIT accidents were initiated by engine failure or lack of performance. Only one accident was the direct result of mechanical failure that was beyond the control of the pilot. A large percentage of these accidents involved fuel starvation or exhaustion. Overloading also featured as a common cause.

¹ Safety Study: Risk Factors Associated with Weather-Related General Aviation Accidents. NTSB Report number SS-05-01.

It was determined that air transport passenger accidents were linked to inappropriate decisions rather than control inputs, while private accidents were a combination of inappropriate control inputs and decisions.

The study concludes that many factors can put a fixed wing pilot at risk. Flight skills and decision making are vital in preventing accidents. The study suggests that IFR multi crew passenger transport flights are among the safest flights from a risk factor perspective, while VFR single pilot private operations are among the highest risk groups.

The highest risk pilots are those who have only held their licence for 1 to 2 years and gained that licence after their 50th birthday. Those pilots with the lowest risk are those who have held their licence for more than 8 years and gained that licence before their 35th birthday. These pilots also have substantial time on the type of aircraft they are flying and logged 40 hours (or more) flight time every 90 days.

Competency and currency were identified as key safety indicators. The data showed that training flights produce relatively few accidents compared to other types of operations. The data also showed that pilots with very low total time were less at risk than those with moderate amounts of flight time (200 to 2000 hours). Pilots with low 90 day currency were also at risk. This would suggest that pilots (particularly Private pilots) who are no longer under the supervision of an instructor and fail to maintain their skill base place themselves at risk.

Pilots who blatantly disregard the rules (regardless of experience and age) present the greatest risk for having a fatal accident.

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1 INTRODUCTION

Accidents have been a part of aviation since well before the Wright Brothers' first flight. These accidents fascinate as well as horrify the public. They also kill and injure people.

The mission of the New Zealand CAA is to take action that ensures people and property are not harmed or threatened by New Zealand civil aviation operations. In order to help carry out its mission the New Zealand CAA keeps a record of each accident involving a New Zealand registered aircraft and aircraft involved in New Zealand aviation. This information is stored on the CAA's database along with other details and is used to identify trends to prevent further accidents occurring.

Without a clear understanding of the causes associated with New Zealand aviation accidents it is difficult to develop effective safety initiatives that will help reduce the number of aviation accidents.

If the causal factor chains are identified and understood by the aviation community it will allow for more preventive safety measures rather than reactionary responses.

This study contains valuable data relating to fixed wing accidents, and if used correctly could reduce risk factors and increase the effectiveness of the regulator's role by increasing safety.

2 RESEARCH OUTLINE

2.1 Objectives

The aim of this research is to examine fixed wing aviation accident data from the beginning of 1995 to the end of 2004 to identify any common active or latent failures (See Appendix B for definitions).

Fixed wing aircraft means a “power-driven heavier-than-air aircraft deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight”. The sample does not include microlight aircraft, amateur built aircraft, gliders or sports category aircraft.

Fixed wing aircraft were chosen as the study sample because these aircraft represent the majority of New Zealand registered aircraft as well as a broad base of pilot skill and experience levels and a diverse range of flight operations and environments.

All fixed wing accidents will be included for the first half of the study in order to provide the numbers necessary to give a meaningful sample size.

2.2 Methodology

The study is based on New Zealand fixed wing aviation accidents from 1995 to 2004. The CAA’s database will serve as the main source of data for this study. The data collected by the CAA has been gathered using CAA occurrence forms, personal interviews, and investigations. For the most part this data will be examined using a quantitative methodology and statistical analyses.

2.3 Design

This is a *causal* study looking at what caused New Zealand fixed wing aviation accidents between 1995 and 2004. Using a quantitative methodology the study examines variables ranging from the type of aircraft involved and operational groupings, through to pilot demographics and environmental factors.

The study is structured so that the first half looks at the variables such as pilot experience, aircraft type, time of day and day of week, fatalities and numbers of survivors, age of pilot, gender of pilot, years the licence had been held and flight currency. The first half of the study includes all fixed wing accidents.

The second half of the study groups fixed wing fatal and serious injury accidents into different causational groups and then compare finding types for those accidents. The classification scheme used to group the fatal and serious injury accidents was developed by the Australian Transport Safety Bureau (ATSB) (Appendix A).

3 FIXED WING AVIATION ACCIDENT DATA

3.1 General data

There were 461 fixed wing aviation accidents between 1995 and 2004 involving at least one New Zealand registered aircraft. The total number of aviation accidents (including fixed wing aircraft) for the same time period was 947. From the 461 fixed wing accidents, 55 resulted in fatalities totalling 123 persons.

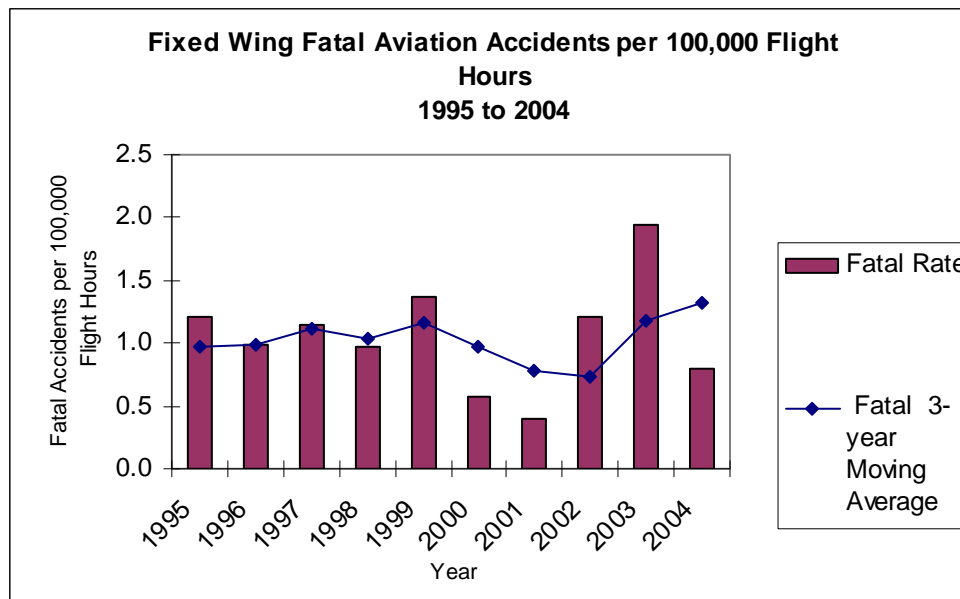
Table 1 below shows the number of fixed wing and fatal fixed wing aviation accidents, their rates (defined as the number of accidents per 100,000 flight hours) and the three-year moving average for both. Figures 1 and 2 depict the rates and associated three-year moving average for each group.

Table 1:

New Zealand Fixed Wing Aviation Accidents 1995-2004										
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Non Fatal Accidents	49	50	39	38	33	58	52	32	31	25
Fatal Accidents	7	5	5	5	7	3	2	6	10	4
Fatal Rate (acc/100,000 flight hr)	1.2	1.0	1.0	1.0	1.4	0.6	0.4	1.2	1.9	0.8
Total Rate (acc/100,000 flight hr)	9.7	10.9	8.5	8.4	7.8	11.8	10.9	7.7	7.9	5.7
Fatal 3-year Moving average (rate)	1.0	1.0	1.1	1.0	1.1	1.0	0.8	0.7	1.2	1.3
Total 3-year Moving average (rate)	11.9	11.3	9.7	9.3	8.2	9.3	10.2	10.1	8.8	7.1

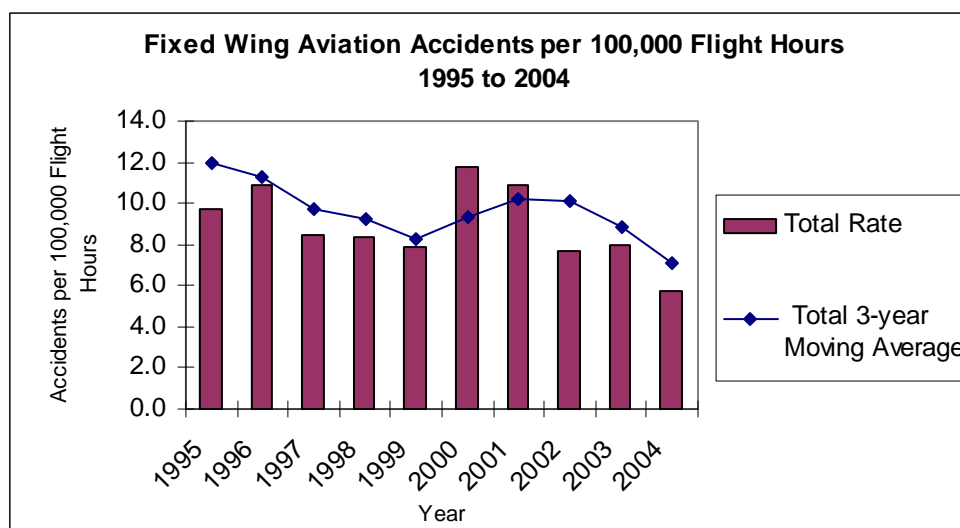
Source: NZ CAA Database

Figure 1:



Source: NZ CAA Database

Figure 2:



Source: NZ CAA Database

The annual accident rate for fatal fixed wing accidents varied from a high in 2003 of 1.9 fatal accidents per 100,000 flight hours to a low of 0.4 in 2001. The average rate for fatal fixed wing accidents for the ten year study period was 1.1 accidents per 100,000 flight hours. The three year moving average for fatal accidents was almost constant from 1995 to 2000 before taking a slight dip to a low of 0.7 in 2002 and then rising sharply to finish at 1.3 in 2004.

The annual accident rate for fixed wing accidents varied from a high of 11.8 accidents per 100,000 flight hours in 2000 to a low in 2004 of 5.7 accidents per 100,000 flight hours. The average rate for fixed wing accidents during the ten year period was 8.9 accidents per 100,000 flight hours. The three year moving average for total fixed wing accidents fell from a high of 11.9 in 1995 to 8.2 in 1999, before rising again to a high of 10.2 in 2001 and then falling to 7.1 in 2004.

The average number of fixed wing aviation accidents per year during the ten year study period was 40.6, while the average fatal number was 5.5 accidents per year.

Not all the fixed wing accidents took place within New Zealand airspace. A total of eight fixed wing accidents involving New Zealand registered aircraft occurred in foreign airspace. Two overseas accidents resulted in fatalities. One accident involved the death of a motor bike rider who collided with a Cresco aircraft that was commencing its takeoff roll for agricultural operations in Malaysia. The other fatal overseas accident was the result of a ditching of a 750XL in the Pacific Ocean between Hawaii and the west coast of the USA.

One other offshore accident involved two seriously injured crew members (flight attendants) as the result of turbulence while operating in Australia.

Two fixed wing accidents involved a collision between two aircraft. Both accidents occurred while the aircraft were taxiing. One involved two Boeing 747s at Los Angeles, while the other involved a Tomahawk and another unidentified aircraft at Ardmore. There were no mid air collisions of fixed wing aircraft between 1995 and 2004.

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3.2 Aircraft demographics

3.2.1 Aircraft categories

Table 2 shows the numbers and rates per 100,000 flight hours for total fixed wing aviation accidents and fatal fixed wing accidents by the category of aircraft involved. (Total flight hours have been estimated using CAA statistical returns. A ratio of those returns received against those sent out was used to achieve the total figures used in this report).

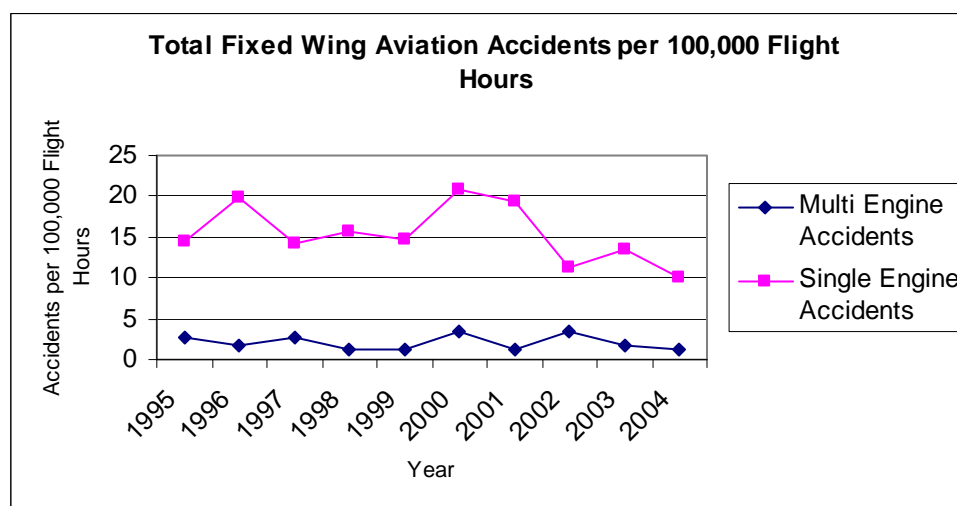
Table 2:

New Zealand Fixed Wing Aviation Accidents and rates per 100,000 Flight Hours by Aircraft Category: From 1995 to 2004											
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Totals
Multi Engine Accidents											
Non Fatal	4	4	5	2	3	9	3	7	2	1	40
Fatal	2	0	2	1	0	0	0	1	2	2	10
Total Rate	2.6	1.6	2.7	1.2	1.2	3.3	1.3	3.5	1.6	1.2	2.0
Fatal Rate	0.9	0.0	0.8	0.4	0.0	0.0	0.0	0.4	0.8	0.8	0.4
Single Engine Accidents											
Non Fatal	45	47	33	36	30	48	49	25	29	24	366
Fatal	5	4	4	4	7	4	2	5	8	2	45
Total Rate	14.4	20.0	14.3	15.6	14.7	20.9	19.4	11.2	13.5	10.0	15.4
Fatal Rate	1.4	1.6	1.5	1.6	2.8	1.6	0.8	1.9	2.9	0.8	1.7

Source: NZ CAA Database

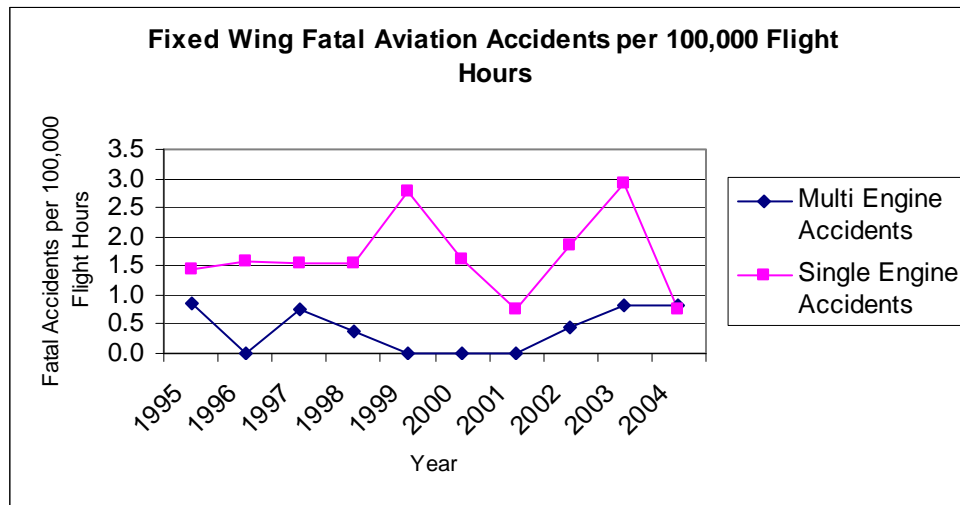
Figures 3 and 4 depict total, as well as fatal, rates of fixed wing accidents per 100,000 flight hours by the different categories.

Figure 3:



Source: NZ CAA Database

Figure 4:



Source: NZ CAA Database

There were 10 multi engine aircraft involved in fatal accidents from 1995 to 2004. These resulted in 39 fatal injuries (an average of 4.5 deaths per accident). For the same time period there were 45 fatal single engine accidents. These resulted in 84 fatal injuries (an average of 1.9 deaths per accident).

The number of multi engine accidents per 100,000 flight hours varied from a high of 3.5 in 2002 to a low of 1.2 in 1998, 1999 and again in 2004. The fatal rate for multi engine aircraft varied during the same time period from a high of 0.9 in 1995 to a low of 0.0 in 1996, 1999, 2000 and 2001.

The number of single engine accidents per 100,000 flight hours varied from 20.9 in 2000 to 10.0 in 2004. The fatal rate for single engine aircraft during the same period varied from a high of 2.9 in 2003 to a low of 0.8 in 2001 and 2004.

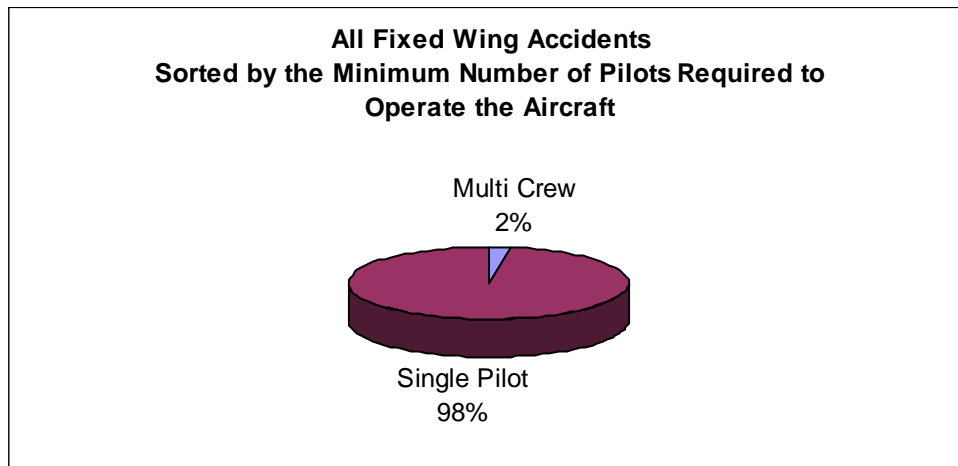


Four people died after this multi engine Dash-8 crashed into terrain near Palmerston North in 1995

3.2.2 Pilot numbers required by accident aircraft

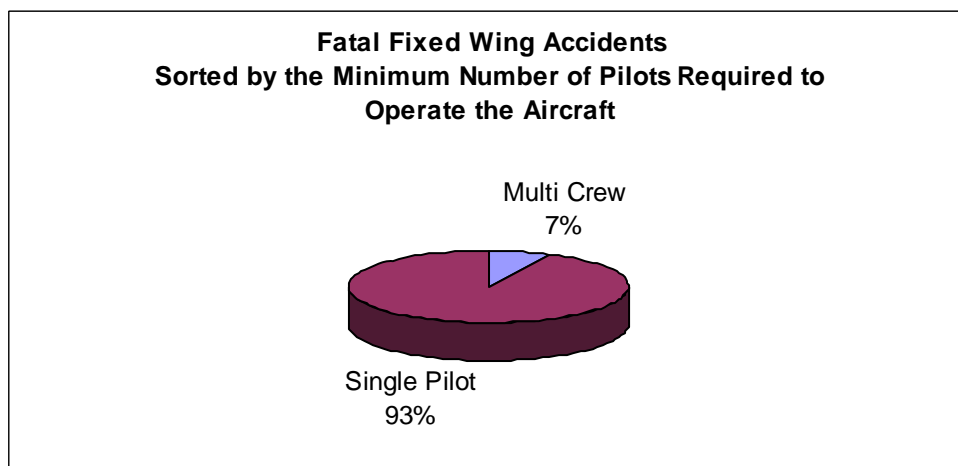
Figures 5 and 6 below show the type of aircraft involved in fatal, as well as all, fixed wing accidents over the ten year study period. The aircraft have been grouped by the numbers of pilots needed to operate them as stipulated by the flight manual and operating procedures (some single pilot accident aircraft had two licensed pilots on board at the time of the accident – there was no evidence to suggest these flights were operating as a multi crew or had been trained to do so and therefore were grouped with the single crew aircraft).

Figure 5:



Source: NZ CAA Database

Figure 6:



Source: NZ CAA Database

For both fatal and total fixed wing accidents, multi crew aircraft make up only a small percentage of accidents. However, it is interesting to note that multi crew aircraft make up a larger percentage of fatal accidents than for the whole fixed wing population.

Table 3 below shows fixed wing accidents per 100,000 flight hours sorted by the minimum number of pilots required to operate the aircraft.

The results of table 3 indicate that a single crew pilot is 42 times more likely to have an accident than a multi crew pilot, and 13 times more likely to have a fatal accident.

Although multi crew aircraft are far less likely to have a fatal accident than a single pilot aircraft, the number of fatalities from a multi crew accident are likely to be greater due to the larger aircraft involved and the nature of the operations.

There are many possible reasons why there are fewer multi crew aircraft accidents per 100,000 flight hours than single crew aircraft accidents. Crew experience levels, available organisational resources, type of operations, operating rules, crew work loads, and flight environment are just some of the factors that must be considered when comparing multi and single crew aircraft.

Multi crew aircraft usually require more capital investment than single crew aircraft. Companies that operate multi crew aircraft usually have more funds to invest in training and safety initiatives than single crew operators. They also seek to employ more experienced crews, leaving the less experienced pilots for single crew operators to employ. Almost all multi crew aircraft are operated on IFR flight plans. The work load for pilots operating as a multi crew can also be less than that of a pilot operating solo.

It is outside the scope of this report to investigate all these contributing factors. However, it is believed that the above mentioned factors contribute towards multi crew aircraft having fewer accidents than single crew aircraft.

Table 3:

Fixed Wing Accidents/100,000 flight hours 1995-2004					
Sorted by minimum number of pilots required to operate the aircraft					
	Total Accidents	Fatal Accidents	Estimated Flight Hours 95-04	Accidents/100,000 flight hours	Fatal Accidents/100,000 flight hours
Multi Crew	11	4	2590010	0.42	0.15
Single Crew	450	51	2565022	17.54	1.99
Totals	461	55	5155032		

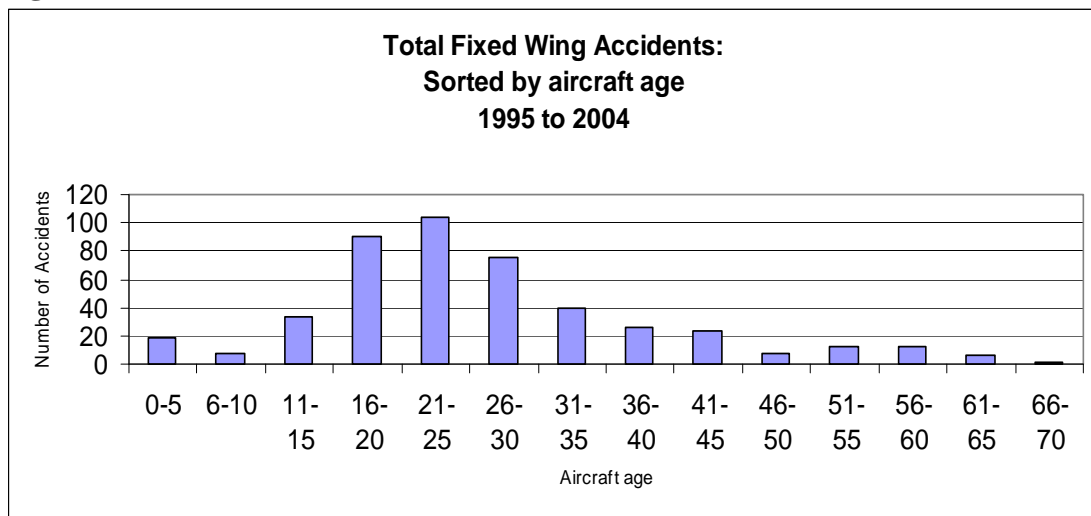
Source: NZ CAA Database

3.2.3 Aircraft age

The average age for New Zealand registered fixed wing accident aircraft was 26 years with a standard deviation of 12.7. The range of aircraft ages was 0 to 70 years. The average age for fatal and serious injury accident aircraft was also 26 years with a standard deviation of 12.4. The range of aircraft ages for fatal and serious injury accidents was 0 to 61 years.

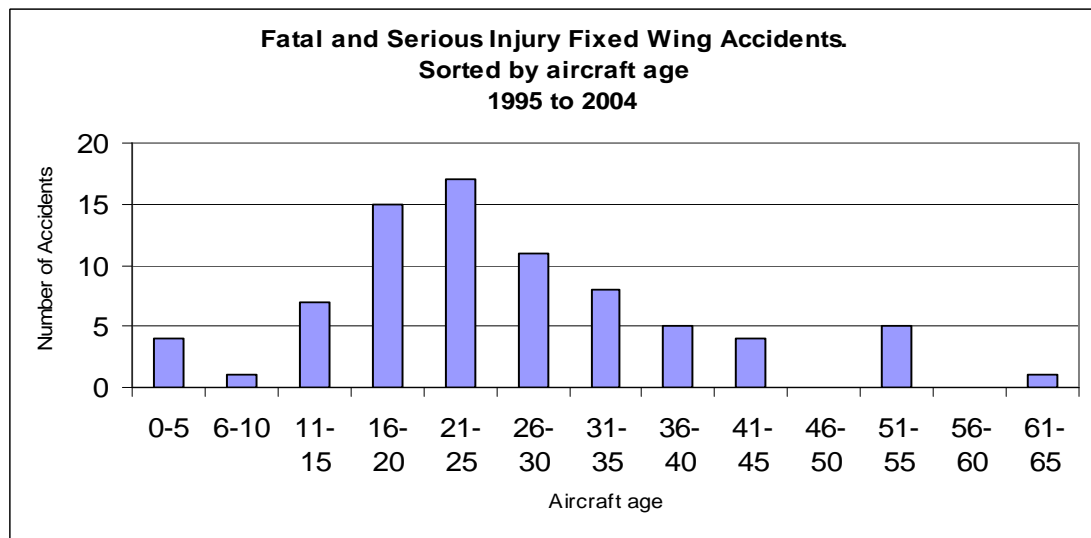
Figures 7 and 8 below show the distribution of accident aircraft by age. The majority of fixed wing aircraft were between 16 and 30 years old (this holds true for both groupings).

Figure 7



Source: NZ CAA Database

Figure 8

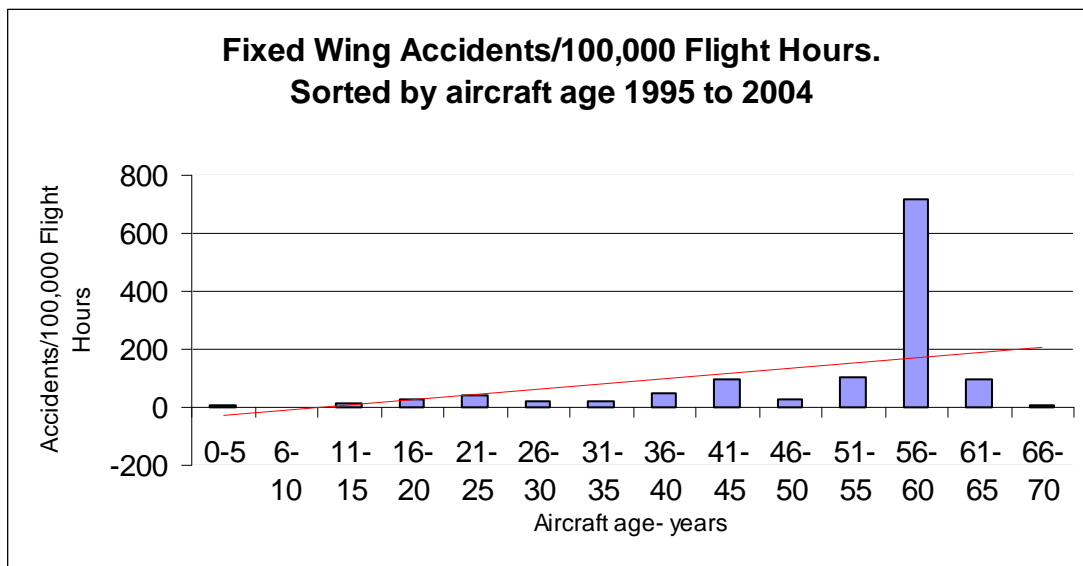


Source: NZ CAA Database

Figure 9 below shows total fixed wing accidents sorted by the aircraft age and normalised against recorded flight hours between 1995 and 2004. The graph shows an increasing risk of having an accident as the age of the aircraft increases. Other variables such as the age of the pilots flying older aircraft and cause factors were not examined.

However, mechanical failures only formed a very small percentage of fixed wing accident causes between 1995 and 2004.

Figure 9

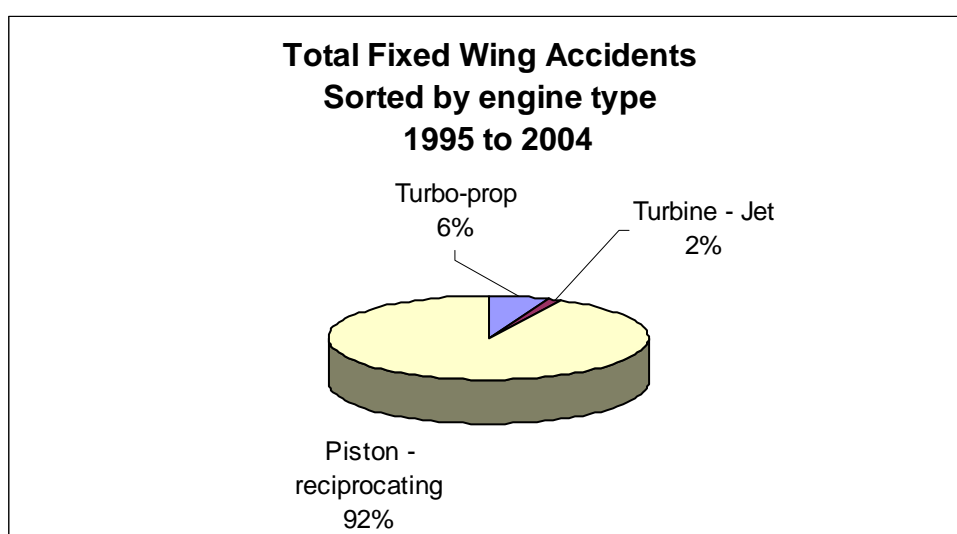


Source: NZ CAA Database

3.2.4 Aircraft engine type

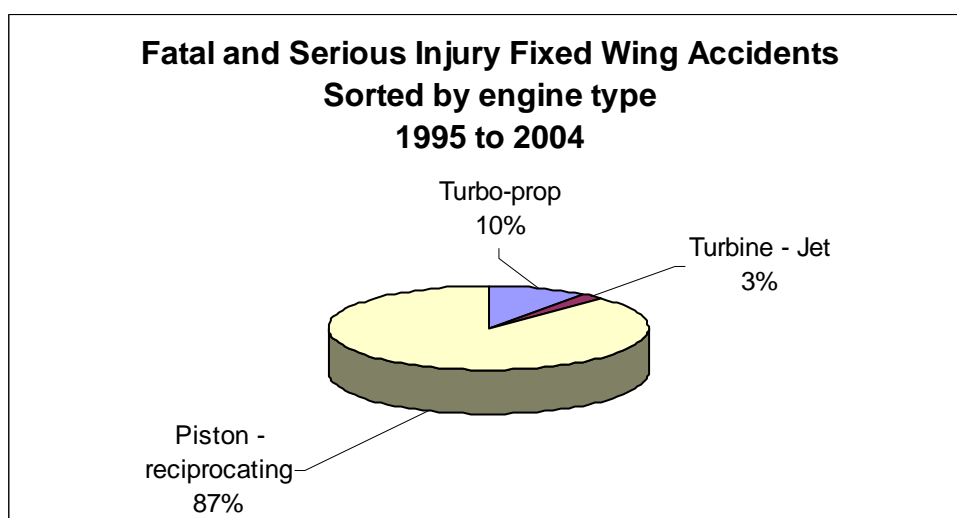
Figures 10 and 11 below show total and injury accidents sorted by the type of engine the accident aircraft had. In both groups the majority of aircraft had piston reciprocating engines. There were slightly higher percentages of fatal and serious injury accidents involving turbo prop and jet turbine powered aircraft than for the total fixed wing group. The breakdown for all New Zealand registered fixed wing aircraft was: Turbo prop 9%, Jet Turbine 4%, and Piston reciprocating 87%. The representation of turbo props and jet turbine aircraft for total accidents was slightly lower than all registered aircraft. The percentage split for fatal and serious injury accidents was almost identical to that for all registered aircraft.

Figure 10:



Source: NZ CAA Database

Figure 11:



Source: NZ CAA Database

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3.3 Type of operation

3.3.1 Total accidents sorted by type of operation

Tables 4 to 7 below show fixed wing accidents by the type of operation they were conducting at the time of the accident.

Table 4:

New Zealand Fixed Wing Aviation Accidents by Operational Groups. 1995 to 2004											
Operational Groups	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	95-04
AGRICULTURAL	11	11	7	6	7	13	17	12	12	3	99
FERRY/POSITIONING		1		1	1	1	1	1	2		8
FREIGHT ONLY			2				2	1	1	2	8
OTHER AERIAL WORK *	2	4		1	2	2	8	2	2	1	24
PRIVATE OTHER	22	21	21	22	22	26	18	13	14	16	195
TRAINING DUAL	2	2	3	5	1	5	3	4	3	3	31
TRAINING SOLO	9	4	4	5	2	5	4		4	3	40
TRANSPORT PASSENGER	10	12	7	3	5	9	1	5	3	1	56
Totals	56	55	44	43	40	61	54	38	41	29	461
* Other Aerial Work Breakdown											
<i>Advertising</i>							1				1
<i>Aerial Application/dropping</i>	1	2					1	1			5
<i>Parachuting</i>		1		1	1	2	2				7
<i>Experimentation</i>									1		1
<i>Flight Test</i>					1		1				2
<i>Air Ambulance</i>								1			1
<i>Other</i>	1	1					2			1	5
<i>Towing</i>							1		1		2
Totals	2	4	0	1	2	2	8	2	2	1	24

Source: NZ CAA Database

Table 4 above shows the total number of fixed wing aviation accidents by type of operation. The category of “Other Aerial Work” has been broken down at the bottom of the table into sub-categories.

Of the eight operational groups, Private operations had the most accidents with a total of 195 between 1995 and 2004 (an average of 19.5 accidents per year) which accounted for 42% of fixed wing accidents. Although the private operations group scored the highest number of accidents it has had a downward trend over the last four years.

The next highest group was Agricultural operations with a total of 99 for the ten year period (an average of 10 accidents per year).

When the “Other Aerial Work” category was broken down, Parachuting operations scored the highest number of accidents between 1995 and 2004 (an average of 0.7 accidents per year).

It is also worth noting that solo training operations had higher numbers than dual operations. The raw numbers of solo training accidents were 1.3 times higher than that of dual operations.

3.3.2 Fatal accidents sorted by type of operation

Table 5:

New Zealand Fatal Fixed Wing Accidents by Operational Groups. 1995 to 2004											
Operational Groups	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	95-04
AGRICULTURAL	2	1	2		1		2	2	2	1	13
FERRY/POSITIONING									1		1
FREIGHT ONLY			2						1	1	4
OTHER AERIAL WORK		1							1		2
PRIVATE OTHER	2	1	2	2	5	3		3	2		20
TRAINING DUAL									1	1	2
TRAINING SOLO	1								1		2
TRANSPORT PASSENGER	2	1		3	1	1		1	1	1	11
Totals	7	4	6	5	7	4	2	6	10	4	55

Source: NZ CAA Database

Table 5 above shows fatal fixed wing accidents by operational groups. Once again the private group generated the most accidents with a total of 20 between 1995 and 2004 (an average of 2 fatal accidents per year). Agricultural operations were the next highest with 13 fatal accidents over the ten year period and then transport passenger operations were third with 11 fatal accidents resulting in 48 deaths (an average of 4.4 deaths per accident).

3.3.3 Accident rates sorted by type of operation

Table 6:

Total Fixed Wing Accident Rates Per 100,000 Flight Hours. By Operational Group 1995 to 2004											
Operational Groups	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average
AGRICULTURAL	18.1	22.4	13.3	12.5	13.4	23.3	28.3	19.4	21.7	5.4	17.8
FERRY/POSITIONING	0.0	11.4	0.0	13.1	11.7	13.0	13.6	12.5	21.4	0.0	9.7
FREIGHT ONLY	0.0	0.0	10.5	0.0	0.0	0.0	10.6	5.6	5.5	12.7	4.5
OTHER AERIAL WORK	25.9	21.9	0.0	4.8	11.2	12.3	48.7	12.2	10.3	4.6	15.2
PRIVATE OTHER	107.9	58.2	48.9	43.5	42.1	53.3	39.9	25.7	29.6	33.9	48.3
TRAINING DUAL	2.1	2.4	3.6	6.1	1.4	7.1	3.6	4.7	3.2	3.5	3.8
TRAINING SOLO	13.1	7.6	7.7	10.0	4.5	10.1	7.7	0.0	7.3	5.3	7.3

TRANSPORT PASSENGER	3.5	5.6	3.2	1.4	2.2	3.8	0.5	2.6	1.4	0.5	2.5
Average	21.3	16.2	10.9	11.4	10.8	15.4	19.1	10.3	12.6	8.2	13.6

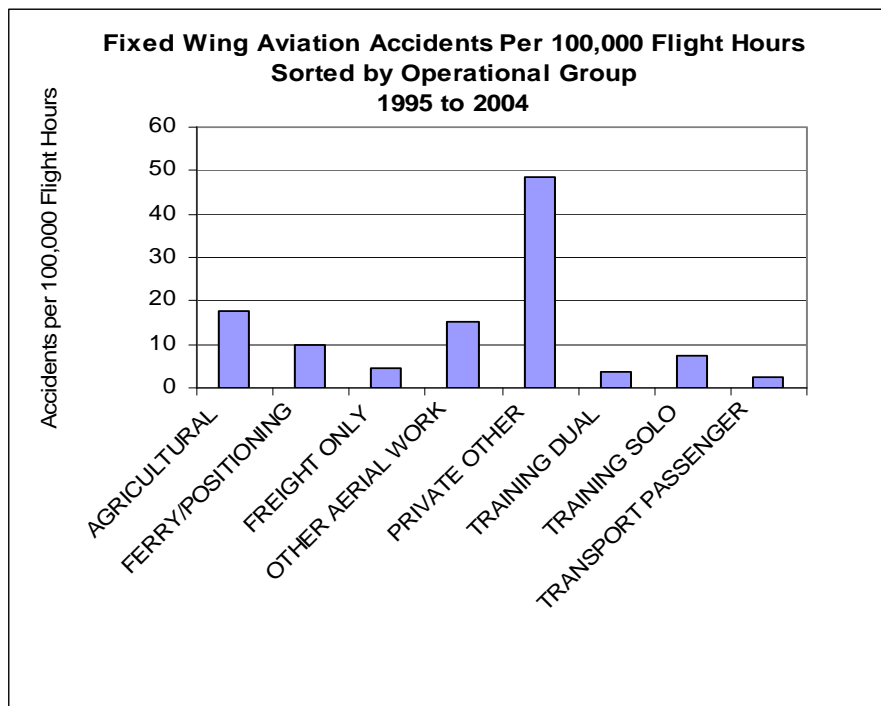
Source: NZ CAA Database

Table 6 (previous page) and Figure 12 show the total fixed wing accident rates per 100,000 flight hours by operational groups. The data shows that even when the different operational groups were normalised against the number of flight hours for that group, private operations resulted in the highest number of accidents per 100,000 flight hours (Average rate of 48.3 – almost three times the average rate of the next category).

Note:

Transport Passenger operations scored the third highest number of accidents over the ten years, but had the lowest average rate over the same time period. Solo and dual training operations had similar actual numbers of accidents, yet their rates differed significantly, with solo accident rates nearly double those of dual training operations.

Figure 12:



Source: NZ CAA Database

Table 7 and Figure 13 (next page) show the fatal rates per 100,000 flight hours for fixed wing aviation accidents involving New Zealand registered aircraft between 1995 and 2004, sorted by operational group. Private operations resulted in the highest average rate of fatal accidents at 4.7 per 100,000 flight hours. Agricultural operations were the second highest, with a rate that was less than half of that for private operations (2.3 fatal accidents per 100,000 flight hours). Freight operations had an average rate of 2.2 fatal accidents per 100,000 flight hours. The total number of freight accidents between 1995 and 2004 was 8, with 4 of those resulting in 6 fatalities.

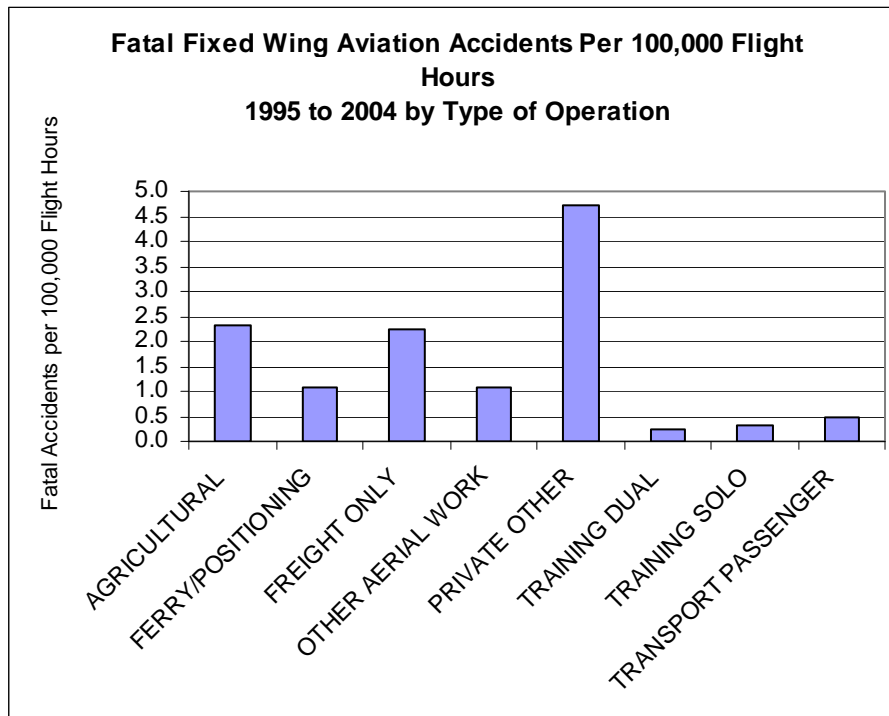
The lowest rate per 100,000 flight hours for fatal accidents was achieved by training flights. Transport passenger accidents had one of the highest counts of fatal accidents, but one of the lowest rates when normalised against flight hours.

Table 7:

Fatal Fixed Wing Accident Rates Per 100,000 Flight Hours: By Operational Group 1995 to 2004											
Operational Groups	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Average
AGRICULTURAL	3.3	2.0	3.8	0.0	1.9	0.0	3.3	3.2	3.6	1.8	2.3
FERRY/POSITIONING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	0.0	1.1
FREIGHT ONLY	0.0	0.0	10.5	0.0	0.0	0.0	0.0	0.0	5.5	6.3	2.2
OTHER AERIAL WORK	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.0	1.1
PRIVATE OTHER	9.8	2.8	4.7	4.0	9.6	6.2	0.0	5.9	4.2	0.0	4.7
TRAINING DUAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.2	0.2
TRAINING SOLO	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.3
TRANSPORT PASSENGER	0.7	0.5	0.0	1.4	0.4	0.4	0.0	0.5	0.5	0.5	0.5
Average	1.9	1.3	2.4	0.7	1.5	0.8	0.4	1.2	4.1	1.2	1.6

Source: NZ CAA Database

Figure 13:



Source: NZ CAA Database

3.4 Injuries



This Convair freight aircraft impacted with the sea off the coast of Paraparaumu in late 2003. Both crew members were killed.

3.4.1 Fatal injuries

The 55 fatal fixed wing aviation accidents between 1995 and 2004 resulted in 123 fatalities. Table 8 and Figure 14 show the number of fatalities per year for crew members, passengers and persons on the ground.

Table 8:

Fixed Wing Aviation Fatalities											
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	95-04
Crew Fatalities	8	3	5	5	7	4	2	6	11	4	55
Passenger Fatalities	10	5	6	8	11	8	0	8	9	2	67
Persons on Ground	0	0	1	0	0	0	0	0	0	0	1
Total Fatalities	18	8	11	13	18	12	2	14	20	6	123

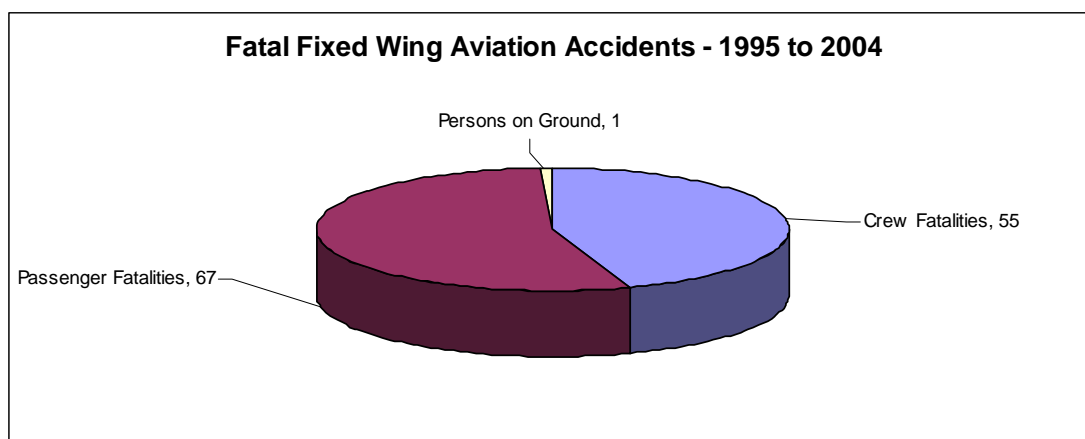
Source: NZ CAA Database

The highest number of fatalities (20) occurred in 2003 and the lowest number (2) occurred in 2001. The average number of fatalities for the ten year period was 12.3 per year.

The one death of a person on the ground in 1997 involved a motor cyclist who rode out in front of the Cresco aircraft on take off. The propeller struck the motor cyclist who died as a result of the injuries. The accident took place in Malaysia.

There were slightly higher numbers of passenger deaths (67) when compared with crew fatalities (55).

Figure 14:



Source: NZ CAA Database

Table 9 below shows the total number of fatalities for all aircraft classifications involving New Zealand registered aircraft between 1995 and 2004.

Table 9:

Total fatalities by Aircraft Classification: 1995-2004		
Aircraft Classification	Fatalities	% of Total Fatalities
Fixed Wing Aeroplanes	123	56%
Amateur Built Aeroplanes	13	6%
Balloons	3	1%
Gliders	7	3%
Helicopters	56	25%
Microlights	18	8%
Total Fatalities	220	100%

Source: NZ CAA Database

There were 220 deaths from 114 fatal accidents (55 fixed wing fatal accidents) for all aircraft classifications between 1995 and 2004. Fixed wing aircraft fatalities represented 56% of the total fatalities, while helicopter fatal accidents contributed 25% of all fatalities. The aircraft classification with the lowest number of fatalities was balloons. The 3 balloon fatalities were the result of a single accident where the balloon was swept out to sea near Christchurch. There were 9 people on board the balloon.

Table 10 shows the frequency of fatal injuries in fixed wing fatal accidents. Seventy percent of fatal fixed wing accidents resulted in either one or two fatalities. The highest number of fatalities in a single accident was eight.

Table 10:

Fixed Wing Fatalities - by number of fatal injuries per fatal accident			
Number of fatalities per fatal accident	Number of fatal accidents	% of all fatal accidents	Fatalities
1	27	49.1%	27
2	12	21.8%	24
3	7	12.7%	21
4	1	1.8%	4
5	3	5.5%	15
6	4	7.3%	24
7	0	0.0%	0
8	1	1.8%	8
Total	55	100%	123

Source: NZ CAA Database

3.4.2 Fatal injuries by aircraft category

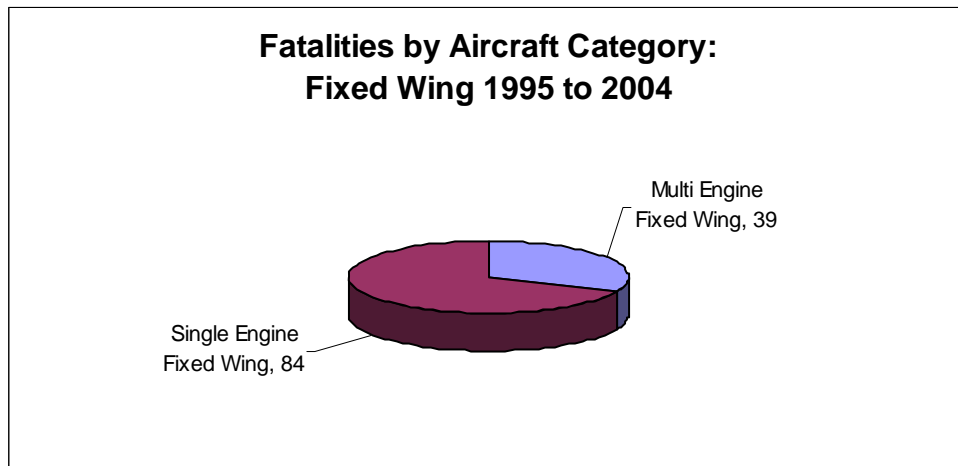
Table 11:

Fixed Wing Fatalities by Aircraft Category 1995-2004											
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	95-04
Multi Engine Fixed Wing											
Crew fatalities	3	0	2	1	0	0	0	1	3	3	13
Passenger fatalities	7	0	5	4	0	0	0	2	7	1	26
Total multi engine fatalities	10	0	7	5	0	0	0	3	10	4	39
Single Engine Fixed Wing											
Crew fatalities	5	3	3	4	7	4	2	5	8	1	42
Passenger fatalities	3	5	1	4	11	8	0	6	2	1	41
Persons on Ground	0	0	1	0	0	0	0	0	0	0	1
Total single engine fatalities	8	8	5	8	18	12	2	11	10	2	84
Total Fatalities	18	8	12	13	18	12	2	14	20	6	123

Source: NZ CAA Database

Table 11 above and Figure 15 (next page) show the number of fatalities sorted by aircraft category. There were 10 fatal multi engine fixed wing accidents resulting in 39 fatalities (13 crew members and 26 passengers). During the same time period there were 45 fatal single engine fixed wing accidents resulting in 84 fatalities (42 crew members, 41 passengers and 1 third party fatality).

Figure 15:



Source: NZ CAA Database



This Chieftain multi engine aircraft hit trees while on an instrument approach to Christchurch International Airport killing eight people and seriously injuring two (2003).

3.4.3 Fatal injuries by type of operation

Table 12:

Fixed Wing Fatalities by Type of Operation: 1995-2004											
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	95-04
AGRICULTURAL (total)	2	1	2	0	1	0	2	2	3	1	14
<i>Crew fatalities</i>	2	1	1		1		2	2	2	1	12
<i>Passenger fatalities/ persons on Ground</i>			1						1		2
FERRY/POSITIONING (total)	0	0	0	0	0	0	0	0	1	0	1
<i>Crew fatalities</i>									1		1
<i>Passenger fatalities</i>											0
FREIGHT ONLY (total)	0	0	2	0	0	0	0	0	2	2	6
<i>Crew fatalities</i>			2						2	1	5
<i>Passenger fatalities</i>										1	1
OTHER AERIAL WORK (total)	0	1	0	0	0	0	0	0	1	0	2
<i>Crew fatalities</i>		1							1		2
<i>Passenger fatalities</i>											0
PRIVATE OTHER (total)	5	1	8	2	12	10	0	6	3	0	47
<i>Crew fatalities</i>	2	1	2	2	5	3		3	2		20

<i>Passenger fatalities</i>	3		6		7	7		3	1		27
TRAINING DUAL (total)	0	0	0	0	0	0	0	0	1	2	3
<i>Instructor fatalities</i>									1	1	2
<i>Student fatalities</i>										1	1
TRAINING SOLO (total)	1	0	0	0	0	0	0	0	1	0	2
<i>Crew fatalities</i>	1								1		2
<i>Passenger fatalities</i>											0
TRANSPORT PASSENGER (total)	10	5	0	11	5	2	0	6	8	1	48
<i>Crew fatalities</i>	3			3	1	1		1	1		10
<i>Passenger fatalities</i>	7	5		8	4	1		5	7	1	38

Source: NZ CAA Database

Table 12 above shows fatalities by type of operation. When examining this data it must be kept in mind that the number of fatalities per operational grouping is a function of the activity level and relative risk of that group. For example, an agricultural operation will have fewer people on board than other types such as transport passenger operations, but will have greater associated risks such as planned low flying.

The highest number of fatalities by operational group was the transport passenger group, followed closely by private operators. When looking at the split between crew and passenger fatalities, the transport category has nearly four times as many passenger deaths compared with crew deaths, whereas, private operator accidents have approximately a 50/50 split. This is to be expected given the different nature of each operation.

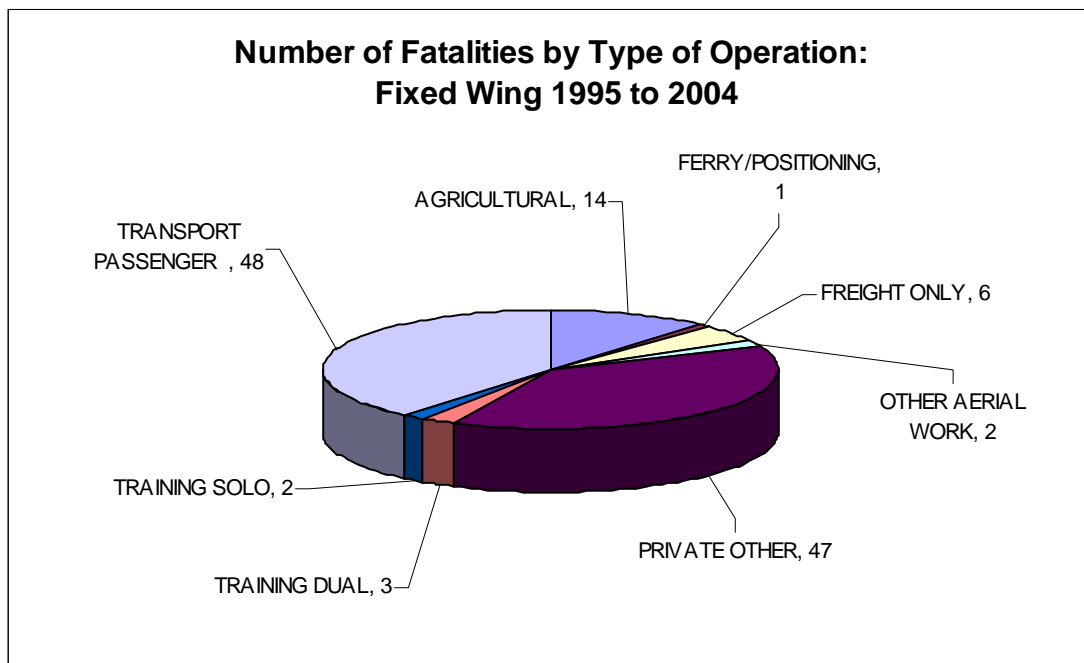
Although transport passenger operations had the most fatalities, this category's rate of fatal accidents per 100,000 flight hours was among the lowest at 0.5. Private operations scored the highest accident rate of 4.7 fatal accidents per 100,000 flight hours.



This single engine Auster aircraft was on a flight from Hokitika to Alexandra when it went missing. Both occupants were killed in the crash. (Alexandra 2002)

Figure 16 below shows the number of fatalities for fixed wing aircraft by operational groupings. Transport passenger and private operations make up over three quarters of all fatalities from fixed wing accidents over the last ten years.

Figure 16:



Source: NZ CAA Database

3.4.4 Survivors

There were 46 accidents that resulted in all occupants being killed, an additional 56 accidents resulted in serious or minor injuries with no deaths, and only 8 accidents

resulted in both injuries and deaths of the occupants. A total of 110 accidents involved deaths or injuries, leaving 351 fixed wing aviation accidents resulting in no deaths or injuries.

There were 123 fatalities and 141 serious or minor injuries as a result of fixed wing aviation accidents involving New Zealand registered aircraft between 1995 and 2004,.

There were 26 fatal fixed wing accidents where the crew were the only occupants onboard the aircraft. (2 accidents involved aircraft with 2 or more required flight crew members).

There were 22 fixed wing fatal accidents with more than one occupant where all the crew and passengers (66 persons) were fatally injured (2 of these accidents involved crew only, where the number of crew members was greater than 1).



Photo courtesy of TAIC

This Cessna 185 Skywagon had an engine failure just after takeoff. The pilot made a forced landing which resulted in five serious injuries and one minor injury. (Motueka 2001)

The injuries other than fatalities sustained by persons involved in fixed wing accidents are shown in Table 13 below.

Table 13:

Non Fatal Injuries Resulting From Fixed Wing Aviation Accidents 1995 to 2004				
	Serious	Minor	Nil	Total
Crew	29	29	366	424
Passenger	37	46	1053*	1502
Total	66	75	1419	1560

* From the total number of people involved in fixed wing aviation accidents three accidents represented 44% of the total (Boeing 747 with POB 435, Boeing 767 with POB 190 and Boeing 737 with POB of 122). From these three accidents only two people were injured.

Source: NZ CAA Database

Table 14 and Figure 16 (next page) show the severity of the injuries sustained for the 110 fixed wing accidents that resulted in injury to at least one person on board the aircraft.

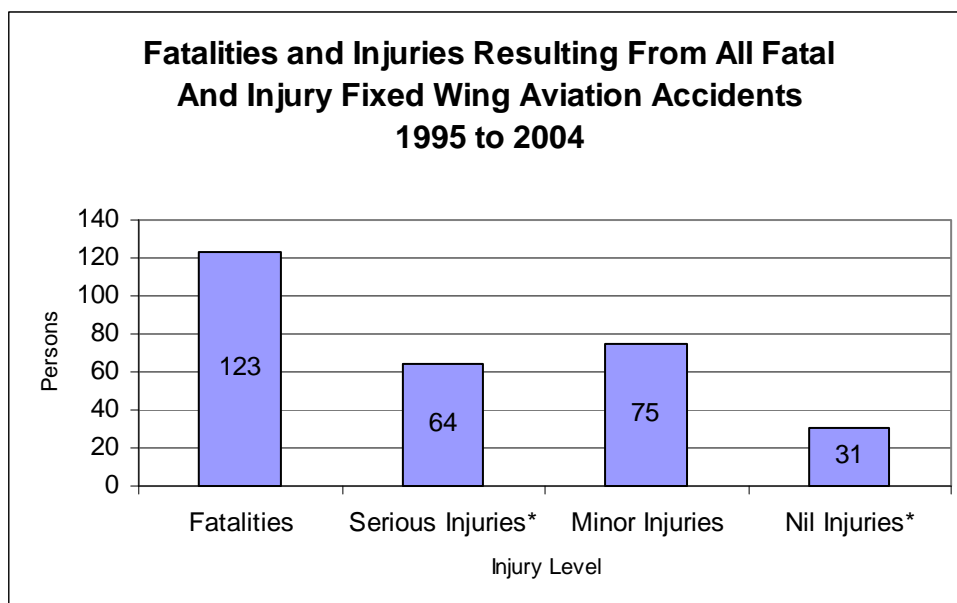
Table 14:

All Fatal and Injury Accidents (110 Accidents) for Fixed Wing Aviation Accidents: 1995 to 2004	
Injuries	Persons
Fatalities	123
Serious Injuries*	64
Minor Injuries	75
Nil Injuries*	31
Total	293

* One accident involved 2 serious injuries in a Boeing 737 with POB of 122. This accident has been excluded from these figures as the POB deviation from the mean (2.5) and the mode (1) distorted any trends associated with the data.

Source: NZ CAA Database

Figure 17:



Source: NZ CAA Database

Table 15 below shows the severity of the injuries sustained to persons on board a fixed wing accident aircraft where at least one person on board the aircraft was killed.

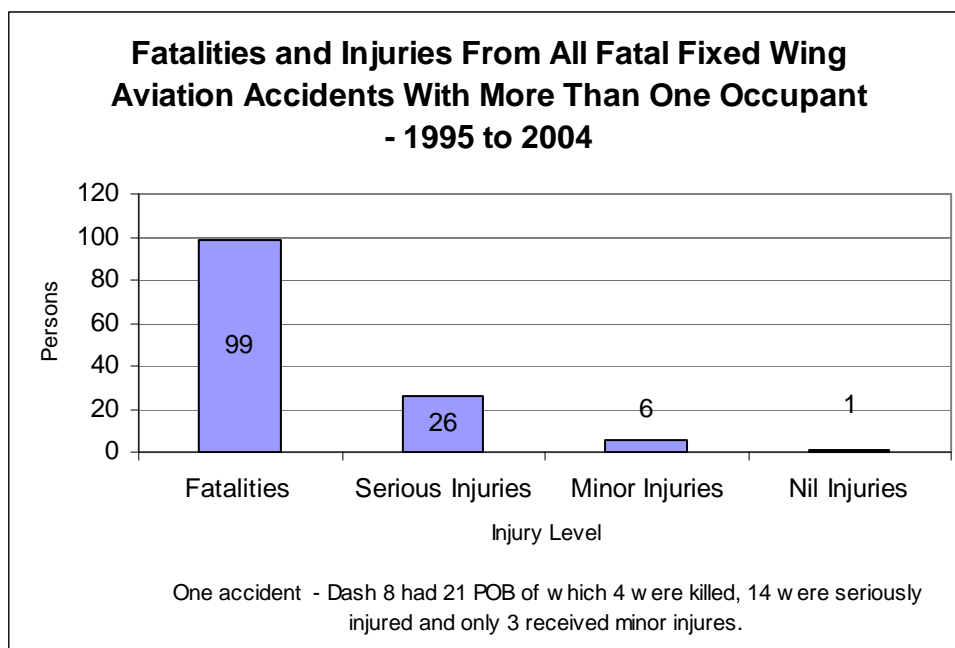
Table 15:

Injuries Sustained from all Fatal Fixed Wing Accidents 1995 to 2004	
Injuries	Persons
Fatalities (24 were the only occupant of the aircraft)	123
Serious Injuries	26
Minor Injuries	6
Nil Injuries	1
Total	156

Source: NZ CAA Database

To assess the survivability of the fixed wing accidents that involved fatalities, the injuries sustained by persons involved in the 33 fatal accidents where there was more than one person on board the aircraft at the time of the accident are graphed in Figure 18. Accidents where people were fatally injured while outside the aircraft and those with only one person on board were not included.

Figure 18:



Source: NZ CAA Database

Figure 18 shows that the probability of coming out of a fatal fixed wing accident unharmed is low. A major contributing factor towards this is the higher speeds and therefore higher energy dissipation in an aircraft accident when compared with other forms of transport accidents.

Table 16:

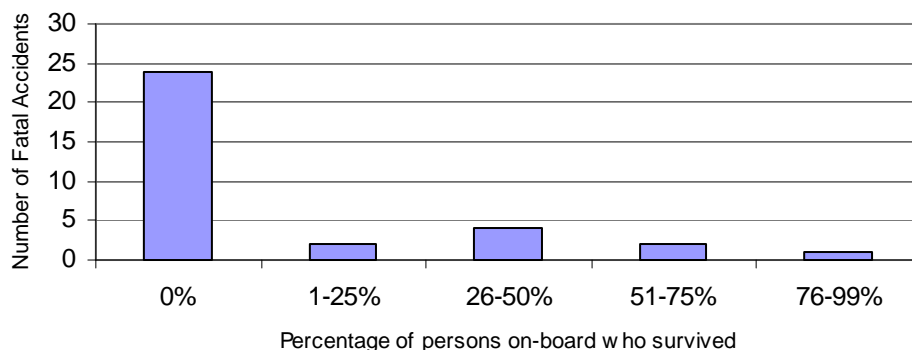
Percentage of survivors in fatal fixed wing accidents where there were multiple persons on board the aircraft 1995-2004	Number of Accidents
0%	24
1-25%	2
26-50%	4
51-75%	2
76-99%	1
Total	33

Source: NZ CAA Database

Table 16 above and Figure 19 (next page) show the percentage of survivors for fatal fixed wing accidents where there was more than one person on board the aircraft at the time of the accident. Of the 33 fatal accidents, there were no survivors in 24 of them; between 1 percent and 25 percent of persons survived in 2 of the fatal accidents; between 26 and 50 percent of persons survived in 4 of the accidents; between 51 and 75 percent of the persons on board survived in 2 of the fatal accidents and more than 75 percent of persons on board survived in only 1 accident.

Figure 19:

Percentage of Survivors in Fatal Fixed Wing Aviation Accidents Where There Were Multiple Persons On Board - 1995 to 2004



Source: NZ CAA Database

The aeroplane was on a private flight in the vicinity of Kaitaia. In the last few seconds of the flight the aeroplane was seen in a vertical climb, which was followed by a manoeuvre resembling a stall turn to the right, and an almost vertical dive toward the ground. The height at which the manoeuvre occurred precluded recovery before the aeroplane struck the ground. The pilot was killed. The aircraft was destroyed by impact forces and fire.

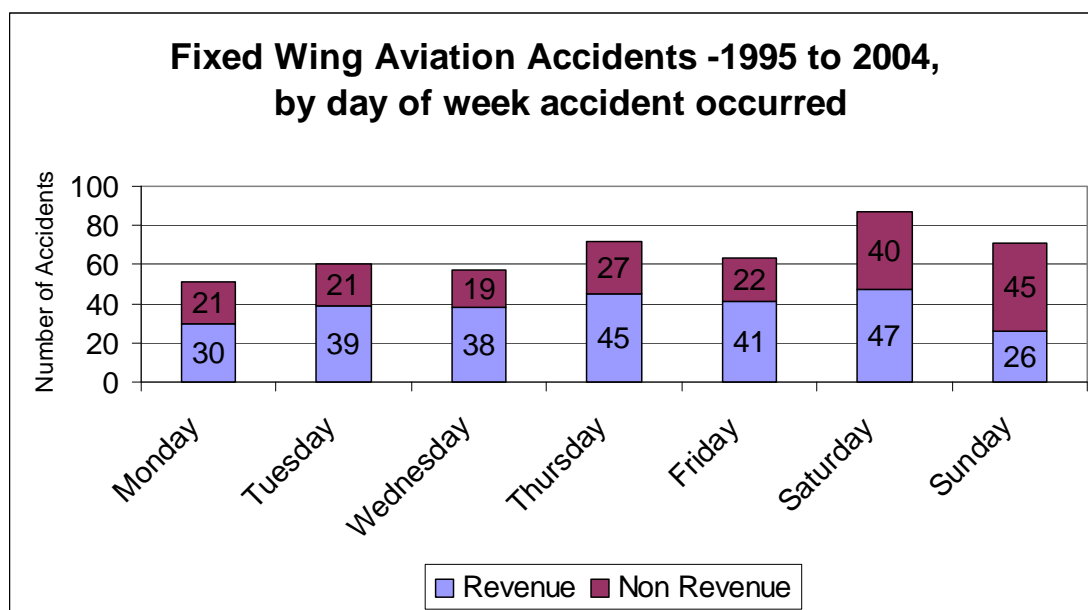
CAA Occurrence Number: 00/1179

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3.5 Number of fixed wing accidents by day-of-week

Figure 20 below shows all fixed wing accidents by the day of the week on which they occurred. The results have been sorted into revenue and non revenue as defined by the type of operation they were involved in during the time of the accident.

Figure 20:



Source: NZ CAA Database

From Monday to Saturday the number of revenue fixed wing accidents exceeded those of non revenue operations. The ratio of revenue to non revenue accidents on the days where revenue was higher was 1.6:1. Saturday was the exception with a ratio of 1.2 revenue accidents to one non revenue accident.

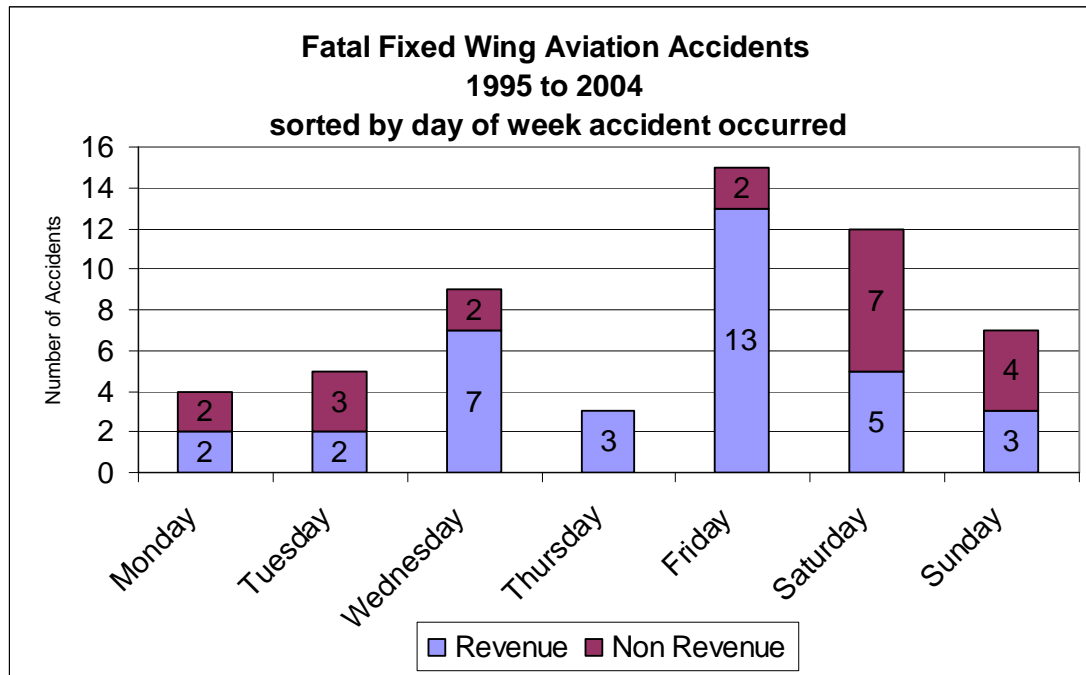
Saturday and Sunday combined had a ratio for revenue to non revenue accidents of only 0.86:1.

Sunday was the only day of the week where there was a higher ratio of non revenue to revenue accidents (1.7:1).

Figure 21 (next page) shows all fatal fixed wing aviation accidents by the day of the week that they occurred. The graph shows a clear increase in fatal accidents for the non-revenue group during weekends. This most likely relates to the fact that most private and non-revenue flying in New Zealand is conducted during the weekends.

Friday had the highest frequency of fatal accidents with a total of 15 fatal accidents occurring on a Friday for the ten year study period. However, the ratio of non revenue verses revenue fatal accidents on a Friday was the lowest at 0.15:1.

Figure 21:



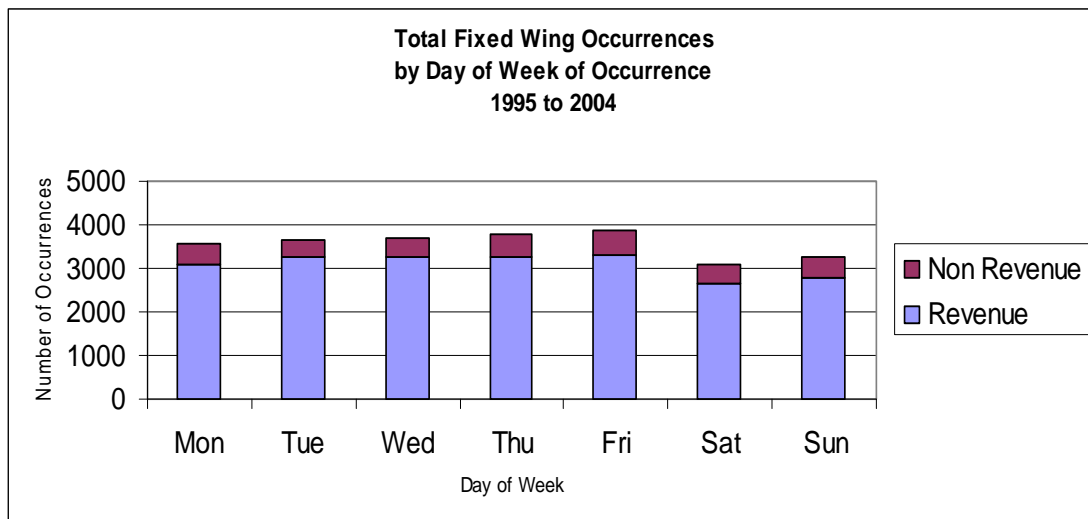
Source: NZ CAA Database

The New Zealand CAA does not record flight hours by the day of the week, and therefore flight hours could not be used as a measure of exposure when examining fixed wing accidents by the day they occurred. The number of occurrences recorded in the CAA's database involving fixed wing aircraft was used to provide an indication of the level of flying activity occurring on each day of the week.

Figure 22 below shows all fixed wing occurrences recorded in the CAA's database grouped by the day of week they occurred and revenue groups. Not all occurrences in the CAA's database had their corresponding revenue group recorded. A simple ratio method was used against the total fixed wing occurrences to estimate the total numbers for each revenue group.

There are comparatively low numbers of non revenue occurrence reports compared to those of the revenue group. It is not certain if the difference between the occurrence groups is a true reflection, or the result of different reporting cultures between the two groups. For this reason it has been decided that only the total occurrence numbers for each day of the week will be used when comparing them against accidents on the same day.

Figure 22:



Source: NZ CAA Database

Figure 23 and 24 (next page) show the percentage of total fixed wing accidents and fatal fixed wing accidents against the percentage of total reported occurrences by the day of the week they occurred.

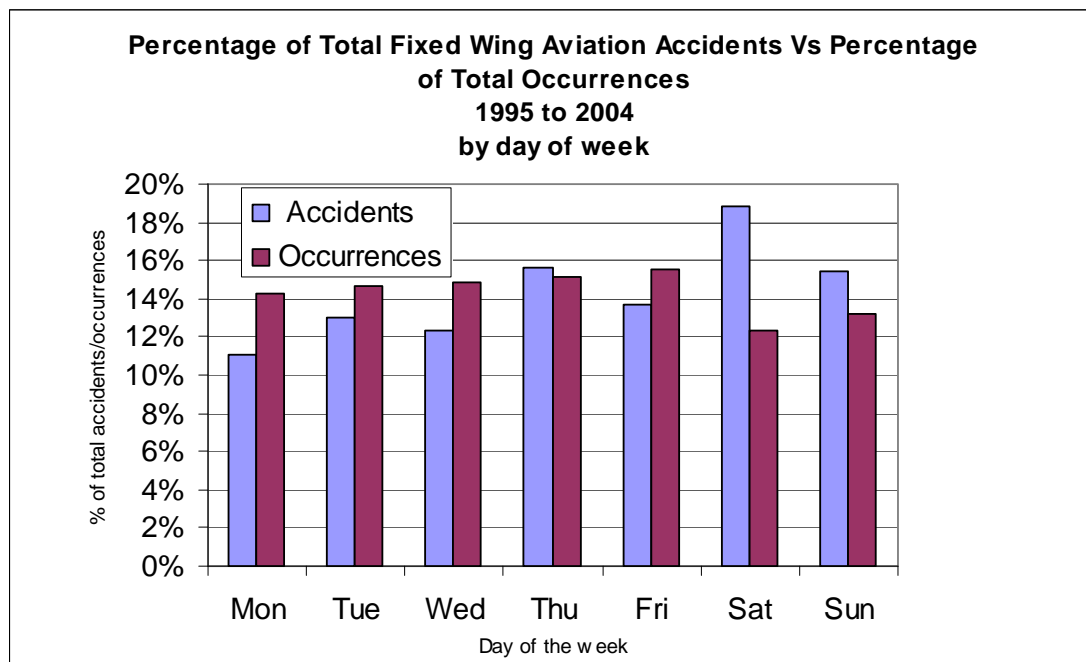
There was a higher percentage of total fixed wing accidents on Thursday, Saturday and Sunday than percentage of reported occurrences for the same days. Saturday showed the greatest difference with 19% of all accidents occurring on that day while only 12% of occurrences were on a Saturday.

There is no positive explanation for the higher accident rate on Saturday and Sunday when compared to occurrences, although reporting habits and reduced air transport activity may be possibilities.

When comparing fatal accidents against occurrences, Friday and Saturday stand out as days where the percentage of accidents outnumbered the percentage of occurrences.

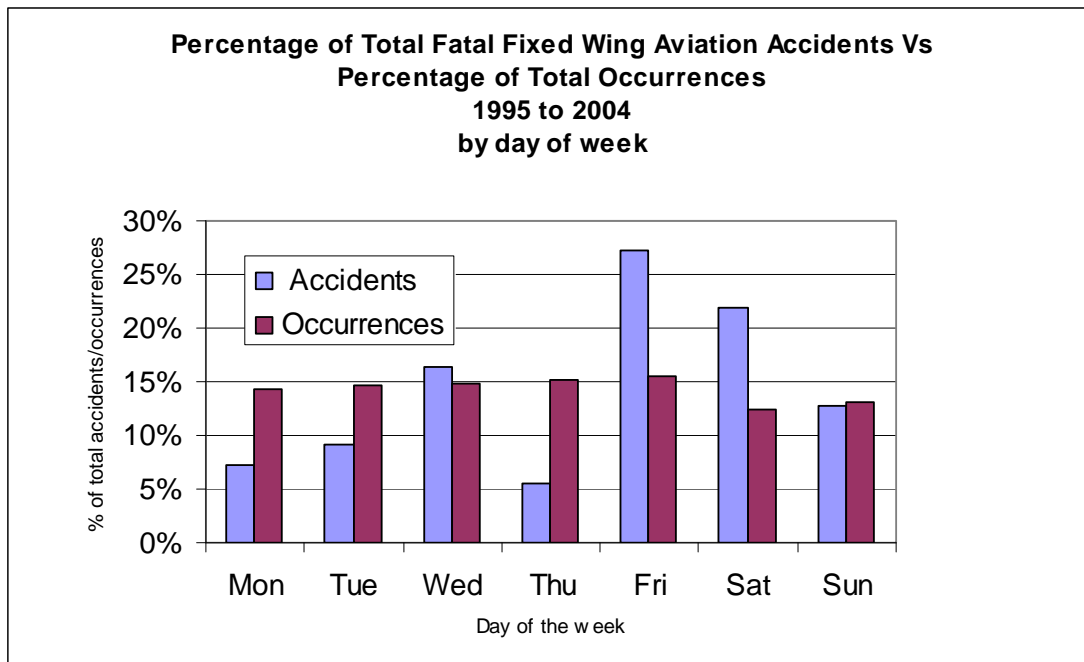
Once again no positive explanation for the increased rates could be found. End of the week fatigue and increased private flying during weekends were possible causes.

Figure 23:



Source: NZ CAA Database

Figure 24:



Source: NZ CAA Database

The Cessna 206 had taken off at 1058 hours from Queenstown for Paraparaumu. At approximately 1145 hours the aircraft was observed executing a turn near the summit of the Lindis Pass. The aeroplane was observed to strike the valley floor in a steep, descending, left turn. The left wing struck the ground first, cart wheeling the aeroplane on to its nose, then the outboard leading edge of the right wing. The aeroplane had rotated to the left through approximately 110° from the first point of impact. The pilot and five occupants were killed as a result of the impact forces.

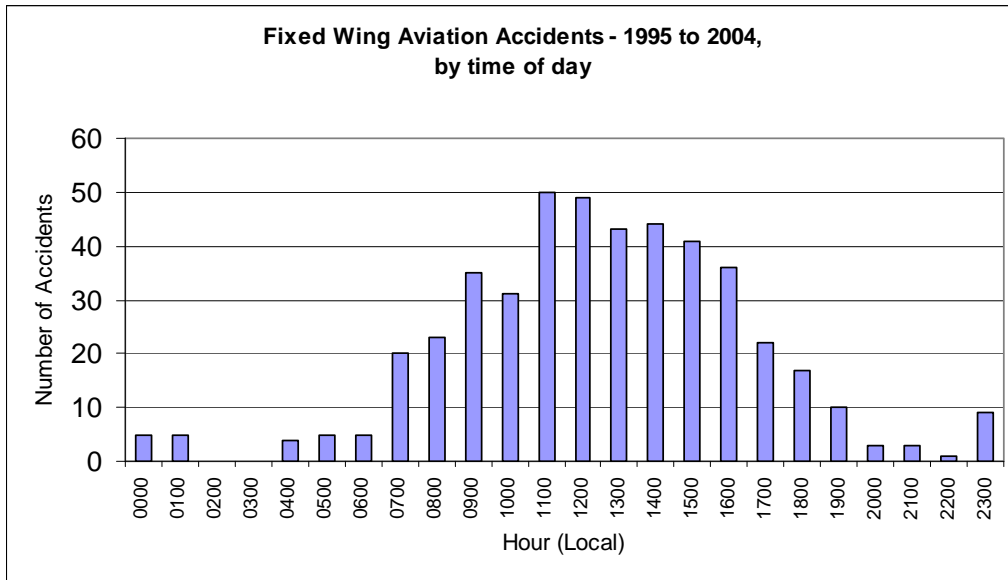
CAA Occurrence Number: 00/1160

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3.6 Accident rates by time of day

Figure 25 below shows the number of fixed wing accidents that occurred during each hour of the day.

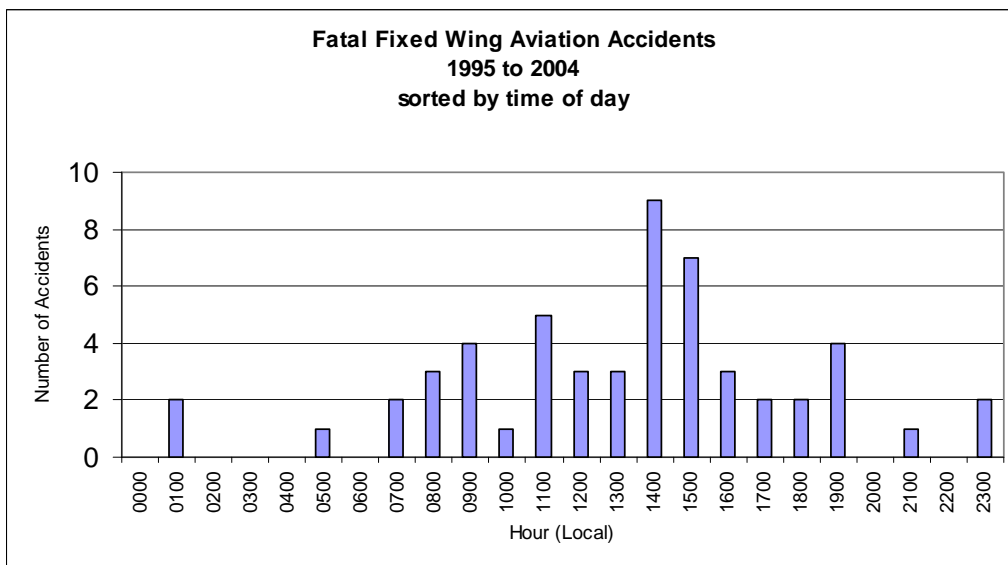
Figure 25:



Source: NZ CAA Database

The number of fixed wing accidents showed peaks at 0900-0959, 1100-1159, 1400-1459 and 2300-2359.

Figure 26:



Source: NZ CAA Database

The number of fatal accidents showed peaks at 0900-0959, 1100-1159, 1400-1459 and 1900-1959.

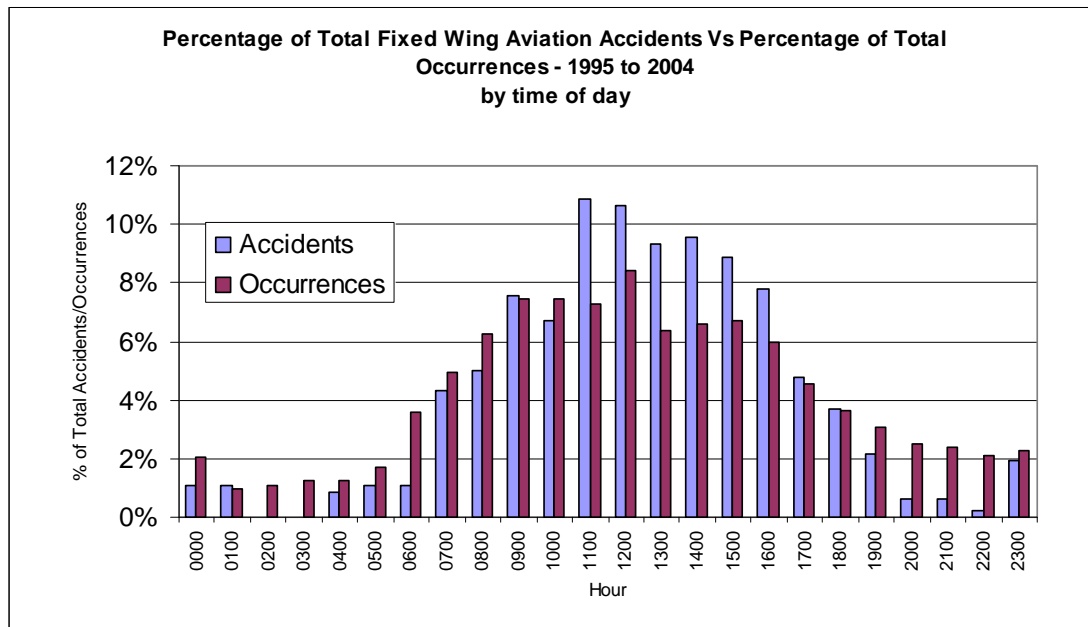
To establish if there was any hour of the day that had a higher rate than other days, the level of activity for each hours of the day was required. This was not possible as the New Zealand CAA does not record flight hours by the time of day they occurred. Therefore, the total number of occurrences involving fixed wing aircraft was used as an approximate level of flight activity occurring during each hour of the day.



This New Zealand registered 750XL ditched in the Pacific Ocean between Hawaii and the west coast of America, killing the pilot. (2003)

Figure 27 shows the percentage of all fixed wing accidents that occurred during each hour of the day along with the percentage of fixed wing occurrences that occurred for each hour of the day during the same time period.

Figure 27:



Source: NZ CAA Database

The period of time from 1100 to 1859 (daylight hours – afternoon) consists of eight consecutive hours where the percentage of accidents exceeds the percentage of recorded occurrences. If the rate of occurrence reporting is consistent for occurrences happening at different times of the day, then during this period of the day pilots are 1.5 times more likely to be involved in an accident than at other times of the day.

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3.7 Pilot demographics

As part of its normal business the New Zealand CAA collects data on pilots including date of birth, flight hours and licences held. Similar details are recorded for those pilots involved in aviation accidents. The data was collated to provide the following data groups for accident pilots as well as non-accident pilots. This enabled a comparison between the two datasets.

- The age of the pilot at the time of the accident.
- The age of the accident pilot when they gained their pilot qualification or licence.
- The highest licence held by the accident pilot at the time of the accident.
- The total number of years that a pilot qualification had been held at the time of the accident.
- The total flying experience at the time of the accident.
- The total time on the type of aircraft involved in the accident.
- The pilot's flight currency for the 90 days leading up to the accident.
- The accident pilot's gender.

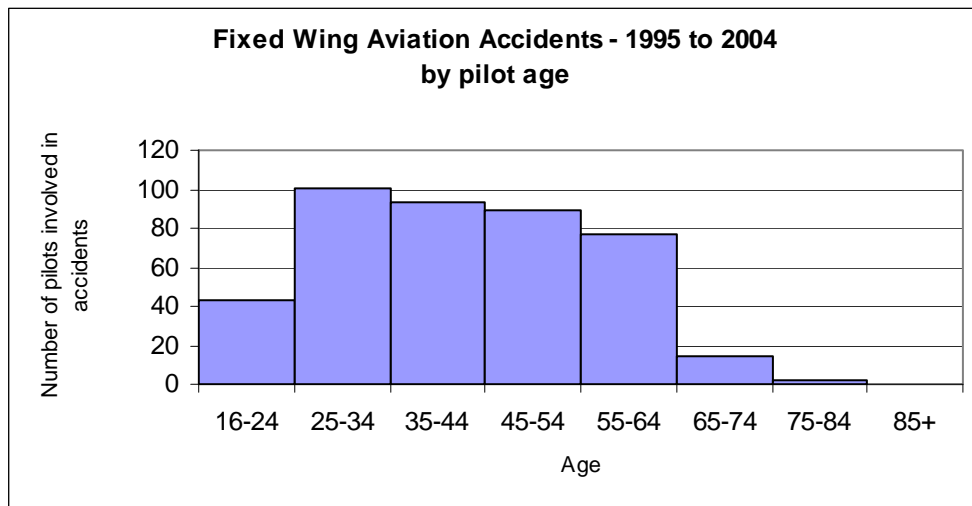


The pilot was on a solo circuit after being checked out by an instructor and authorised for the flight. The aircraft reached the approximate point for a turn from downwind onto base leg when it was observed to spiral out of the sky and crash into the front yard of a residential property. The first person at the scene of the accident found the pilot dead. (Paraparaumu 2003)

3.7.1 Pilot age

Figure 28 below shows the age of all fixed wing accident pilots at the time of the accident. Of the 461 fixed wing aviation accidents between 1995 and 2004, 419 had the pilot's date of birth recorded.

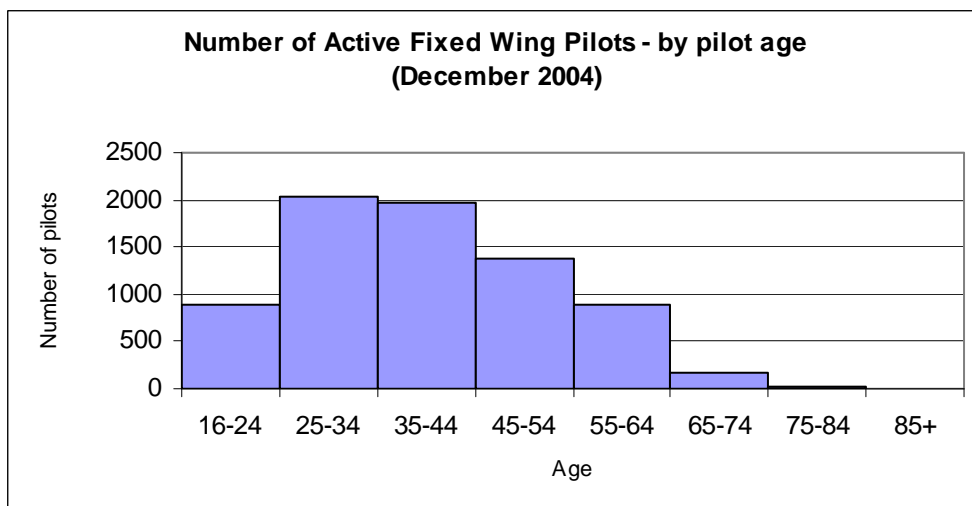
Figure 28:



Source: NZ CAA Database

The highest number of pilots recorded was for the 25 to 34 years of age group. The lowest number of pilots was recorded for the 75 to 84 years of age group. Figure 28 shows a downward trend for fixed wing accidents as age increases.

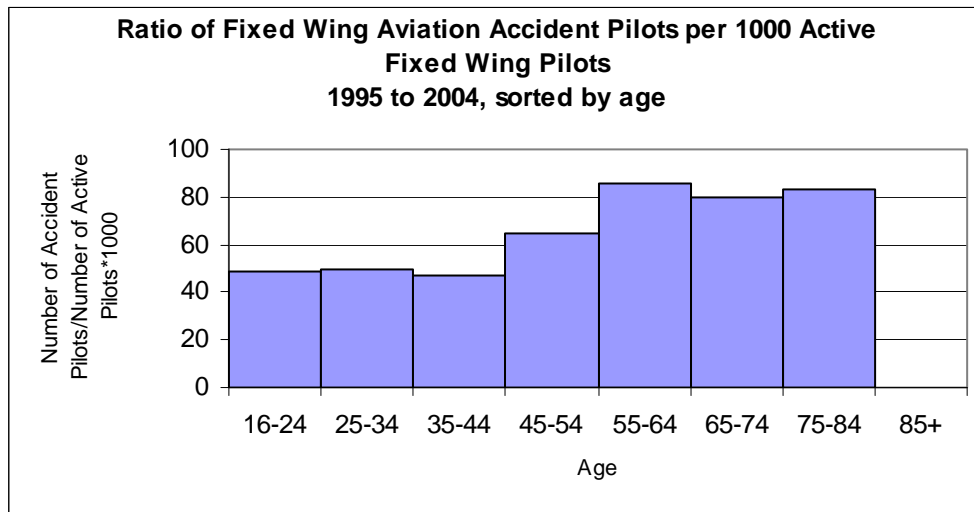
Figure 29:



Source: NZ CAA Database

Figure 29 above shows the total number of licensed fixed wing pilots by pilot age. Although the numbers are higher than those in Figure 28 the distribution and associated trend for the data displayed in Figure 29 is similar.

Figure 30:



Source: NZ CAA Database

Figure 30 above shows the ratio of fixed wing accident pilots per 1000 active pilots sorted by age. The graph suggests that the risk of a pilot being involved in an aviation accident increases with age.

Note: The 75-84 age group only had 24 active pilots and 2 accidents over the last ten years. This makes a ratio of 83 in every 1000 or nearly 10% of these pilots having accidents. These numbers were considered statistically insignificant.

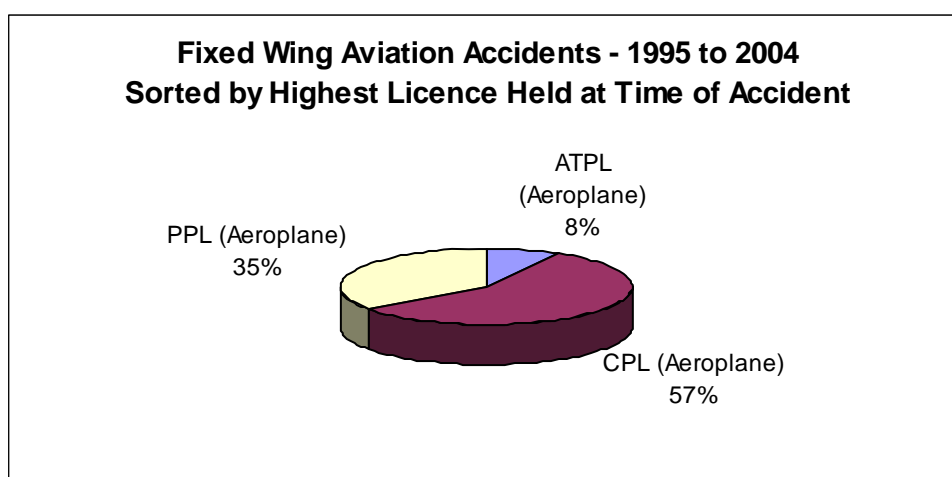
It is important to note that the number of pilots involved in fixed wing accidents is relatively low when compared to the whole pilot population. When these pilots were sorted into age and experience groups the numbers were even lower. Therefore, even a small change in the demographics of the accident pilots could noticeably change the risk associated with each group.

3.7.2 Pilot licence details

Figure 31 below shows the highest licence held at the time of the accident by fixed wing pilots between 1995 and 2004. A total of 389 of the 461 fixed wing accidents (84%) had licence details recorded against them. The highest licence held was not necessarily the licence that the pilot was using at the time of the accident, but does reflect the level of aviation knowledge the individual pilot had at the time of the accident.

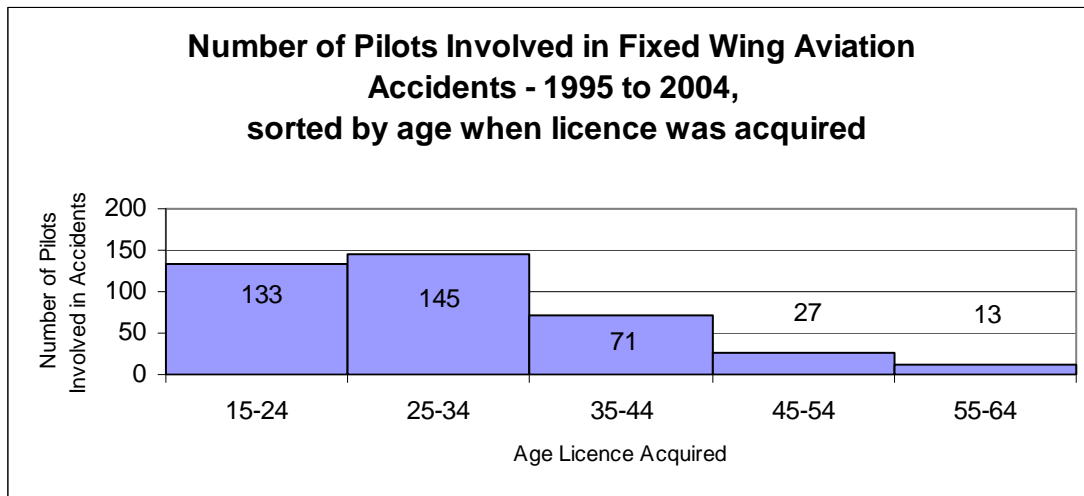
Over half of all fixed wing accidents between 1995 and 2004 involved pilots who held a commercial pilot's licence (CPL). Two thirds of fixed wing accidents involved pilots with professional licences (CPL or ATPL).

Figure 31:



Source: NZ CAA Database

Figure 32:



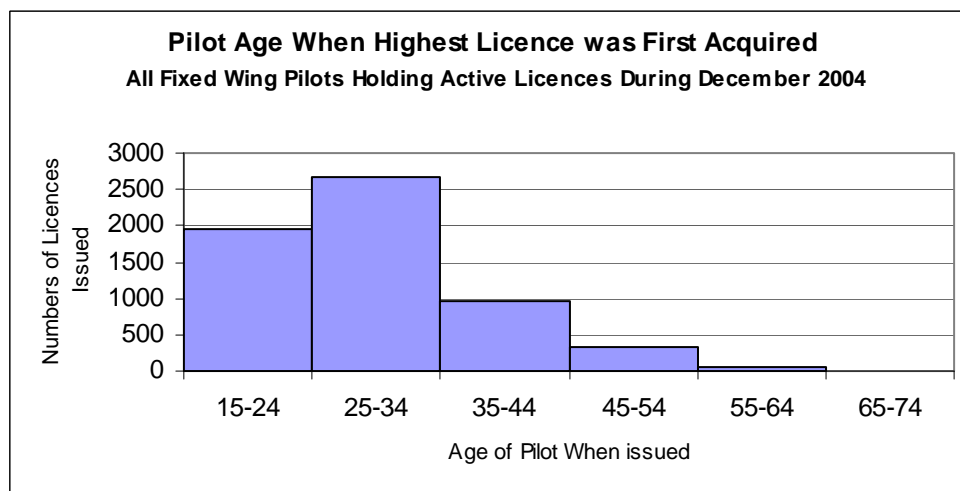
Source: NZ CAA Database

Figure 32 above shows the age at which the pilots involved in fixed wing accidents were when they acquired their licence. The majority of pilots involved in accidents gained their licences between the ages of 15 and 34 years.

Figure 33 below shows the age at which all pilots holding active fixed wing licences were when they acquired their licence.

The majority of pilots gained their licences between the ages of 15 and 34 years. Relatively few pilots gain licences after the age of 34 years.

Figure 33:

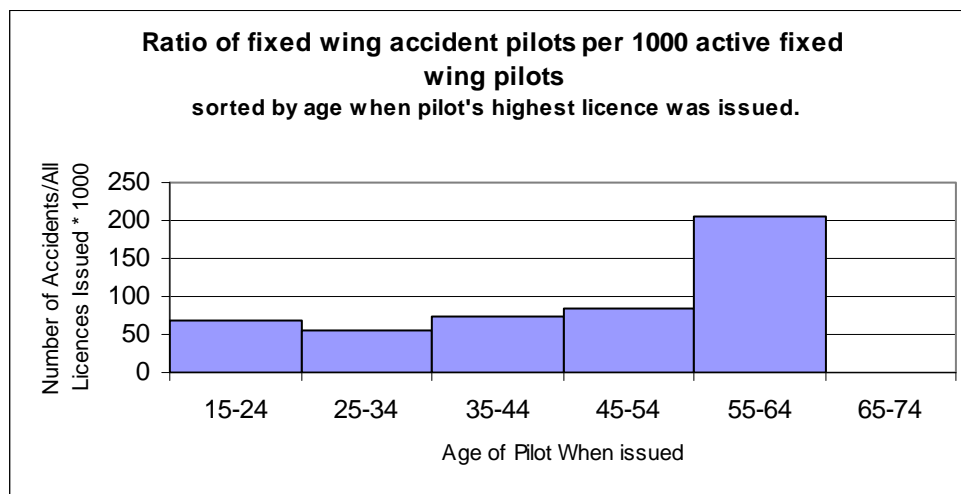


Source: NZ CAA Database

Figure 34 shows the ratio of fixed wing accident pilots per 1000 active fixed wing pilots sorted by the age they were when they first gained their highest licence. The highest ratio of 206 accident pilots per 1000 total pilots was for those pilots who gained their highest licence between the ages of 55 and 64 years. The lowest group with a ratio of 54/1000 was the 25 to 34 years group.

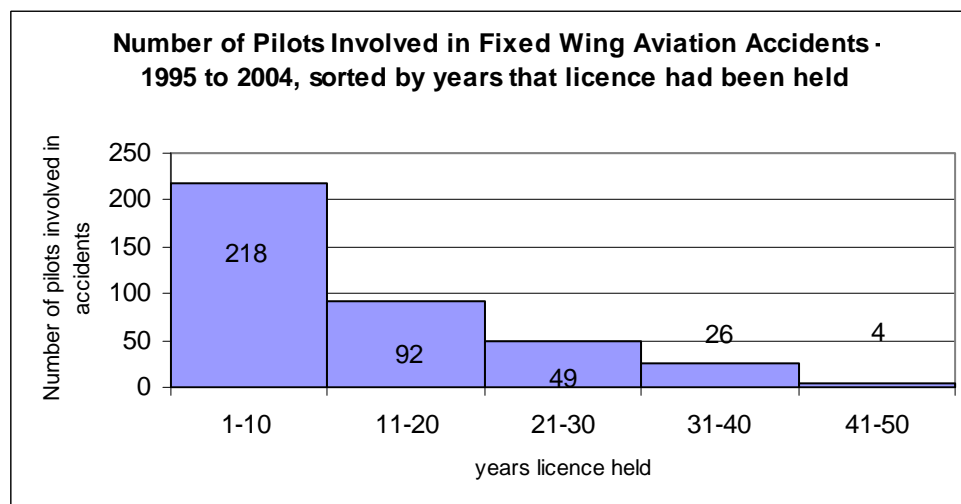
When examining Figure 34 it must be kept in mind that the 55 to 64 age group only had a total population of 63 pilots who gained their licences at this age and only 13 accidents over the ten years involving pilots who gained their licences between 55 and 64 years of age.

Figure 34:



Source: NZ CAA Database

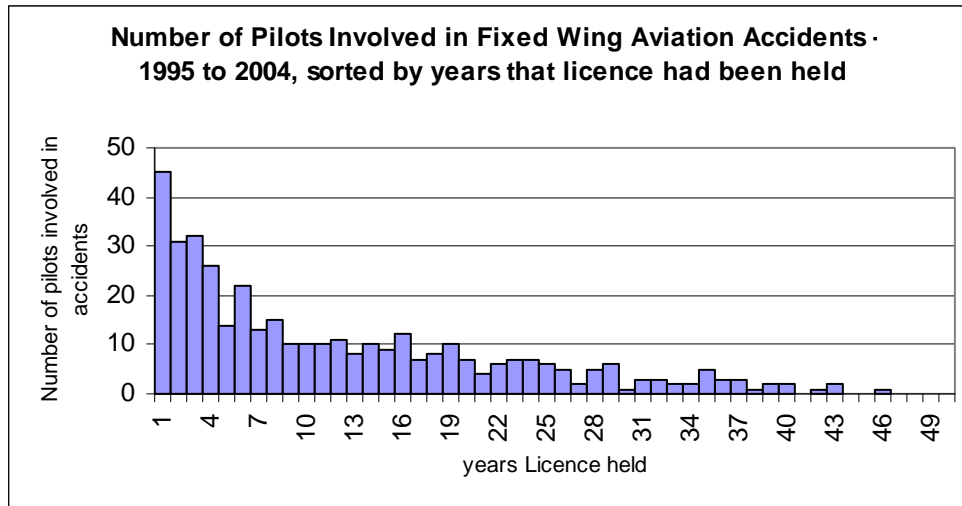
Figure 35:



Source: NZ CAA Database

Figures 35 (previous page) and 36 show fixed wing accidents sorted by the number of years the pilot had held a licence before the accident. Figure 35 shows that the majority of accidents involved pilots who had only held their licence for 10 years or less. Figure 36 below breaks the years down to single digits. This graph would suggest that the first four years of a pilots flying career are the most dangerous, with the first year after the licence is obtained posing the highest risk of having an accident.

Figure 36:

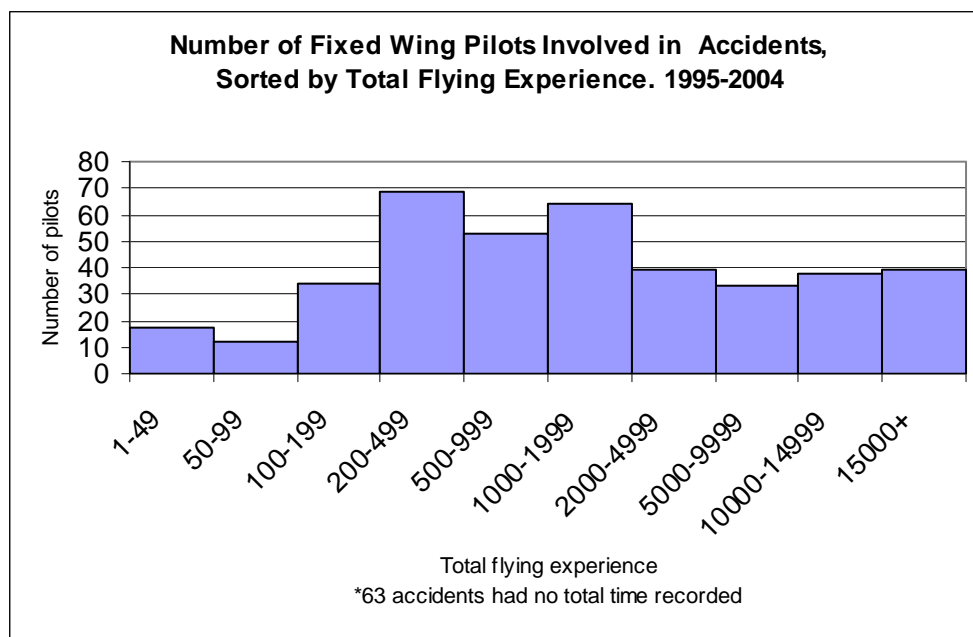


Source: NZ CAA Database

3.7.3 Pilot flight experience

Figure 37 below shows fixed wing aviation accidents sorted by the pilot's total flying experience.

Figure 37:



Source: NZ CAA Database

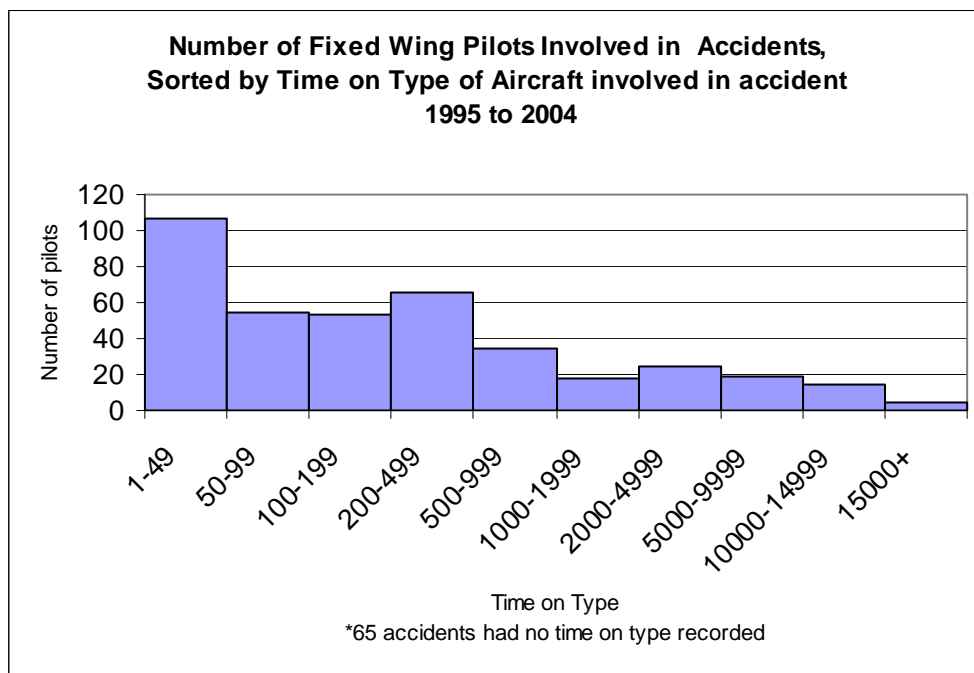
The highest group was the 200 to 499 flight hour pilots, while the lowest group was those pilots with 50 to 99 hours total flying. Between 200 and 2000 hour pilots were at the greatest risk. Most of these accidents involved commercial licence holders.

Most pilots in New Zealand are under supervision until they gain a CPL at around the 200 hour mark. While under supervision pilots are limited in the risks they can take and are assisted with decision making skills such as weather interpretation and route selection.

Most career pilots will not get their first job outside of a GA Part 135 or Part 141 organisation until they have between 1500 and 2000 hours. During their time in the GA sector they are often flying single pilot aircraft which can add extra risk factors such as overload.

Figure 38 below shows fixed wing accidents sorted by pilot flight time on the type of aircraft involved in the accident. The highest number of accidents occurred where the pilot had less than 50 hours logged on that type of aircraft. There was a small peak at the 200 to 499 mark before the downward trend continued. This graph would suggest that the more time a pilot has on a certain type of aircraft the safer they are in that type. There can be a vast difference between cockpit ergonomics for different aircraft types and manufacturers. This risk factor has already been recognised by the larger airlines, where time on type is a key safety indicator.

Figure 38:

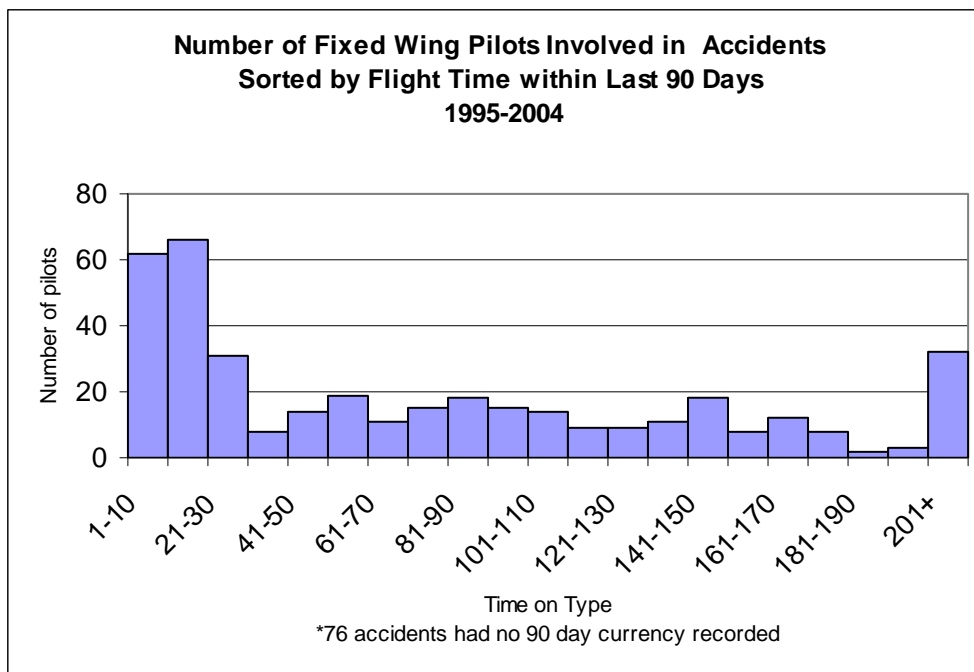


Source: NZ CAA Database

Flight Currency or recent flight time is already recognised as a risk factor within aviation. Most regulators have minimum limits for recent flight experience before a pilot can fly with passengers or under certain flight rules such as Instrument Flight Rules (IFR). Figure 39 below shows fixed wing accidents sorted by flight time within the last 90 days before the accident. The two highest groupings of flight time within the last 90 days were the 1-10 and 11-20 groups. The 201+ group shows all accidents where the pilot had 201 or more flight hours within the last 90 days before the accident. If this group was scaled and distributed in the same way as the rest of the accidents, the trend would continue downwards and the peak at 201+ would not occur (due to space limitations these accidents were grouped together as one column)

The data indicates that those pilots who fly less than 40 hours every 90 days have a greater risk of an accident than those who fly more often.

Figure 39:

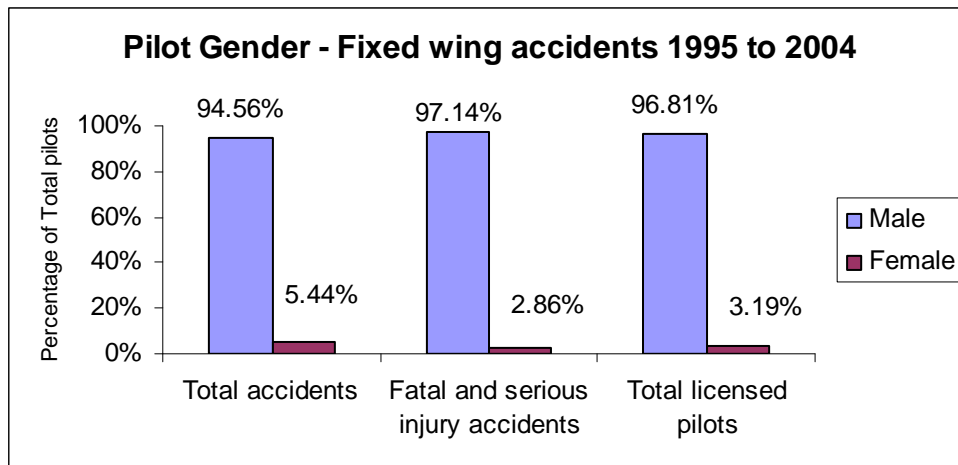


Source: NZ CAA Database

3.7.4 Pilot gender

Figure 40 below shows fixed wing accidents sorted by the pilot's gender. The total pool of licensed fixed wing pilots consists of 3.19% female and 96.81% male pilots. Female pilots represented a higher proportion of total accident pilots than for total licensed pilots and a lower proportion than the total licensed pilots for fatal and serious injury accidents (the reciprocal was true for male pilots).

Figure 40:



Source: NZ CAA Database

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3.8 Phase of flight that accident occurred

Table 17:

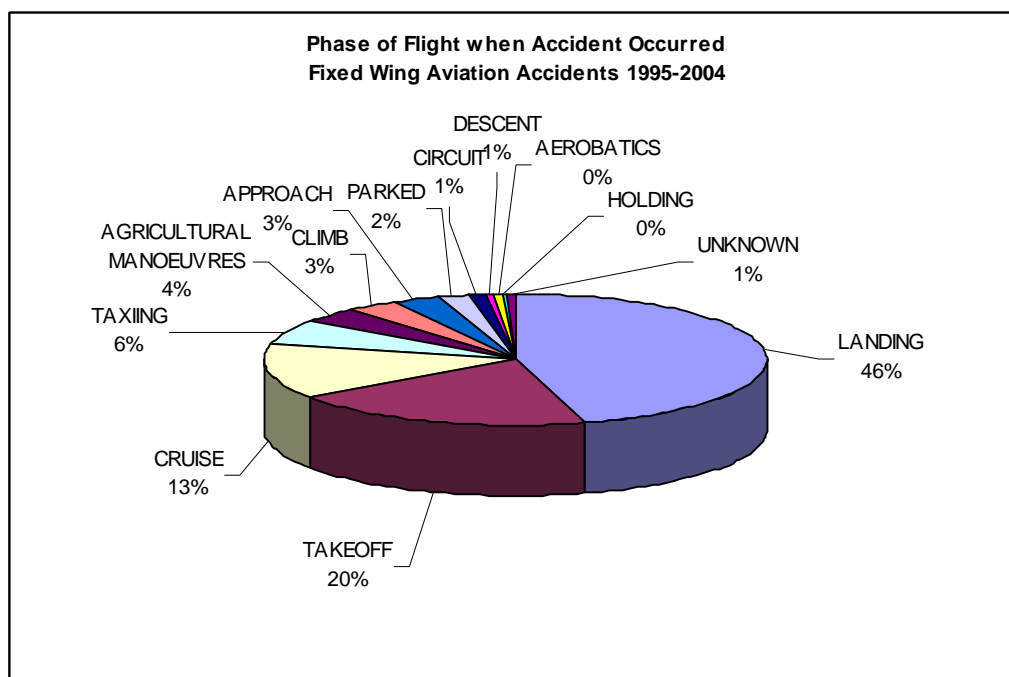
Phase of Flight when Accident Occurred	
Phase of Flight	N° of Accidents
LANDING	210
TAKEOFF	91
CRUISE	61
TAXIING	29
AGRICULTURAL MANOEUVRES	17
CLIMB	16
APPROACH	14
PARKED	9
CIRCUIT	5
DESCENT	3
AEROBATICS	2
HOLDING	1
UNKNOWN	3
Total	461

Source: NZ CAA Database

Table 17 above and Figure 41 below show the phase of flight that the aircraft was in at the time of the accident. The largest phase of flight group for all fixed wing accidents was the landing group. Two thirds of all fixed wing accidents occurred during the landing or takeoff phase of flight.

Landing and takeoff can often represent a busy time for pilots involving high work loads while close to objects and the ground and little time or room for evasive action if needed.

Figure 41:



Source: NZ CAA Database

Table 18:

Phase of Flight when Accident Occurred for Fatal and Serious Injury Accidents	
Phase of Flight	N° of Accidents
CRUISE	30
TAKEOFF	12
AGRICULTURAL MANOEUVRES	12
LANDING	6
CLIMB	5
APPROACH	4
PARKED	3
CIRCUIT	2
DESCENT	2
AEROBATICS	2
Total	78

Source: NZ CAA Database

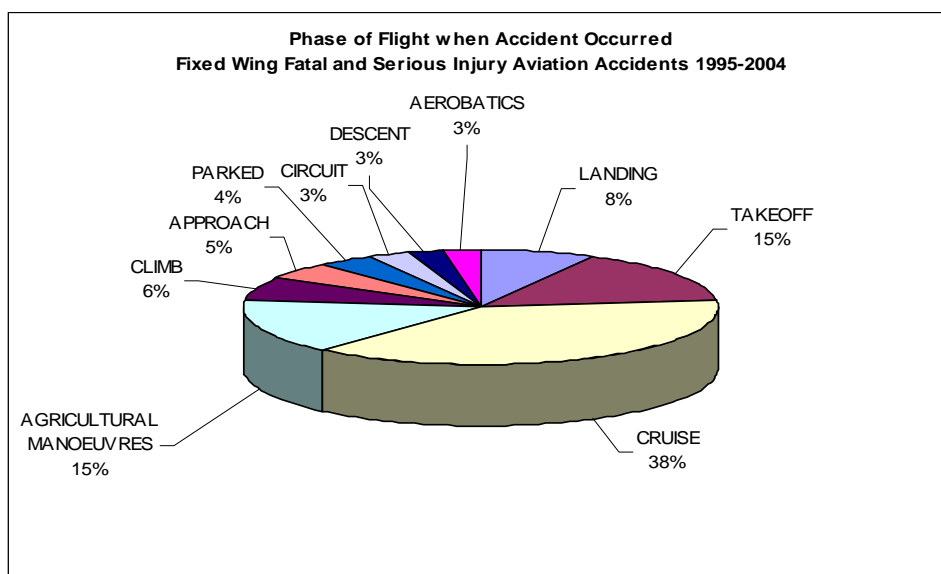
Table 18 above and Figure 42 below show the phase of flight that the aircraft was in at the time of the accident for all fatal and serious injury fixed wing accidents. Cruise was the most common phase of flight for a fatal or serious injury accident.

The landing group which represented nearly half of all fixed wing accidents only made up 8% of fatal and serious injury accidents. There were no fatal injuries during the landing phase of flight.

The high numbers of injuries and fatalities occurring during agricultural manoeuvres reflect the inherent risks of the operating environment.

High speeds and energy exchange would be contributing factors towards the high numbers of fatal and serious injuries during the cruise portion of flight.

Figure 42:



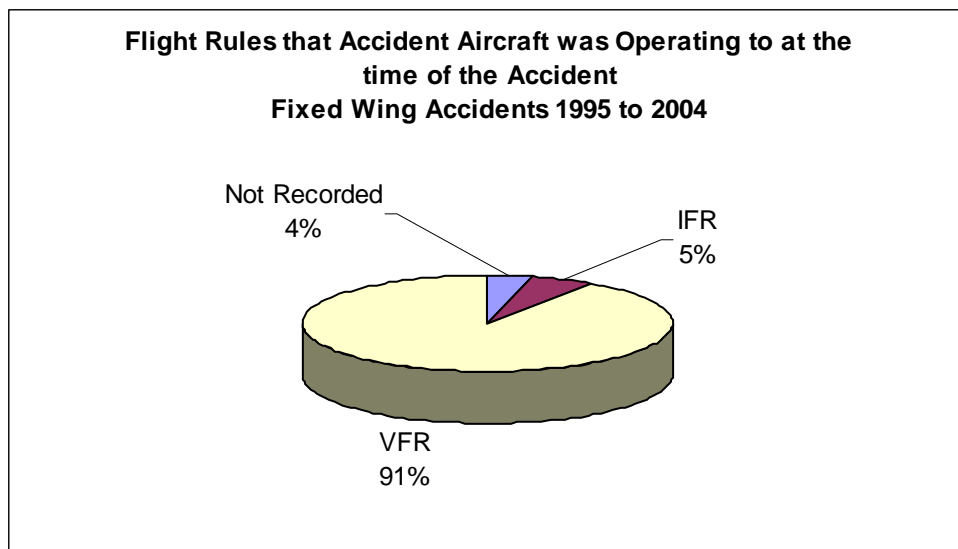
Source: NZ CAA Database

3.9 Flight rules at time of accident

Figure 43 below shows the flight rules that fixed wing accident aircraft were operating to at the time of the accident. The majority of aircraft were operating to VFR flight rules.

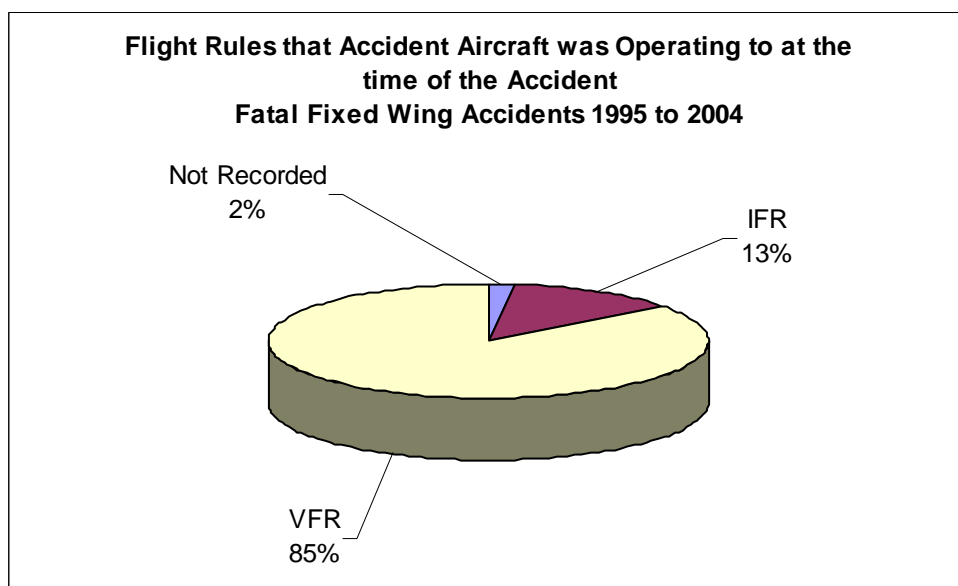
Figure 44 shows the flight rules that all fatal fixed wing accidents were operating to at the time of the accident. Approximately half of the fatal IFR accidents involved multi crew aircraft.

Figure 43:



Source: NZ CAA Database

Figure 44:



Source: NZ CAA Database

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4 FATAL AND SERIOUS INJURY ACCIDENTS

The following constitutes an in-depth analysis of all accidents where there was at least one fatal or serious injury as the result of the accident. There were 80 fixed wing accidents involving New Zealand registered aircraft between 1995 and 2004 that resulted in fatal or serious injuries. These accidents resulted in 123 fatalities, 66 serious injuries and 19 minor injuries (1 minor injury is not accounted for as part of the analysis of these accidents).

The analysis focused on serious, as well as fatal, accidents to allow significant numbers for analysis, and because it was recognised that there were valuable lessons to be learnt from all accidents resulting in injuries.

4.1 *Categorisation of fatal and serious injury accidents*

Part of the aim of the ATSB's research project B2004/0010 was to develop a coding framework for analysing accidents that allowed meaningful categorisation of fatal accidents.

This study has used the same coding of accidents as the ATSB's project. It was decided to use the same coding as these enabled accidents to be grouped and analysed more completely, as well as allowing results to be compared with the Australian study.

The classifications are listed below, and described in Appendix A.

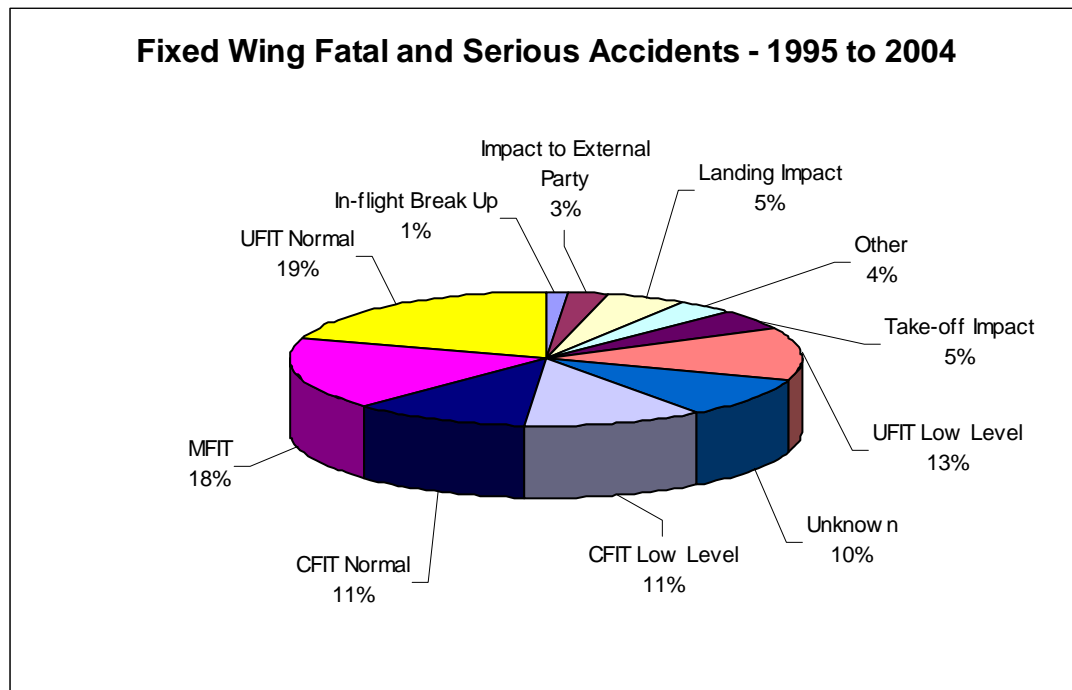
Controlled flight into terrain (CFIT)	- low-level operations - 'normal' operations
Impact to external party	
In-flight break-up	
Landing impact	
Managed flight into terrain (MFIT)	
Other	
Take-off impact	
Uncontrolled flight into terrain (UFIT)	- low-level operations - 'normal' operations
Unknown	

The sub-grouping of CFIT and UFIT accidents was done according to the planned operating height of the aircraft. Therefore, the fatal and serious injury accident classification scheme separated CFITs and UFITs that occurred during planned low-level flying from the other CFITs and UFITs. The CFIT and UFIT accidents that occurred during flight other than planned low-level flying were considered to have occurred during 'normal' operations.

Grouping the accidents using the ATSB’s classification scheme allowed the accidents to be categorised into mutually exclusive groups which essentially described the state of the aircraft when it sustained damage or a person was fatally or seriously injured.

Figure 45 below shows the types of fatal and serious injury fixed wing accidents, by classification, which occurred between 1995 and 2004.

Figure 45:



Source: NZ CAA Database

From a total of 80 fatal and serious injury fixed wing accidents, 72% were in the controlled flight into terrain (CFIT), managed flight into terrain (MFIT), or uncontrolled flight into terrain (UFIT) groups.

The differing nature of these accident types leads to different analyses of these categories. With CFIT accidents, the analysis must focus on why the pilot was not aware of the approaching impact. MFIT involved events that were not necessarily life threatening; but the nature of the crash site was not favourable and resulted in fatal or serious injuries to the crew and passengers. Therefore, the analysis for MFIT accidents must focus on the type of terrain the aircraft impacted as well as why the aircraft lost full or partial power. When looking at UFIT accidents it is important to know why the pilot lost control of the aircraft rather than what the aircraft impacted.

4.2 Controlled Flight into Terrain (CFIT) fatal and serious injury accidents

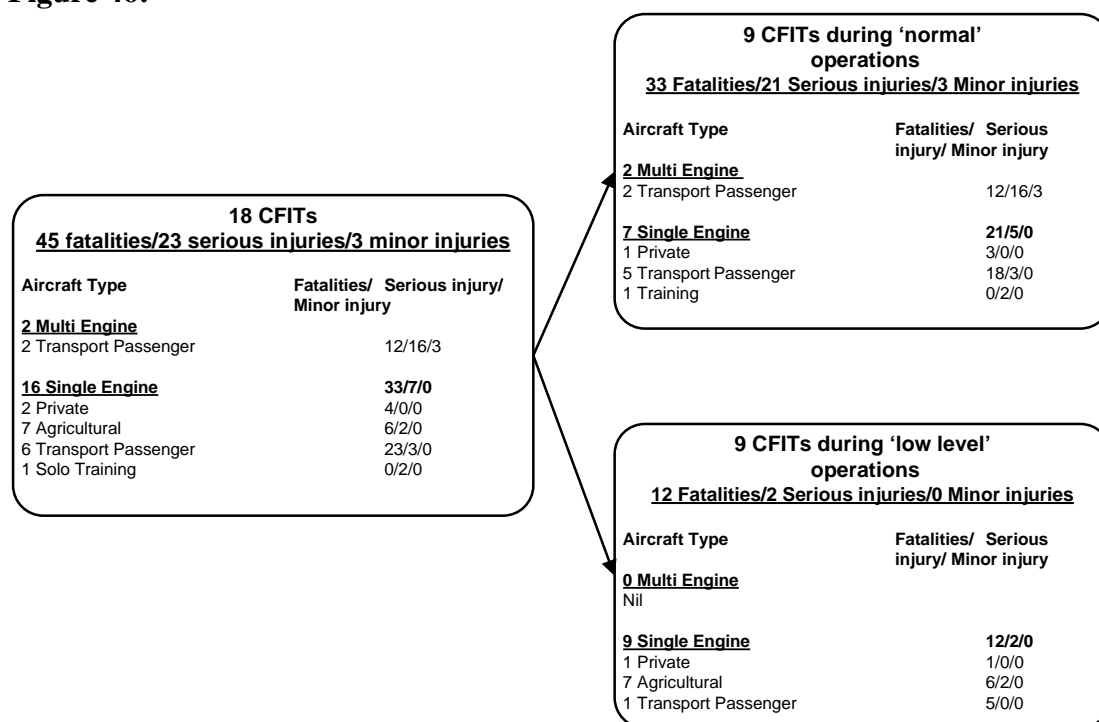
A CFIT accident was defined as an event where an aircraft collided with obstacles, objects or terrain during powered, controlled flight with little or no awareness on the part of the pilot of the impending impact.

There were 18 CFIT fixed wing accidents between 1995 and 2004 (22.5% of fatal and serious injury accidents). These accidents resulted in 45 fatalities (37% of total fatalities), 23 serious injuries (35% of total serious injuries), and 3 minor injuries.

The CFIT accidents were sorted to separate those accidents that occurred during planned low-level operations from accidents that occurred during ‘normal’ operations. Low-level flights are operated close to obstacles, objects and terrain and are hence planned for by the pilot. ‘Normal’ operations involve flights where the pilot plans to observe minimum safe altitudes to avoid objects, obstacles and terrain during all phases of flight.

Figure 46 shows the split between ‘normal’ and ‘low-level’ CFIT fixed wing accidents. The diagram also identifies the type of operation the aircraft was conducting at the time of the accident.

Figure 46:



4.2.1 CFIT fatal and serious injury accidents during low-level operations.

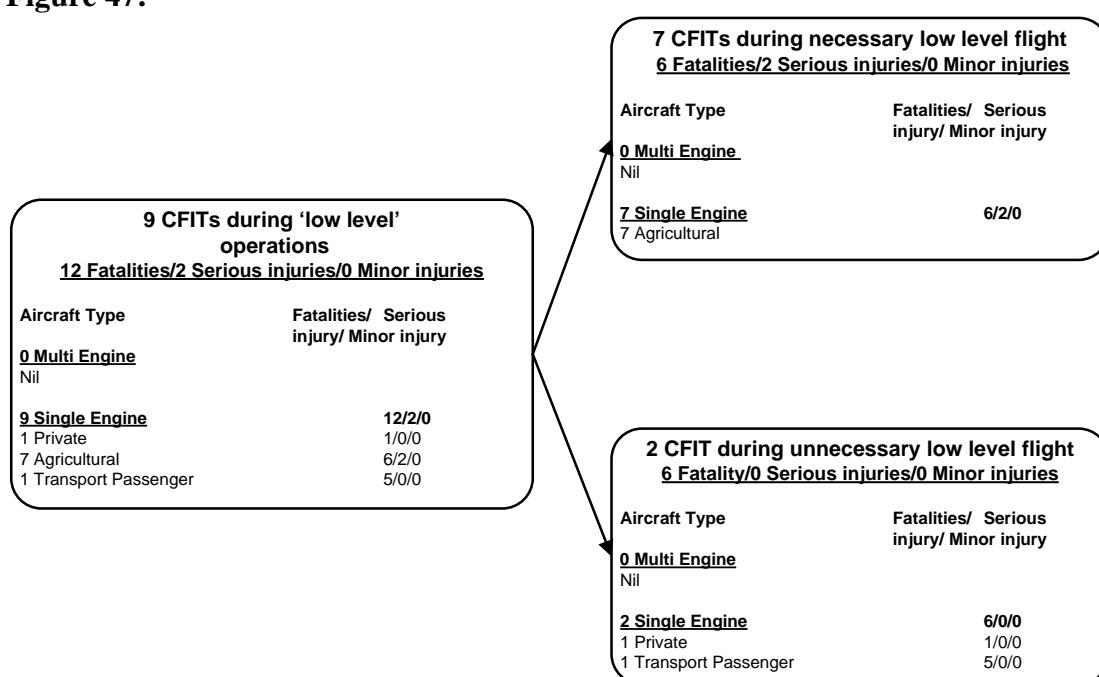
Low-level flying requires pilots to carefully consider obstacles, objects and terrain before and during the flight. There are also many other considerations during low-level flights including perceived speed, depth perception and aircraft limitations. All these considerations and potential hazards make low-level flight operations very vulnerable to CFIT accidents.

There were 9 CFIT accidents that were deemed to have occurred during low-level flying (11% of total fatal and serious injury accidents). These accidents resulted in 12 fatalities (10% of total) and 2 serious injuries. Three quarters of these accidents occurred during agricultural operations where there is usually only one person on-board the aircraft.

The low-level CFIT accidents were grouped into those that were planned and authorised as low-level operations and those that involved unnecessary or unauthorised low flying.

Figure 47 below shows all low-level CFIT fixed wing accidents and the split between necessary and unnecessary low-level operations.

Figure 47:



On average, the pilots involved in necessary low-level CFIT accidents were older than those involved in unnecessary low-level operations and had greater total flight times and experience on the type of aircraft involved in the accident. The pilot involved in the private operation conducting unnecessary low-level flying had the youngest age, lowest total time and lowest time on type of the entire pilots in this category.

4.2.2 CFIT fatal and serious injury accidents occurring during necessary low-level flight

There were 7 CFIT accidents that were categorised as occurring during necessary low-level flying. These accidents resulted in 6 fatalities and 2 serious injuries. All 7 accidents occurred while the aircraft were conducting agricultural operations.

The aircraft struck a variety of obstacles; the majority hit trees or hills. There was only one wire strike accident which resulted in 1 serious injury.

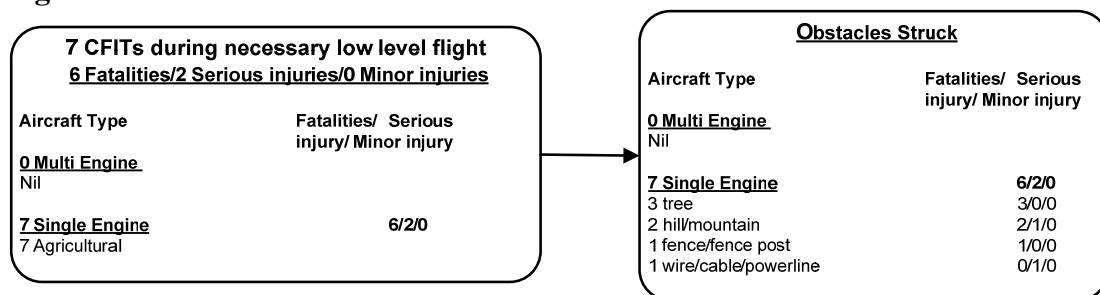
New Zealand's topography consists of many hills and mountainous areas. The country also has an abundance of trees and other vegetation. This would explain why these obstacles featured in higher numbers than other obstacles.

New Zealand's hilly terrain also poses many challenges to the agricultural pilot and it is therefore important that these pilots examine the site well and consider their options (including turning radius and aircraft performance) before commencing operations.

The average total time for pilots involved in low-level necessary CFIT accidents was almost 5500 hours. This would suggest that high total time is not a guarantee that pilots will avoid CFIT accidents.

Figure 48 below shows the 7 CFIT accidents that occurred during necessary low-level flying and the obstacles they hit. There were no multi-engine aircraft involved in low-level CFIT accidents.

Figure 48:



4.2.3 CFIT fatal and serious injury accidents occurring during unnecessary low-level flight

There were only 2 CFIT accidents that were categorised as unnecessary low-level flying. There were 6 fatalities and no survivors from these two accidents.

The first accident involved a private flight where the pilot engaged in unauthorised low level aerobatics. The pilot failed to recover from a vertical dive before impacting the ground. The pilot was a relatively low time pilot in his mid twenties.

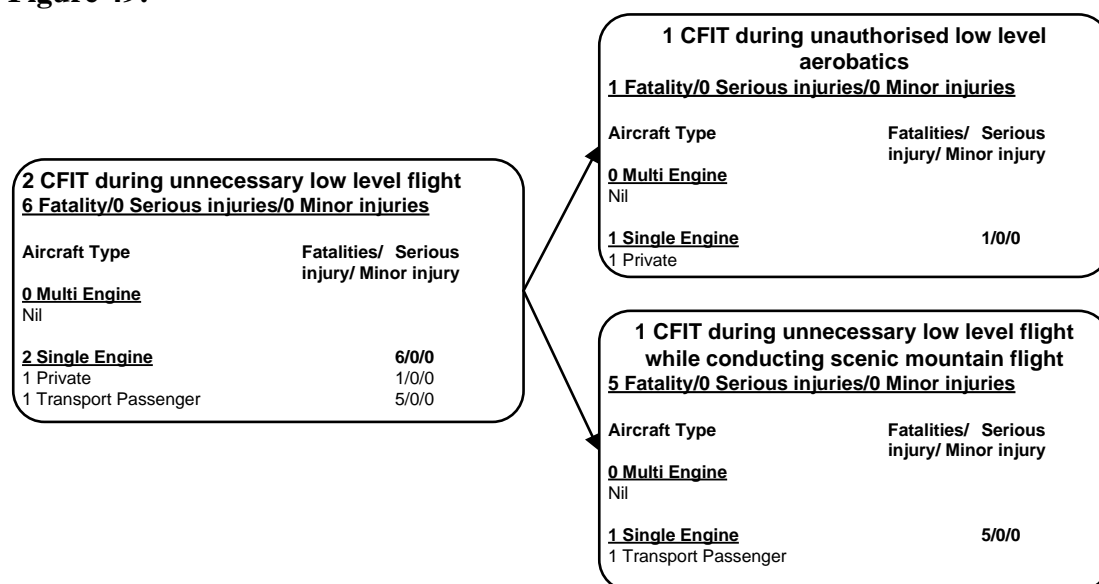
The second accident resulted from unnecessary low-level flying while the pilot was conducting an air transport scenic flight. The aircraft collided with a ridge as the aircraft attempted to cross it at low level. The pilot had in excess of 5000 hours (4500 on type) and was in his mid forties. The pilot had a history of unauthorised low-level flying while conducting scenic flights.

Both these accidents demonstrate a desire from the pilot to impress or thrill their passengers or observers by flying at low-levels. Both pilots were male.

Figure 49 shows the 2 CFIT accidents that occurred during unnecessary low level flying, the type of operation, and the resulting fatalities.

This type of accident should easily be avoided by complying with the rules and operating limitations of the aircraft.

Figure 49:



4.2.4 CFIT fatal and serious injury accidents occurring during 'normal' operations

CFIT fatal and serious injury accidents occurring during 'normal' operations were defined as those accidents where the pilot intended to operate at a safe altitude clear of obstacles, but for various reasons (including approach) the aircraft flew close to terrain which resulted in unexpected collisions.

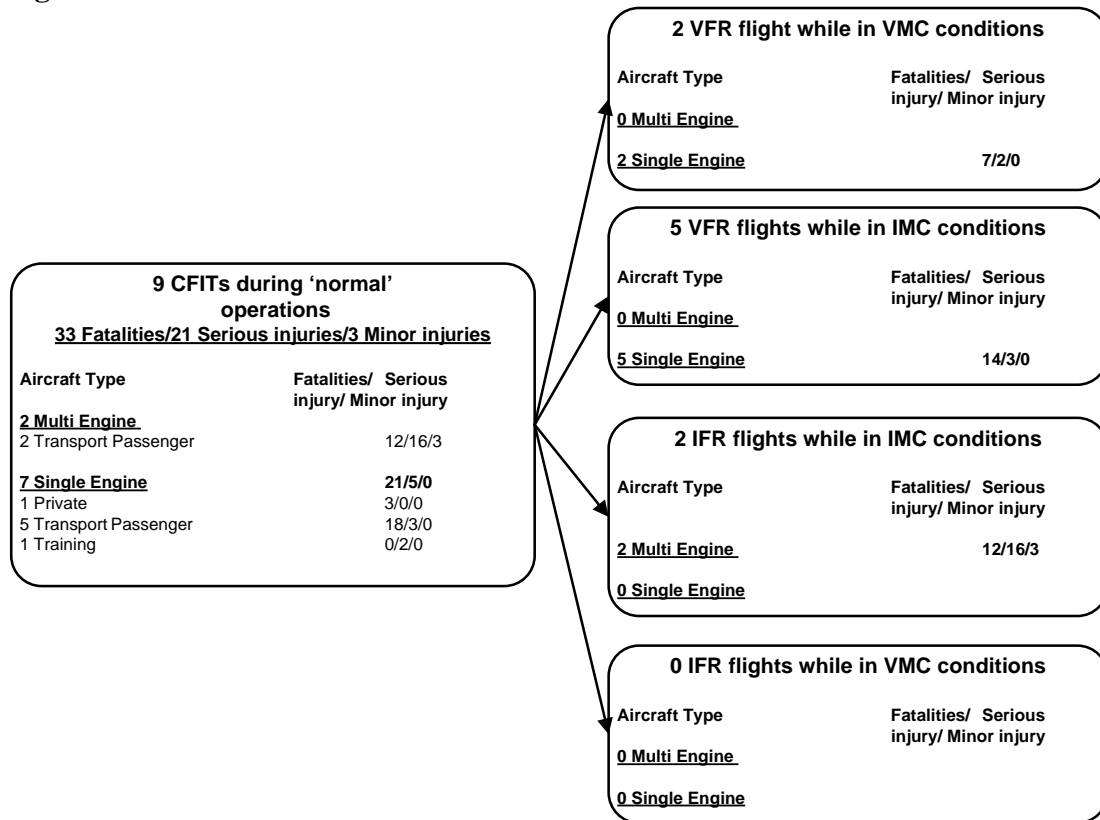
There were 9 CFIT fatal and serious injury accidents that occurred during 'normal' operations (11% of the total fatal and serious injury accidents). These accidents resulted in 33 fatalities (27% of fatalities), 21 serious injuries (32% of serious injuries) and 3 minor injuries. Two of the nine accidents contributed to a third of the fatalities and over half the serious injuries.

As CFIT accidents occurred when aircraft collided with objects or terrain and the pilot had little or no warning of the impending impact, it was decided to divide the accidents by taking into account whether the pilot was flying by Visual Flight Rules (VFR) or Instrument Flight Rules (IFR). It was also determined whether the pilot was flying in Visual Meteorological Conditions (VMC) or Instrument Meteorological Conditions (IMC).

Figure 50 (next page) shows the 9 CFIT accidents that occurred during 'normal' operations. The accidents have been sorted into 4 groups. These groups are:

- VFR while in VMC conditions: This means the pilot was navigating using visual references while clear of clouds and should have been able to see any approaching obstacles or terrain.
- VFR while in IMC conditions: This category involves pilots who were navigating using visual references but for various reasons lost sight of the external environment (flew into clouds, darkness).
- IFR while in IMC conditions: These pilots were navigating and controlling their aircraft by reference to the instrument panel and were either operating inside clouds or at night.
- IFR while in VMC conditions: These pilots were navigating and controlling their aircraft by reference to the instrument panel but should have been able to see the outside environment.

Figure 50:



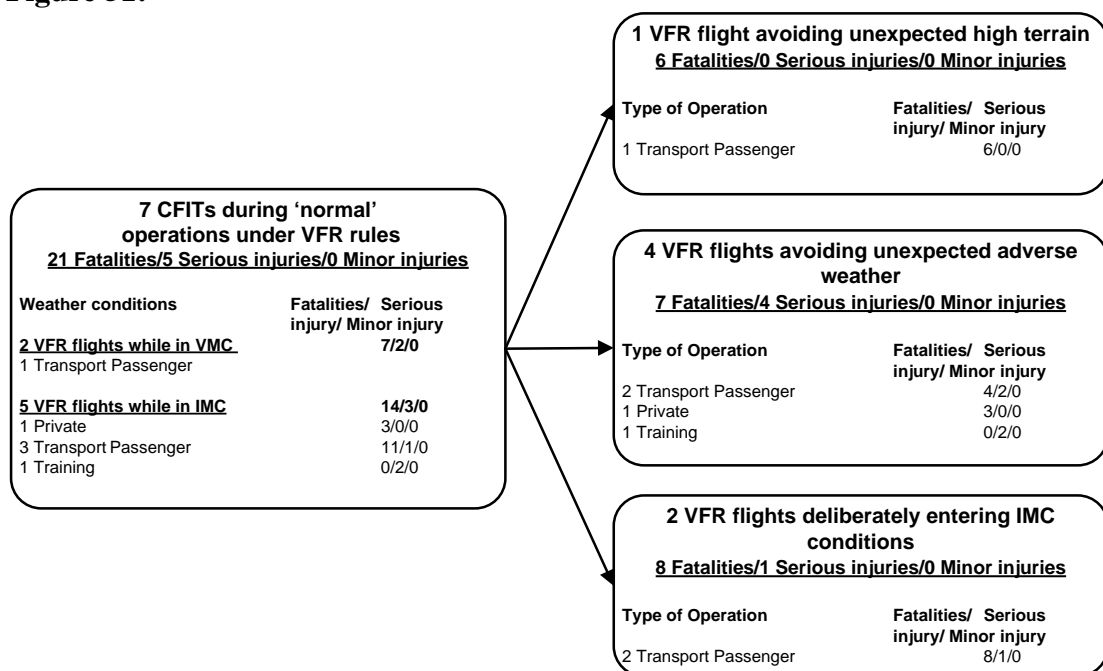
The majority of the CFIT accidents that occurred during 'normal' operations involved VFR flights.

At about 1225 hours a Queen Air multi engine aircraft stalled and spun from a low altitude after having both engines fail within a short space of time. The aeroplane had just departed Hamilton on a scheduled flight to New Plymouth. All six occupants died in the accident. Causal factors identified were a fuel tank mis-selection and failure to execute a forced landing.

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Figure 51 below shows the 7 VFR CFIT accidents that happened during ‘normal’ operations. Limited or zero external visibility was a factor in all these accidents. There were two accidents where the pilots deliberately entered IMC. Both these accidents involved Transport Passenger flights. Transport pilots are often under pressure to get to their destinations and this can lead to risk taking that may not otherwise be attempted. New Zealand’s variable weather and terrain can often produce scenarios where VFR pilots find themselves flying close to terrain with poor visibility and limited manoeuvring space.

Figure 51:

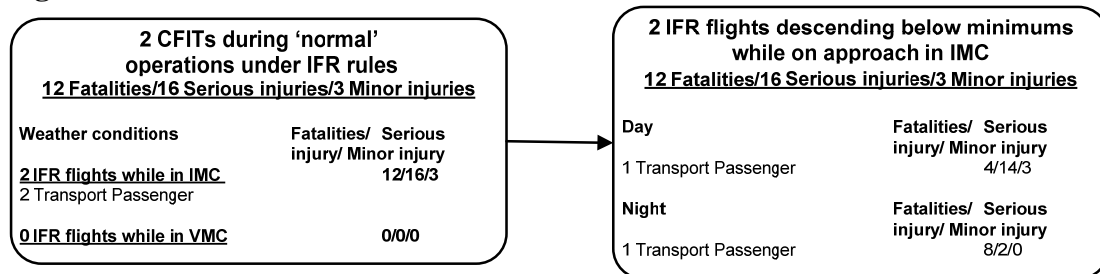


The two CFIT accidents shown in Figure 52 involve aircraft that were operating on IFR flight plans and crashed while in IMC conditions. Both accidents involved multi engine aircraft conducting air transport passenger flights. The two accidents resulted in 12 fatalities (10% of total fatalities), 16 serious injuries and 3 minor injuries.

The aircraft that crashed during daylight hours was a multi crew airliner where the crew were dealing with a failed system while conducting an approach in IMC conditions. The crew failed to notice a deviation from the minimum safe altitude while dealing with the system malfunction and collided with high terrain resulting in multiple fatalities and serious injuries. The Pilot in Command (PIC) of this flight had a considerable amount of total flying time, but only a relatively small amount of time on the aircraft involved in the accident. The PIC was close to the average age for fixed wing accident pilots (43 years).

The accident that occurred during night time involved a single pilot aircraft conducting an instrument approach. The pilot departed the published profile for the approach and collided with trees just short of the runway threshold. The PIC of this aircraft had a large amount of flight time, and almost 1000 hours on type. He was almost ten years older than the average fixed wing accident pilot and had gained his instrument rating late in his career.

Figure 52:



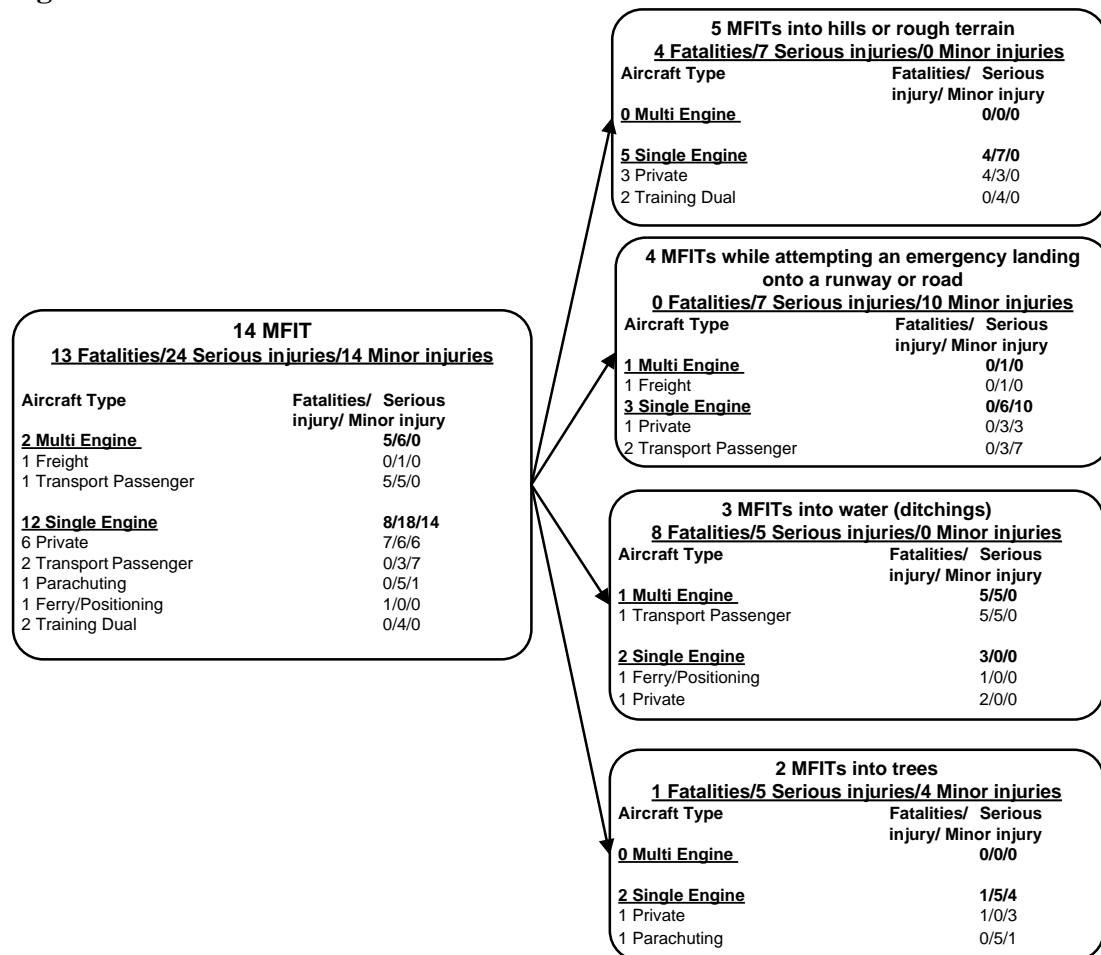
4.3 Managed Flight into Terrain (MFIT) fatal and serious injury accidents

A ‘managed flight into terrain’ (MFIT) accident was defined as an event where an aircraft collided with obstacles, objects or terrain while being flown under limited control or reduced performance, with insufficient height/performance to reach a designated landing area.

There were 14 MFIT fatal and serious injury accidents resulting in 13 fatalities (11% of total fatalities), 24 serious injuries (36% of total serious injuries) and 14 minor injuries (77% of minor injuries).

Figure 53 below shows MFIT accidents divided into operational groups and impacted objects or terrain.

Figure 53:



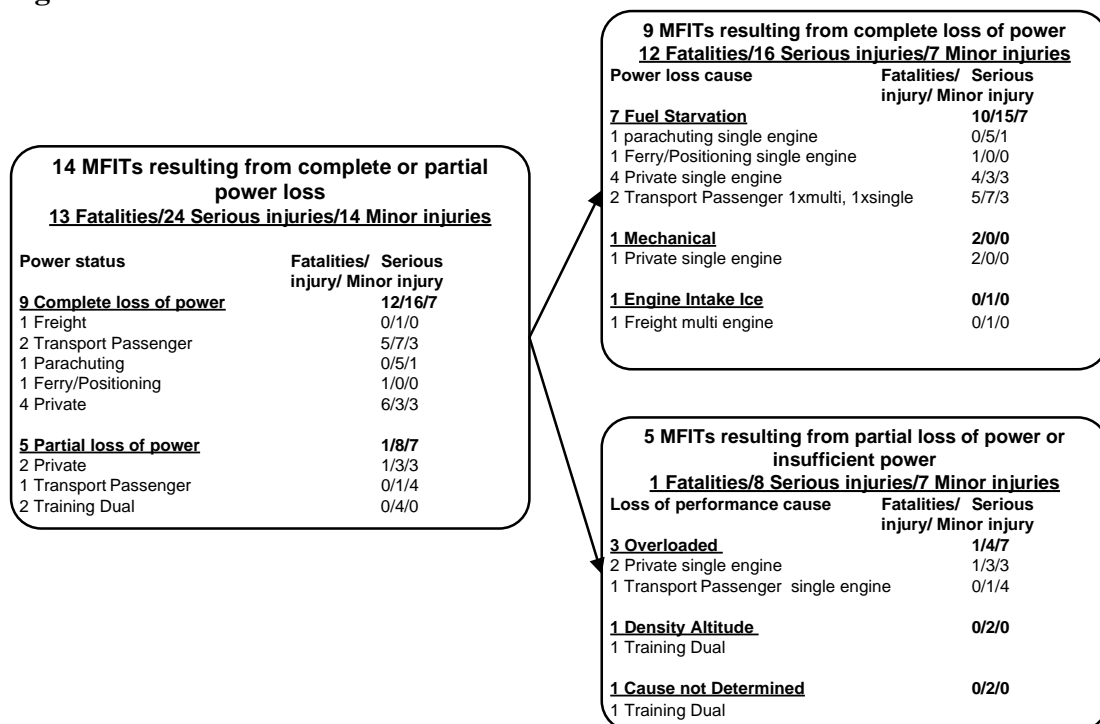
MFIT accidents produced the highest numbers of serious and minor injuries. Unlike CFIT or UFIT accidents, MFIT accidents allow the pilot and passengers some time to prepare for impact. The aircraft is still under the control of the pilot and therefore he or she will attempt to reduce the forces of impact by flaring the aircraft.

The majority of the fatalities for MFIT accidents occurred during ditching. All these fatalities were the result of drowning after the accident, not as a direct result of the impact forces. None of the persons who drowned after ditching were wearing lifejackets. Those involved in these accidents who were wearing lifejackets survived.

Figure 54 below shows MFIT accidents divided into complete or partial engine power loss. There were 9 MFIT accidents resulting from complete power loss and 5 from partial power loss. Of the 9 complete power loss accidents there were 7 that resulted from fuel starvation or exhaustion. Only one accident was due to mechanical problems that were out of the pilot's control.

The 5 accidents where partial power or insufficient performance was a cause were divided into three subsets. The majority of these accidents resulted from aircraft that were overloaded or operated in unsuitable atmospheric conditions.

Figure 54:



4.4 Uncontrolled Flight into Terrain (UFIT) fatal and serious injury accidents

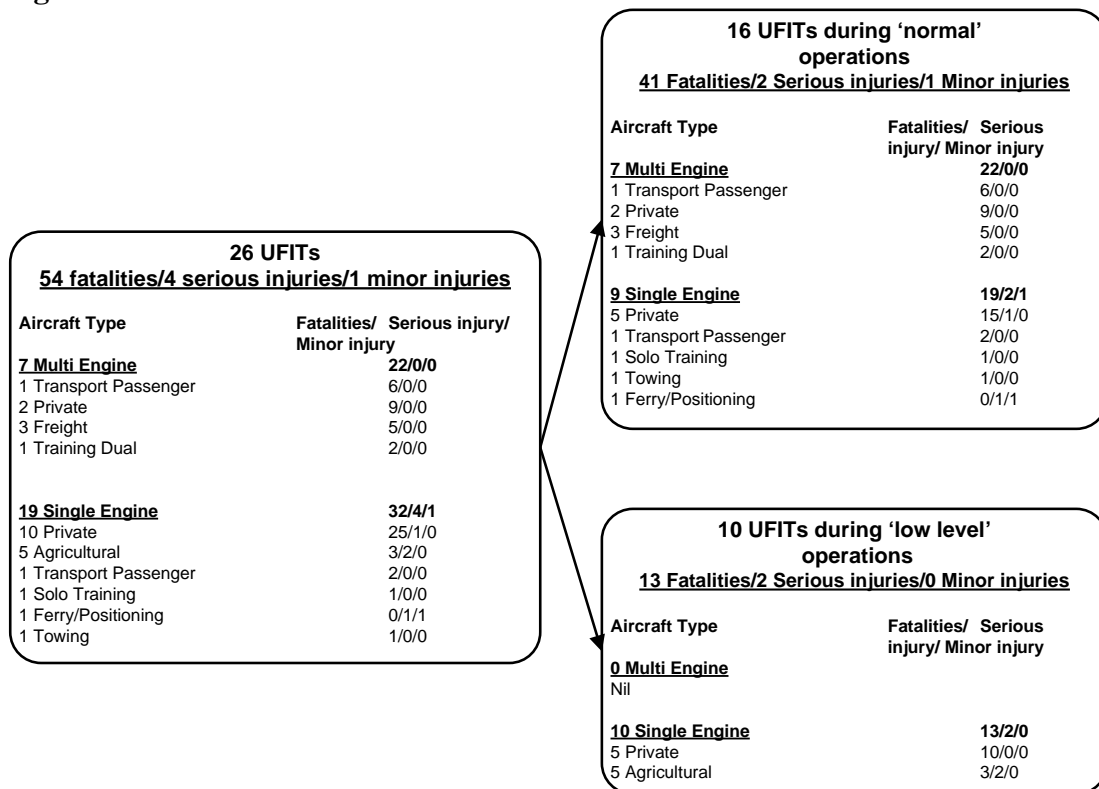
A UFIT accident was defined as an event where an aircraft collided with obstacles, objects or terrain after control of the aircraft was lost in-flight (includes cases where the pilot became incapacitated and where the aircraft structure changed after loss of control and prior to impact).

There were 26 UFIT accidents resulting in 54 fatalities (44% of all fatalities), 4 serious injuries and only 1 minor injury.

There were 16 UFIT accidents that occurred during 'normal' operations. These accidents had a total of 41 fatalities, 2 serious injuries and 1 minor injury.

There were 10 UFIT accidents that occurred during 'low level' operations. These accidents resulted in 13 fatalities, 2 serious injuries and no minor injuries.

Figure 55:



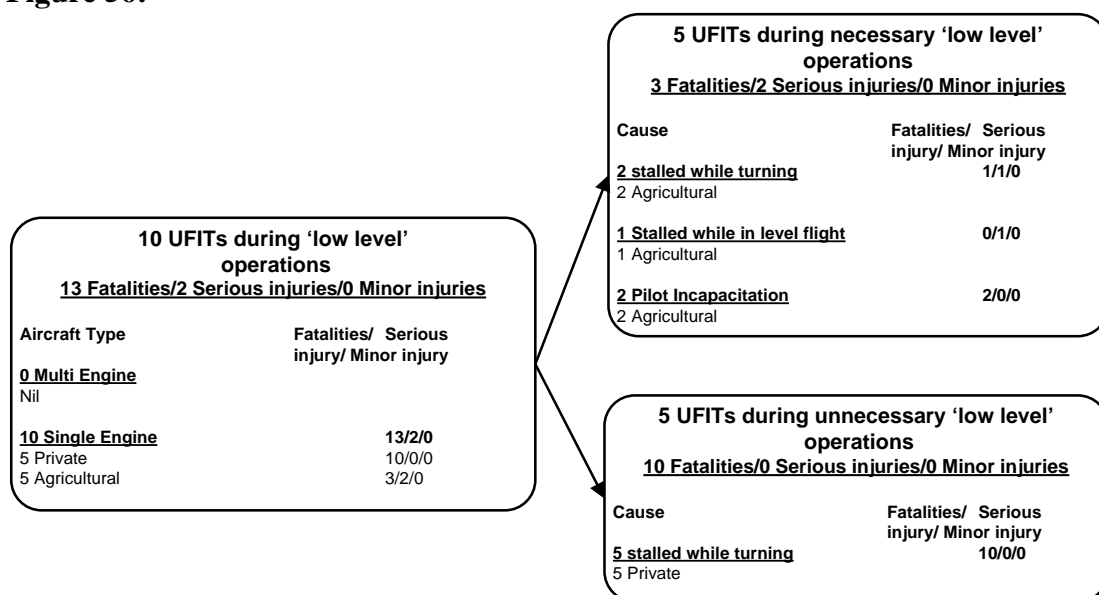
4.4.1 UFIT fatal and serious injury accidents during low level operations

There were 10 UFIT accidents that were classed as ‘low level’ operations. 5 UFIT accidents occurred during necessary ‘low level’ operations and 5 occurred during unnecessary ‘low level’ operations.

All of the unnecessary ‘low level’ UFIT accidents were the result of a stall while turning. These accidents resulted in 10 fatalities and no survivors. Low flying requires special training and has unique dangers such as perceived ground speed and depth perception that must be accounted for. Low flying operations also leave very little time for recovery if control of the aircraft is lost. The majority of pilots involved in ‘low level’ UFIT accidents had low total time and relatively low time on type. The majority of pilot’s had low 90 day currency (between 1 and 14 hours).

There were 2 pilot incapacitation accidents from the necessary ‘low level’ UFIT category, and 3 accidents resulting from stalls. All the necessary ‘low level’ UFIT accidents occurred during agricultural operations.

Figure 56:



4.4.2 UFIT fatal and serious injury accidents during ‘normal’ operations

There were 16 UFIT accidents that occurred during ‘normal’ operations. These accidents caused 41 fatalities (33% of all fatalities), 2 serious injuries and 1 minor injury.

Figure 57 (page 83) lists these accidents by aircraft type and operational category. These accidents have been split into 9 subsets based on the common cause that lead to loss of control.

The causes were:

- Inappropriate control inputs.
- Loss of visual reference.
- Weather related.
- Icing conditions.
- Aerobatics.
- Loss of engine power.
- Flight control failure.
- Avoiding obstacles.
- Undetermined causes.

4.4.2.1 Inappropriate control inputs

There were two accidents where control of the aircraft was lost as a direct result of inappropriate control inputs by the pilot. These two accidents resulted in 2 deaths and one serious injury. Both accidents were the result of stalls during turns. One occurred while turning onto finals while the other happened after take-off.

During take-off and landing, aircraft are usually at slow speeds and high drag configurations. An uncoordinated turn during these phases of flight can result in a stall and spin with little time for recovery. This was the case with both these accidents.

The solo training pilot had very low time while the private flight had a higher total time but very low 90 day currency. Both pilots were younger than the average age for accident pilots.

4.4.2.2 Loss of visual reference

There were two UFIT accidents where a loss of visual references was identified as the primary cause of the accident. These accidents resulted in 8 fatalities and no survivors.

One accident occurred when the pilot entered IMC during aerobatics and then lost control. The aircraft exited IMC conditions with insufficient time to recover control of the aircraft.

The other accident involved an aircraft stalling after takeoff when the natural horizon was lost due to terrain. This accident involved a low time pilot who was not qualified to control the aircraft by instruments alone.

4.4.2.3 Weather related

There were two UFIT accidents where loss of control was attributed to marginal weather. There were 6 fatalities, 1 serious injury and 1 minor injury as a result of these accidents.

Both accidents involved stalls during turns while the pilot was trying to escape adverse weather and restricting terrain. Inappropriate pilot control inputs were the cause of the stalls, but the turns would not have been necessary if the adverse weather was not present. Although both pilots had made a decision to reverse course, there was evidence to suggest these decisions were left too late and should have been made when poor weather was first encountered.

4.4.2.4 Icing conditions

There were two 'normal' UFIT accidents that resulted from in-flight icing adhering to control surfaces. These accidents resulted in 3 fatalities and no survivors. Both aircraft were multi engine IFR freight flights. All the pilots (one aircraft was multi crew) had relatively high time. Both accidents occurred at night while the aircraft were in IMC and both accidents occurred within a relatively short geographic distance of each other.

One of the aircraft broke up after control was lost before impacting with the ocean. The pilot of the other accident aircraft may have had his situational awareness impaired by carbon monoxide poisoning.

4.4.2.5 Aerobatics

There was only one 'normal' UFIT accident that resulted from aerobatic manoeuvres (2 fatalities). The pilot deliberately entered a spin from which he did not recover. No definite cause was established for this accident, although passenger interference was suspected.

The pilot was a high time experienced aerobatic pilot.

4.4.2.6 Loss of engine power

There were two 'normal' UFIT accidents where loss of engine power was the causal factor. These two accidents resulted in 9 deaths and no survivors. Both accidents involved multi engine aircraft. Both accidents involved pilots with approximately 1000 hours flying time and about 70 hours on type.

The pilot of the private flight lost control of his aircraft after one engine failed and he was attempting to land his aircraft back on the runway. The aircraft stalled while turning in a high drag configuration.

The other accident occurred after both engines failed due to fuel starvation. The pilots lost control of the aircraft while dealing with the double engine failure.

4.4.2.7 Flight controls failure

There was one aircraft where failure of the flight controls led to a UFIT accident. The pilot failed to notice that the control lock for the duplicate set of flight controls in the rear seat was not removed prior to flight. The aircraft was towing a glider at the time of the accident. The pilot had low time on the type of aircraft involved and only a small amount of experience as a tow pilot.

4.4.2.8 Avoiding obstacles

There was one 'normal' UFIT accident where the pilot was trying to avoid an obstacle at the time of the accident. The aircraft was seen to be flying through a valley when it pulled up sharply to avoid a wire. The aircraft stalled and then impacted the ground. All three occupants were killed.

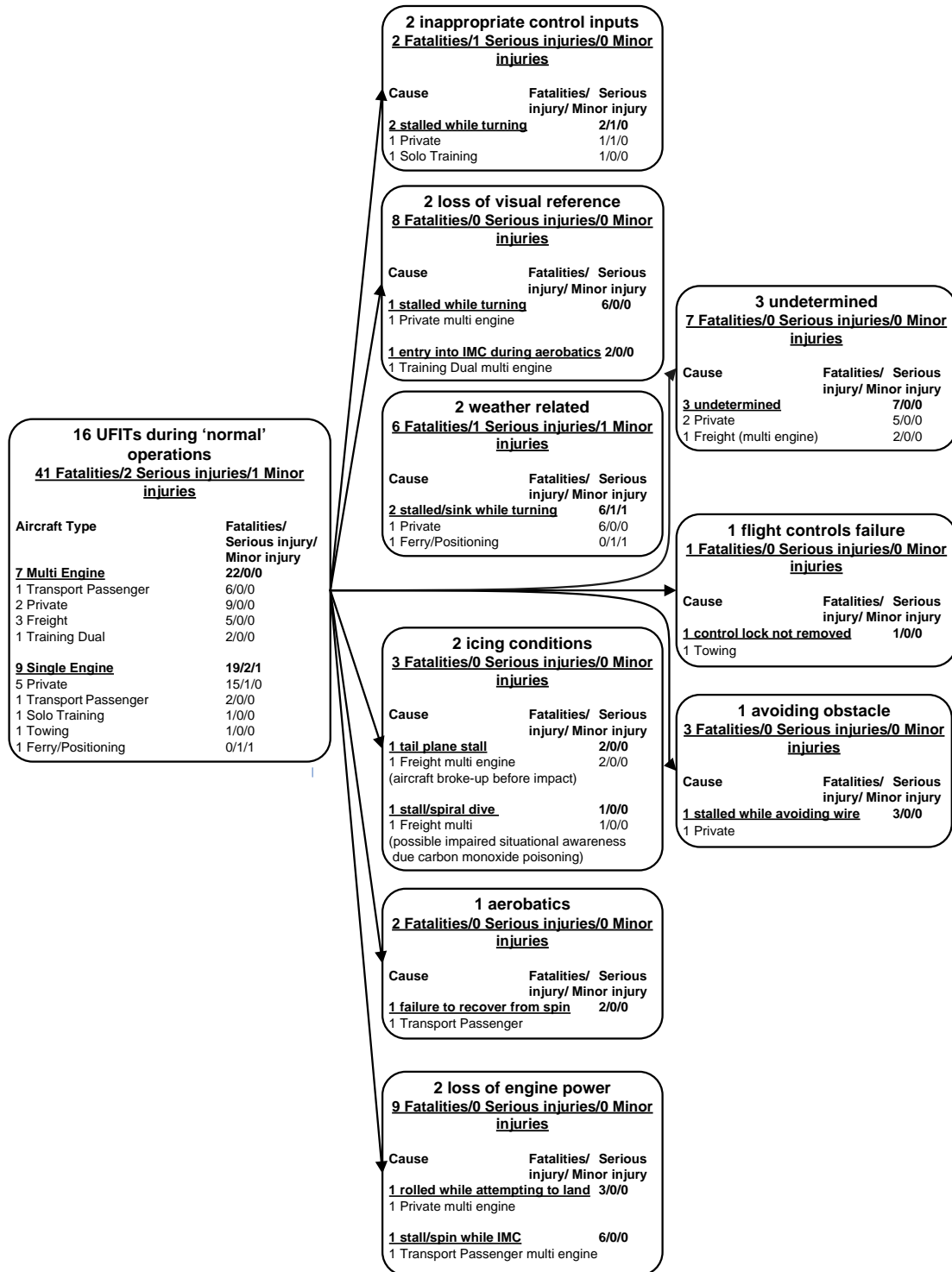
4.4.2.9 Undetermined causes

There were three accidents where control of the aircraft was lost for undetermined causes. These accidents resulted in 7 fatalities and no survivors.

It is worth noting that inappropriate control inputs by the pilot were the cause of most of the 'normal' UFIT accidents. Inappropriate control inputs may not have been the only cause of the accident but they were the ultimate cause for loss of control. It is also worth noting that a high number of these accidents involved stalls (resulting in spins) while the aircraft was turning.

Pilots should be aware that excessive bank angles will increase the stall speed of an aircraft significantly.

Figure 57:



4.5 Remaining fatal and serious injury accident types.

The following accidents were not classed as CFIT, MFIT or UFIT accidents. There were 22 accidents in this category (27.5% of total fatal and serious injury accidents). These accidents resulted in 11 fatalities, 15 serious injuries and no minor injuries.

4.5.1 Impact to external parties

An impact to external party accident was defined as an event where there was an impact to persons external to the aircraft as a result of the aircraft's normal activities.

There were two accidents involving impact to an external person. These accidents resulted in two fatalities.

The first accident occurred while the aircraft was waiting to refuel with the engine still running. The accident was caused when the spotter decided to leave the aircraft while the engine was running and make his way to a helicopter at the refuelling point by the shortest route. He was struck by the rotating propeller and fatally injured. The contributory factors were the ambient noise level generated by the rotors of the helicopter and the blending of the aircraft's propeller against the background.

It is unclear why the passenger was allowed to depart the aircraft while the engine was still running, but it is likely that the pilot thought the passenger would exit to the rear of the aircraft and not over the leading edge.

The other accident involved a Pacific Aerospace Cresco in Malaysia. On take-off a motor cyclist rode out in front of the aircraft. The propeller struck the motor cyclist who died as a result of the injuries.

Both pilots involved in these accidents had close to 2000 hours with high time on type and high currency time. The pilot involved in the collision with the motor cyclist was in his early thirties while the other pilot was in his late fifties.

Figure 58:

2 impact to external parties	
2 Fatalities/0 Serious injuries/0 Minor injuries	
Aircraft Type	Fatalities/ Serious injury/ Minor injury
0 Multi Engine	0/0/0
2 Single Engine	2/0/0
1 Aerial work	1/0/0
1 Agricultural	1/0/0

4.5.2 Take-off impacts

A take-off impact accident was defined as an event where an aircraft impacted with the runway or terrain/obstacles adjacent to the runway during take-off prior to getting airborne.

There were four accidents classified as take-off impacts. These accidents resulted in 1 fatality and 3 serious injuries.

Three of these accidents occurred during agricultural operations. Agricultural air strips are often used infrequently and are maintained by private land owners. Airstrip condition was a cause in at least one of the take-off impact accidents. Other causes included pilot incapacitation (pilot age 63) and inadequate performance due to aircraft overload.

There was one take-off impact accident that occurred during a private operation. The accident involved a high performance WWII military aircraft. The pilot failed to set the rudder trim to the correct position for take-off. The pilot was very experienced but had less than 6 hours on type at the time of the accident.

The average flight time for the four pilots involved in take-off impact accidents was 14,000 hours. All the pilots had good currency and time on type (other than the private operation).

Figure 59:

4 take-off impacts	
<u>1 Fatalities/3 Serious injuries/0 Minor injuries</u>	
Aircraft Type	Fatalities/ Serious injury/ Minor injury
<u>0 Multi Engine</u>	0/0/0
<u>4 Single Engine</u>	1/3/0
1 Private (Spitfire)	0/1/0
3 Agricultural	1/2/0

4.5.3 Fatal and serious injury accidents resulting from landing impacts.

A landing impact accident was defined as an event where an aircraft impacted with the runway or terrain/obstacles adjacent to the runway during landing or landing roll.

There were four fixed wing fatal or serious injury accidents that resulted from landing impacts. No persons received fatal injuries as a result of these accidents. Six persons were seriously injured.

It is worth noting that 46% of all fixed wing accidents between 1995 and 2004 occurred during the landing phase of flight. This statistic would reinforce the claim that the most dangerous phase of flight is landing.

However, there were no fatal injuries that occurred during the landing phase of flight. The phase of flight that produced the most fatalities and serious injuries was the cruise.

There were three private landing impact accidents and one dual training accident involving a float plane. All the accidents involved inappropriate control inputs. One accident occurred while trying to land in strong crosswinds, another was the result of a failed go-around, and the final accident involved unexpected control inputs by a student.

Figure 60:

4 landing impact		
<u>0 Fatalities/6 Serious injuries/0 Minor injuries</u>		
Aircraft Type	Fatalities/	Serious injury/
	Minor injury	
<u>0 Multi Engine</u>		0/0/0
<u>4 Single Engine</u>		0/6/0
3 Private		0/4/0
1 Training Dual (Float plane)		0/2/0

4.5.4 Fatal and serious injury in-flight break-ups

An in-flight break-up was defined as an event where pieces of an aircraft necessary for controlled flight separated from the aircraft during flight.

There was only one fixed wing fatal accident that was the direct result of an in-flight break-up. This accident occurred during agricultural operations and resulted in one fatality.

The tail fin separated in flight; the aircraft struck a ridge and caught fire. The pilot was killed and the aircraft destroyed. The fin separation was beyond the pilot's control and was caused by cracks² concealed beneath the rubber abrasion strip fitted to the fin making them difficult for engineers to detect during inspection.

Figure 61:

1 in-flight break-up		
<u>1 Fatalities/0 Serious injuries/0 Minor injuries</u>		
Aircraft Type	Fatalities/	Serious injury/
	Minor injury	
<u>0 Multi Engine</u>		0/0/0
<u>1 Single Engine</u>		1/0/0
1 Agricultural (separation of tail fin during flight)		

² The 'cracks' occurred along score lines on the skin of the aircraft that engineering staff made while cutting covering materials with a knife. These score lines were later concealed by a rubber abrasion strip.

4.5.5 Fatal and serious injury accident with unknown causes.

There were 8 accidents with limited or no information available to fully determine the cause of the accident. These accidents lead to 7 fatalities and 2 serious injuries.

Two of the accidents involved aircraft that went missing (one was later found by hunters five years after the accident).

Figure 62:

8 unknown accident types		
<u>7 Fatalities/2 Serious injuries/0 Minor injuries</u>		
Aircraft Type	Fatalities/	Serious injury/
	Minor injury	
<u>0 Multi Engine</u>		0/0/0
<u>8 Single Engine</u>		7/2/0
3 Agricultural		2/1/0
2 Private		2/0/0
1 Training Solo		1/0/0
1 Freight		1/0/0
1 Training Dual		1/1/0

4.5.6 Fatal and serious injury accident with 'other' causes.

There were 3 accidents that were classed as 'other'. Two accidents involved passengers falling down steps while departing the aircraft. The other accident resulted in two flight attendants receiving serious injuries after their Boeing 737 hit severe turbulence

Figure 63:

3 Other		
<u>0 Fatalities/4 Serious injuries/0 Minor injuries</u>		
Aircraft Type	Fatalities/	Serious injury/
	Minor injury	
<u>3 Multi Engine</u>		0/4/0
3 Transport Passenger (2 crew + 2 Passengers)		0/4/0
<u>0 Single Engine</u>		0/0/0

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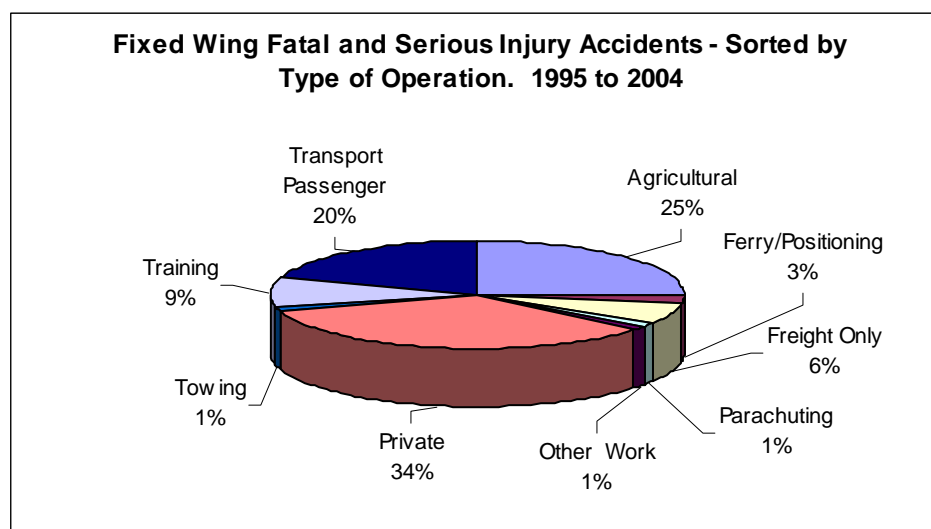
5 SEPARATE EVENT ANALYSES

This section of the report groups fatal and serious injury accidents by type of operation. Figure 64 shows the various types of operations that fixed wing aircraft were flying at the time of the fatal or serious injury accident.

Operational groups were chosen for the separate analysis because of their differing characteristics. A mistake that can be fatal for one type of operation can go unnoticed for another type. By breaking the accidents down into common operational groups it is hoped that a better understanding of the main safety issues facing the different groups will be understood.

The three largest groups were Private flights, Agricultural operations and Transport Passenger flights. These three operational groups had a combined count of 109 fatalities, 52 serious injuries and 17 minor injuries.

Figure 64:



Source: NZ CAA Database

5.1 Agricultural fatal and serious injury accidents

There were 20 fatal and serious injury accidents that occurred during agricultural operations (see Appendix B for definition of Agricultural Operation) between 1995 and 2004. These accidents resulted in 14 fatalities and 7 serious injuries. Only one of these accidents involved more than one person.

Most agricultural operations are conducted by single pilots and by definition do not carry passengers. This would account for the low count of fatalities and injuries when compared with other operation types.

Figure 65 below shows those accidents that occurred during agricultural operations. The accidents have been sorted into descriptor categories and those have been further sorted into causal factors.

CFIT accidents formed the largest grouping for agricultural operations. Trees and other objects protruding from the ground were the most common objects that were struck by agricultural aircraft. This highlights the need for agricultural pilots to maintain a diligent lookout while conducting spraying and other forms of agricultural operations.

Pilot incapacitation was common among agricultural fixed wing accidents. The average age of agricultural pilots involved in fatal or serious injury accidents was 41 years. There were 2 UFIT accidents and 1 take-off impact accident where pilot incapacitation was the main cause. The average age of these pilots was 50 years (nine years higher than the total average). All the pilots involved in agricultural accidents were male.

Stalls also featured as a common cause for agricultural accidents. Agricultural pilots are often called upon to perform tight turns and operate in restricted areas. This can lead to pilots exceeding the limitations of their aircraft.

Agricultural aircraft are operated in high 'G' situations and often at maximum weight (or overloaded if authorisation has been granted by the CAA³). These factors can put extra strain on the airframe and alter the stall and handling characteristics of an aircraft.

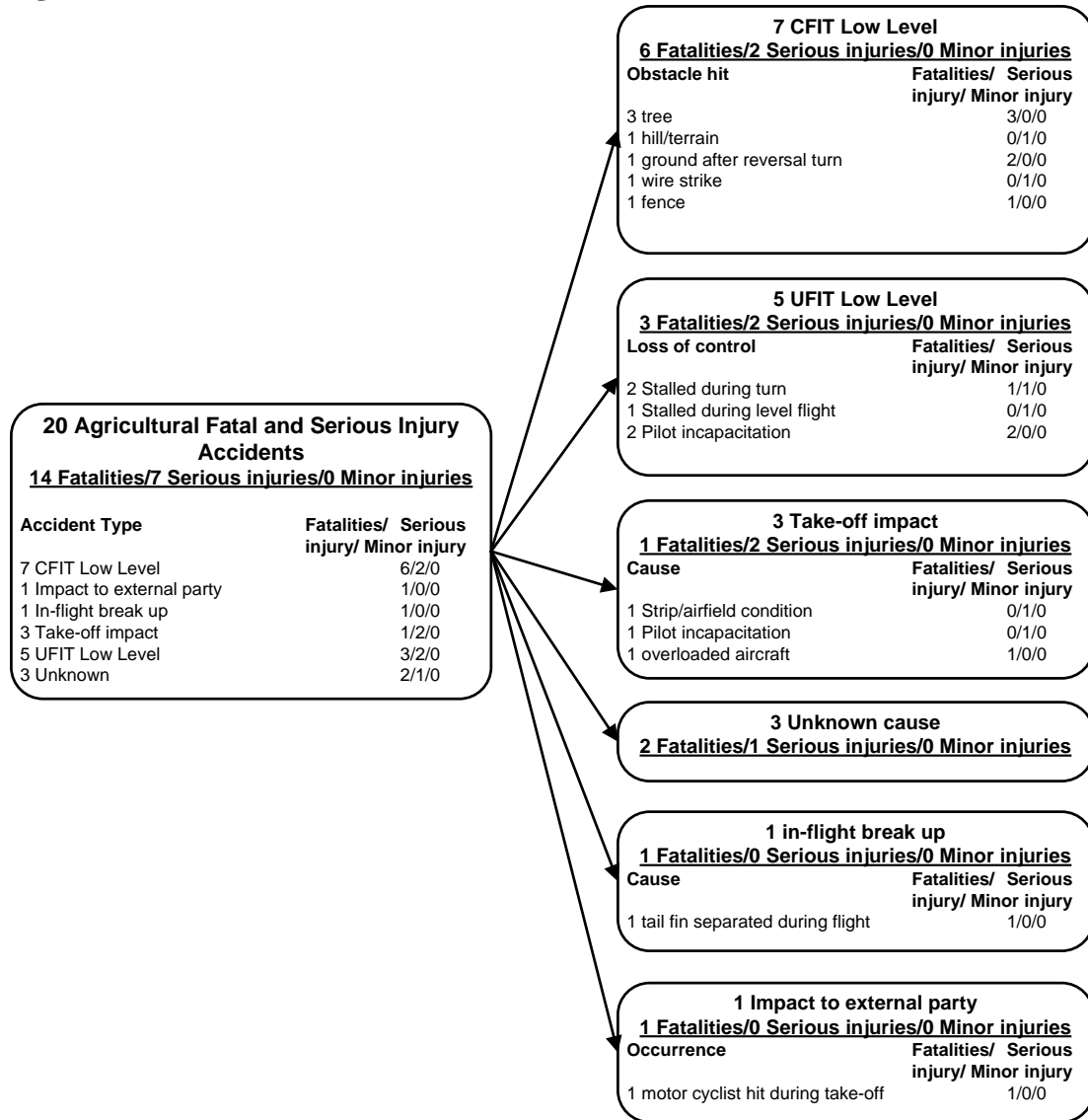
When examining all agricultural fixed wing accidents other areas of concern were identified. Strip condition, overloading and pilot fatigue played a part in many agricultural accidents, and although not necessarily the main cause these factors contributed to the accident causal sequence.

Flight time for pilots involved in fatal or serious injury agricultural accidents ranged from 260 to 22,100 hours with an average of 6,000 hours. The average time of type

³ Civil Aviation Rule Part 137.103 and Appendix B provide for agricultural aircraft to take-off at a weight greater than the MCTOW (The "Agricultural Overloading Rule"). Appendix B provides that the pilot must take into account certain factors when considering whether to operate at the greater weight. However the Agricultural Overloading Rule does not provide any guidance as to what specific flight operational matters those factor may effect. – CAA Reference 1R-CAR137-13 (DW1101458-0)

for these accidents was 3200 hours with an average of 110 hours for the 90 day currency.

Figure 65:



5.2 Private fatal and serious injury accidents

For the purposes of this report a private fixed wing flight is defined as any non-commercial (any flight operated by, or used by, a business or organisation) flight conducted for recreation or transport. It excludes business and training flights as well as ferry/positioning flights and all other Aerial work (both profit and non-profit). It also excludes test flights.

There were 27 fatal or serious injury fixed wing accidents between 1995 and 2004 that were classed as private flights. These accidents resulted in 47 fatalities (38% of total fatalities), 14 serious injuries, and 7 minor injuries.

Figure 66 below shows those accidents that occurred during private operations. The accidents have been sorted into descriptor categories and those have been further sorted into causal factors. The final two groupings in Figure 64 highlight two common traits among accidents involving private flights.

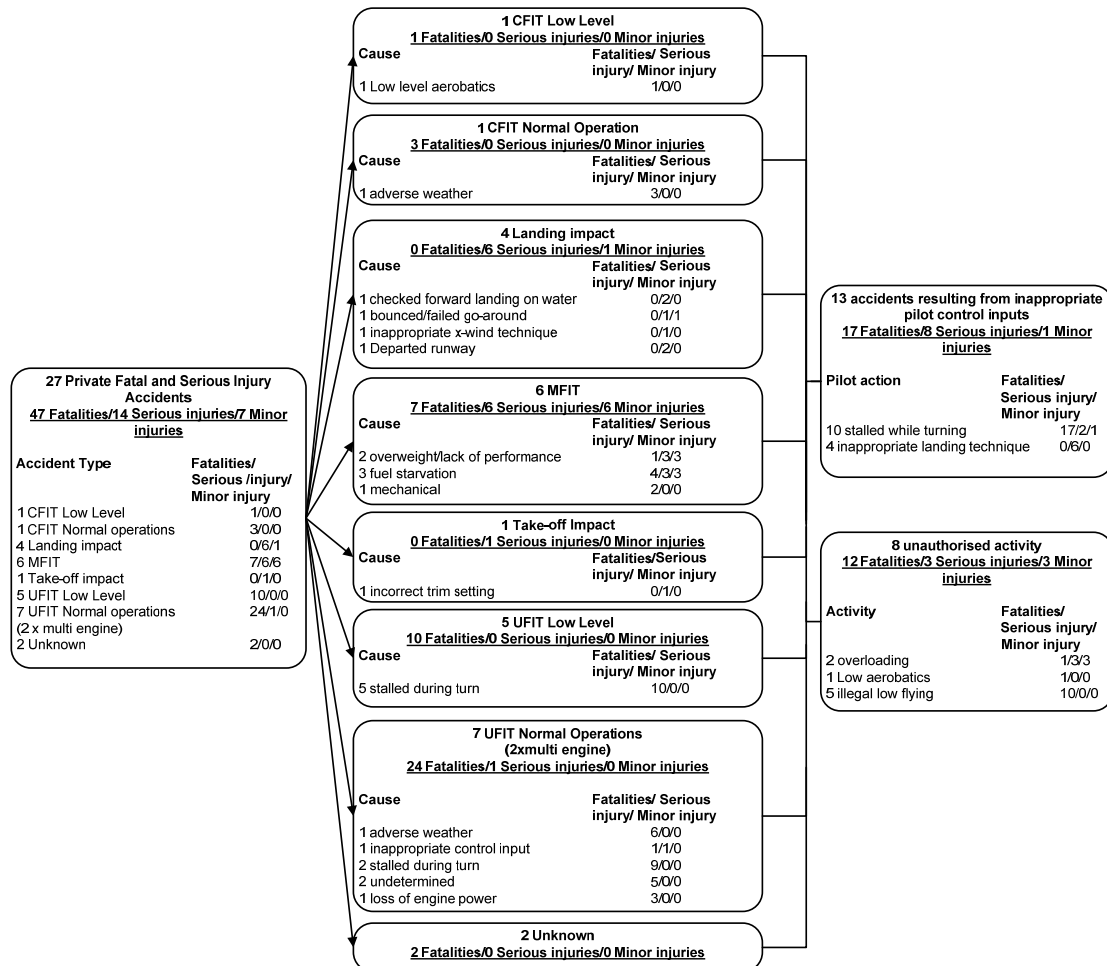
The most frequent type of accidents for private operations was UFIT. There were 7 UFIT accidents during normal operations and 5 during low level operations. Private UFIT accidents resulted in 34 fatalities (72% of Private fatalities) and only one survivor (serious injury). All of the low-level Private UFIT accidents occurred during unauthorised activities (illegal low flying). Almost all of the Private UFIT accidents were the direct or indirect result of inappropriate control inputs.

Private pilots are often not as current as commercial pilots and do not have the same accountability structure as air transport pilots. Re-currency training for the private pilot is less frequent than for a commercial pilot. All these factors can add up to leave the private pilot less prepared for emergency situations than commercial pilots.

The average total flight time for private pilots involved in a fatal or serious injury accident was 1778 hours (median was 500). Approximately 67% of private accident pilots had less than 1000 hours total time. The average time on type, for aircraft involved in the accident, was 332 with a median of 85. The 90 day currency was only 32 hours on average with the median being 19 hours.

Stalling while turning accounted for at least 10 of the 27 private fatal or serious injury accidents. An awareness of the dangers of stalling during various phases of flight is vital for the safe operation of an aircraft. Safety margins should always be added to airspeeds and extreme manoeuvres should be avoided unless well planned and practised.

Figure 66:



5.3 Transport passenger fatal and serious injury accidents

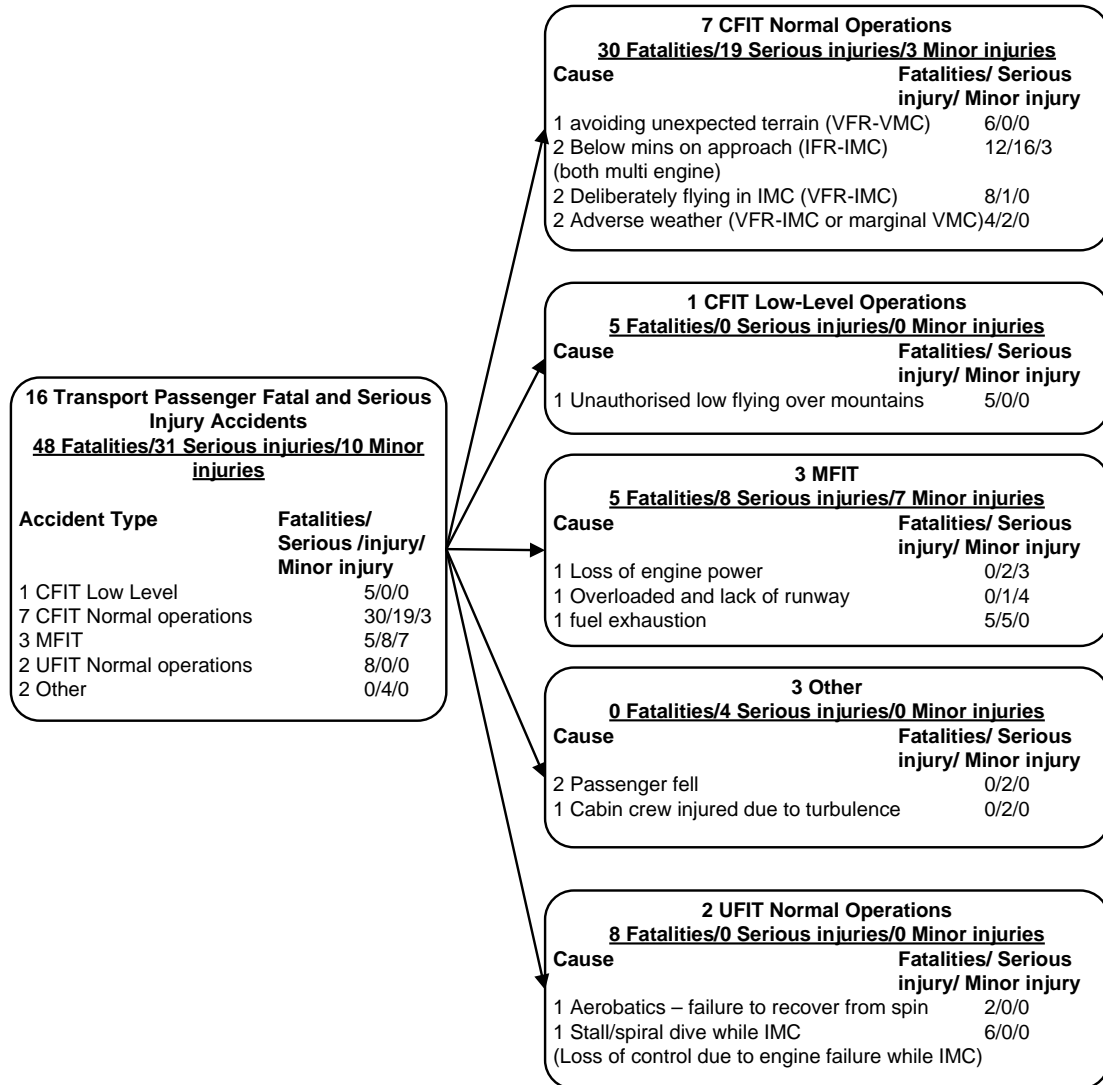
Air transport operation means an operation for the carriage of passengers or goods by air for hire or reward.

There were 16 fatal or serious injury accidents that occurred during transport passenger operations. This category had the highest ratio of fatalities per accident with an average of 3 fatalities per accident. There was a total of 48 fatalities (39% of total fatalities), 31 serious injuries (47 % of total serious injuries), and 10 minor injuries. The average number of Persons on board (POB) for Transport Passenger fatal or serious injury accidents was 6.1 (*one accident with a POB of 122 was excluded as its deviation from the standard distribution was considered too large*). This high POB per aircraft ratio would account for the large number of fatalities and injuries as the result of Transport Passenger accidents.

It is worth noting that many of these accidents were the result of inappropriate decision making, but not necessarily inappropriate control inputs. Poor planning, flying in inappropriate weather, and disregard for the rules were all contributing factors in many of these accidents.

The average flight time of the pilots involved in these accidents was 4407 hours and the average time on type of aircraft involved in the accident was 623. The average 90 day currency of the pilots was 110 hours. These totals are significantly higher than those of private accidents. The average 90 day currency is the same as for agricultural pilots.

Figure 67:



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6 CONCLUSION

This study has identified the different types of fixed wing aviation accidents that have involved New Zealand registered aircraft over the last ten years (1995 to 2004). The study has also attempted to isolate some of the common causal factors and latent risks associated with these accidents.

Thanks to the classification system designed by the Australian Transport Safety Bureau (ATSB), the fatal and serious injury fixed wing accidents could be more accurately analysed and specific risk factors could be identified.

Factors that were identified as possible risk indicators included flight hours, pilot age, type of operation, flight rules and crew numbers. The study identified that total flight time was not a good safety indicator, whereas time on aircraft type and flight currency were. The data also suggested that those pilots who gain their licence at an older age are more at risk than those who start flying at younger ages. Agricultural and private operations scored the highest risk of a fatal accident while passenger transport flights had far less risk. Instrument Flight Rules (IFR) flights were far less likely to be involved in accidents than Visual Flight Rules (VFR) flights. Single pilot aircraft were 42 times more likely to have an accident than multi crew aircraft and 13 times more likely to have a fatal accident than multi crew aircraft.

Other factors such as the time of day and day of week for accident occurrences were less conclusive. Saturday was the most frequent day for fixed wing accidents while Friday was most common for fatal accidents. Midday to mid afternoon was the most common time for accidents with most fatal accidents occurring between 1400 and 1500 local time. No clear explanation can be given for this trend, although end of week fatigue and increased private flying during weekends may have played a part. Revenue flights had higher numbers of accidents midweek and Friday whereas the majority of non-revenue accidents occurred at weekends.

The most common type of fatal or serious injury fixed wing accident was Uncontrolled Flight into Terrain (UFIT) followed by Controlled Flight into Terrain (CFIT) and Managed Flight into Terrain (MFIT) accidents (see Appendix A for definitions).

UFIT accidents happened for a variety of reasons but it is worth noting that inappropriate control inputs featured strongly as a contributing cause in most of these accidents. It is also worth noting that a high number of these accidents involved stalls (resulting in spins) while the aircraft was turning. Icing was a common cause for loss of control by IFR UFIT accidents.

Agricultural operations featured strongly among the CFIT low level accidents with the majority hitting trees or hills; this is consistent with New Zealand terrain. Most of the CFIT accidents during 'normal' operations involved VFR aircraft with limited or zero external visibility. All the IFR CFIT accidents occurred during instrument approaches.

The MFIT accidents resulted in more serious injuries than fatalities. Most of the fatalities for MFIT accidents were the result of ditching. All these fatalities resulted from drowning rather than impact forces. All those who drowned were not wearing lifejackets.

All the MFIT accidents were initiated by engine failure or lack of performance. Only one accident was the direct result of mechanical failure that was beyond the control of the pilot. A large percentage of these accidents involved fuel starvation or exhaustion. Overloading also featured as a common cause.

It was determined that air transport passenger accidents were linked to inappropriate decisions rather than control inputs while private accidents were a combination of inappropriate control inputs and inappropriate decisions.

Competency and currency were identified as key safety indicators. The data showed that training flights produce relatively few accidents compared to other types of operations. The data also showed that pilots with very low total time were less at risk than those with moderate amounts of flight time (200 to 2000 hours). Pilots with low 90 day currency were also at risk. This would suggest that pilots (particularly Private pilots) who are no longer under the supervision of an instructor and fail to maintain their skill base place themselves at risk.

This study has shown that many factors can put a fixed wing pilot at risk. Flight skills and decision making are vital in preventing accidents. The study would seem to suggest that IFR multi crew passenger transport flights are among the safest flights from a risk factor prospective.

This study contains valuable data relating to fixed wing accidents, and if used correctly could reduce risk factors and increase the effectiveness of safety initiatives.

It is worth noting that this study did not fully examine organisational culture. This should be kept in mind when interpreting the results of this study as there is evidence showing that organisational culture (or lack of it) can influence safety. Culture and company structure may be one reason why Air Transport operations have lower accident rates than other types of operations.

7 APPENDIX A

The following definitions were developed by the ATSB and have been adopted by this report to provide the most complete description available of the largest groups of accidents.

Controlled flight into terrain (CFIT)

An event where an aircraft collided with obstacles, objects or terrain during powered controlled flight with little or no awareness on the part of the pilot of the impending impact.

Ground collision

An event where there was contact between an aircraft with other aircraft, vehicles, objects, animals on runway or taxiway.

Impact to external party

An event where there was an impact to persons external to the aircraft as a result of an aircraft's normal activities (excludes occurrences where control of the aircraft had been lost prior to external party being impacted).

In-flight break-up

An event where pieces of an aircraft necessary for controlled flight separated from the aircraft while in-flight.

Landing impact

An event where an aircraft impacted with runway or terrain/obstacles adjacent to the runway during landing or landing roll (excludes 'ground collision').

Low-level operations

'Low-level' operations were planned and conducted below the envelope of normal operations (see the definition of normal operations), and predominantly comprised agricultural operations and illegal low-level flying.

Managed flight into terrain (MFIT)

An event where an aircraft collided with obstacles, objects or terrain while being flown under limited control or reduced performance, with insufficient height/performance to reach a designated landing area.

'Normal' operations

Operations that were conducted within the normal rules of flight without any special dispensations for low-level operations. Normal operations included take-off and landing, climb and descent normally associated with take-off and landing, and en-route flying and manoeuvring as well as unplanned descent below the normal minimum flying height because of stress of weather. Activities associated with instrument approach procedures were also considered normal operations.

Other

Events where the circumstances were unusual and did not fit into the defined categories. Also includes those accidents where the circumstances were not considered to be matters of aviation safety.

Take-off impact

An event where an aircraft impacted with the runway or terrain/obstacles adjacent to runway during the take-off run prior to getting airborne (excludes 'ground collision').

Uncontrolled flight into terrain (UFIT)

An event where an aircraft collided with obstacles, objects or terrain after control of the aircraft was lost in-flight (includes cases where the pilot became incapacitated).

Unknown

Events where the state of the aircraft prior to accident damage could not be determined from the information available.

8 APPENDIX B

Glossary of terms

Accident

An occurrence that is associated with the operation of an aircraft and takes place between the time any person boards the aircraft with the intention of flight and such time as all such persons have disembarked and the engine or any propellers or rotors come to rest, being an occurrence in which—

- (1) a person is fatally or seriously injured as a result of—
 - (i) being in the aircraft; or
 - (ii) direct contact with any part of the aircraft, including any part that has become detached from the aircraft; or
 - (iii) direct exposure to jet blast— except when the injuries are self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to passengers and crew; or
- (2) the aircraft sustains damage or structural failure that—
 - (i) adversely affects the structural strength, performance, or flight characteristics of the aircraft; and
 - (ii) would normally require major repair or replacement of the affected component— except engine failure or damage that is limited to the engine, its cowlings, or accessories, or damage limited to propellers, wing tips, rotors, antennas, tyres, brakes, fairings, small dents, or puncture holes in the aircraft skin; or
- (3) the aircraft is missing or is completely inaccessible:

Active Failures

Errors and violations that are likely to have a direct impact on safety and have immediate effects.

Agriculture operations

The operation of an aircraft, on a single flight, or on a series of flights, including transit flights to and from a treatment area that is within 5 nautical miles of the loading area, for the following purposes:

- (1) dispensing an agricultural chemical;
- (2) dispensing any other substance intended for plant nourishment, soil treatment, propagation of plant life, or pest control;
- (3) engaging in dispensing activities directly affecting agriculture, horticulture, or forest preservation;
- (4) dropping farm supplies on farms in rural areas or delivering farm materials to farms in rural areas;
- (5) surveying agricultural, forest, or water areas at a height of less than 500 feet above terrain;
- (6) feeding or transferring livestock on farms in rural areas;
- (7) the reconnaissance of the proposed treatment area for the above types of operation.

Fatal accident

An aircraft accident in which at least one person is fatally injured.

Fatal injury

For statistical uniformity only, an injury resulting in death within thirty days of the date of the accident is classified as a fatal injury by ICAO.

Fixed wing Aircraft

Means a “power-driven heavier-than-air aircraft deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight”. The sample does not include micro light aircraft, amateur built aircraft, gliders or sports category aircraft.

Flight crew member

Means a pilot or flight engineer assigned to duty in an aircraft during flight time

Flying training

Flying under instruction for the issue or renewal of a licence or rating, aircraft type endorsement or conversion training. Includes solo navigation exercises conducted as part of a course of applied flying training.

Hours flown

Hours flown are calculated on a ‘chock to chock’ (wheel start to wheel stop) basis, and therefore includes taxiing time.

Incident

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

Latent Failures

Faults with an organisation or procedures that may lay dormant for large periods of time and contribute to a safety failure.

Minor injury

An injury sustained by a person in an accident that was not a fatal or serious injury.

Other aerial work**Private/business flying**

Encompasses flying by the aircraft owner, the operator’s employees or the hirer or the aircraft for business or professional reasons but not directly in trade or commerce and; flying for private pleasure, sport or recreation, or personal transport not associated with a business or profession.

Serious injury

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

- a) requires hospitalisation for more than 48 hours, commencing within seven days from the date the injury was received; or
 - b) results in a fracture of any bone (except simple fractures of fingers, toes, or nose);
- or

- c) involved lacerations which cause severe haemorrhage, nerve, muscle or tendon damage; or
- d) involves injury to any internal organ; or
- e) involves second or third degree burns, or any burns affecting more than 5 per cent of the body surface; or
- f) involves verified exposure to infectious substances or injurious radiation.

VFR flight

A flight conducted in accordance with the visual flight rules.

Visual meteorological conditions

Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima.

IFR flight

A flight conducted in accordance with the instrument flight rules.

Instrument flight

Flight during which an aircraft is piloted solely by reference to instruments and without external reference points.

Instrument meteorological conditions

Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling less than the minima specified for visual meteorological conditions: