New Zealand Helicopter Association

Safety Bulletin

History of helicopter safety in New Zealand

Performance in 2014 so far

Accidents and available

NZHA SAFETY BULLETINS

SB 2

For those who didn't make it to the conference, here's a summary of the main points raised in the presentation on New Zealand Helicopter safety.

We looked at the accident data from 1970 through to the present to establish the overall performance of the industry since it began. Here are some numbers:

People:

188 fatalities; 97 of them pilots and crew, 89 passengers.

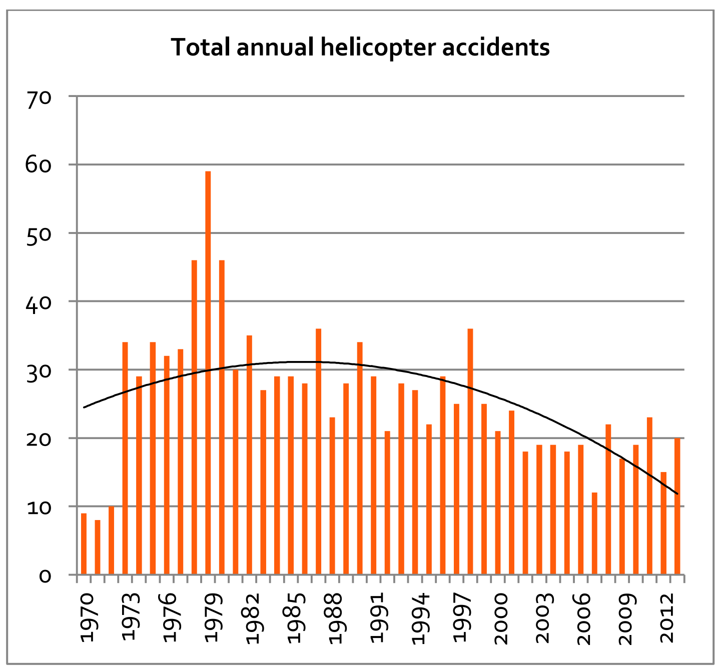
That's 4 deaths a year, on average.

Machines:

346 destroyed or written off; 228 piston, 118 turbine.

That's around $1 Billion in lost equipment and lives in today's dollar terms, and that *doesn't* include injury, recovery *or* those machines that were damaged but repaired.

Safety has improved over time but since 2000 the industry has plateaued at around 20 accidents a year and 3.6 fatalities. The challenge facing the industry now is tackling that plateau.



With 1154 accidents since 1970, we can safely say that we have had every kind of accident we can have. The approach of the NZHA is to squeeze as much information as we can from the data, and to distribute it as widely as we can. It's only by using this information to change our operating policies and procedures that we will stop destroying machines and killing and injuring ourselves and others in accidents.

We also took a look at the commercial helicopter industry as it currently stands:

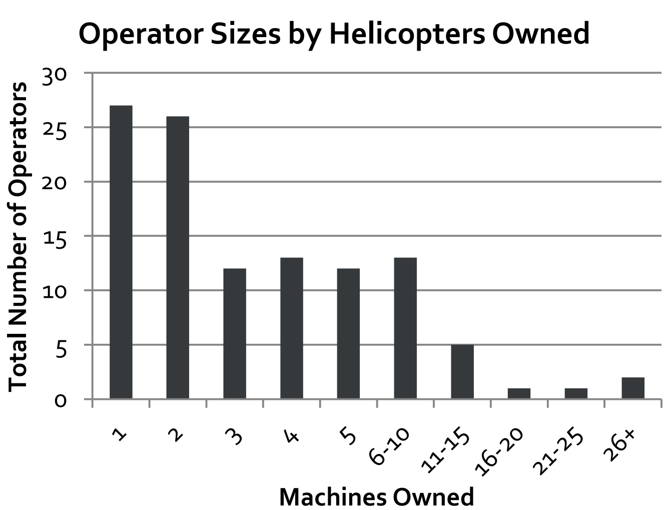
137 commercial operators

who own and operate 512 helicopters.

124 ATPL holders are currently active

and 1237 CTPL holders are currently active.

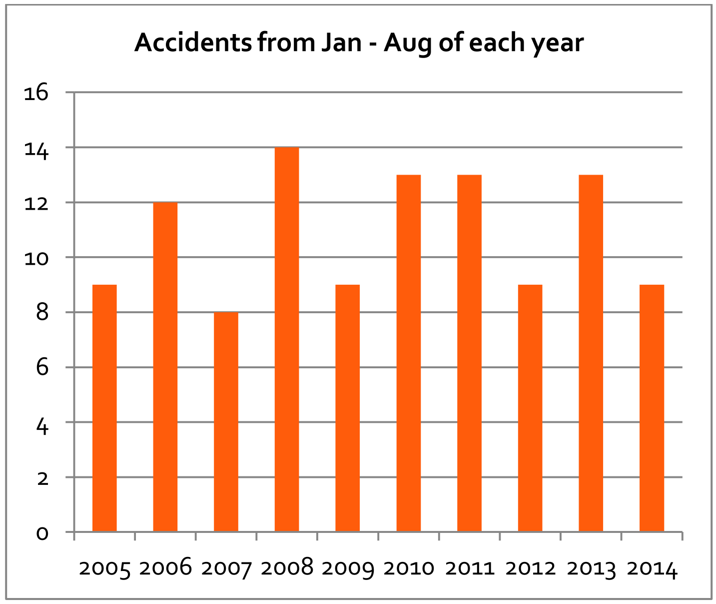
47% of commercial operators own 2 or less machines:



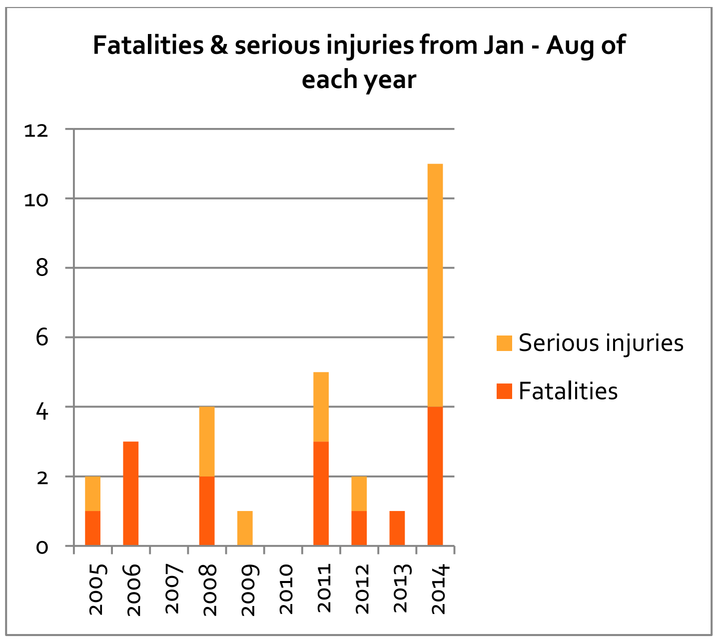
It goes without saying that larger operators are better resourced than smaller operators to collect and use safety information to improve their operating procedures and overall safety. That's what these bulletins are aimed at: getting collective techniques and procedures for good operating out to as much of the industry as possible.

2014 to date: safety performance

So far in 2014 there have been **8** helicopter accidents, **4** fatalities (from 3 of the accidents), **7** serious injuries and **4** minor injuries. There have been **4** helicopters destroyed and **4** sustaining substantial damage as a result of the accidents.Although total accidents for the year to date compares favourably with previous years:



This doesn't hold for the human cost to date:



The new Zealand helicopter industry is currently on track for its most dangerous year since 2004, which saw 6 fatalities and 1 major injury before the end of August of that year.

The 2014 accidents occurred in the following flight profiles:

Operation type	Accidents
Ag ops	1
Air ambulance	1
Hunting	1
Private ops	1
Training (dual)	1
Passenger transport	4

The number of reported defects is up considerably in 2014 compared to the previous years:

Year to date	Defects reported
2005	69
2006	59
2007	98
2008	80
2009	109
2010	127
2011	128
2012	92
2013	106
2014	177

The large increase is due to the AD for inspections of Fuel Control Unit RSA-10AD1 on R44 II's – 90 of the reports relate to these inspections – there are 116 R44 IIs in NZ.

Accidents involving power availability

Of the 254 helicopter accidents occurring between 2000 and 2012, 49 involved what we termed 'unrealistic expectations of power available'. This refers to helicopters being operated at the limits of their performance capability, usually due to a combination of the load carried and the prevailing conditions.

Accidents of this type predominantly affect light utility models:

Model	Total accidents
R22	29
Hughes 300	10
R44	6
Hughes 500	2
Other	2

A variety of flight types are affected, which also indicates some of the factors underlying this type of accident. High numbers of private and training accidents point to experience as a factor; ag and transport accidents point to loading and operating conditions as factors:

Operation type	Total accidents
Private flight	20
Agricultural	11
Passenger transport	7
Training	6
Other commercial	5

Characteristics of power-related accidents and safety issues

"Any factor that affects engine and rotor efficiency affects performance. The three major factors are density altitude, weight, and wind" – Rotorcraft Flying Handbook – FAA-H-8083-21

Those factors (DA, weight, and wind) all bring in to play the critical importance of good planning and clear procedures. In the accident examples presented in this bulletin it is clear that in the majority of cases no one single factor caused the accident. In most cases, it is the interaction between a prevailing condition and flight planning that lead to a crashed machine.

International research and findings

The International Helicopter Safety Team analysed 523 helicopter accidents occurring over three years. The most common accident type was 'Loss of Control' (41% of all accidents). Of the 217 loss of control accidents they identified, 79 were due to performance management issues.

"..loss of control predominantly occurs from a human factors point of view. In most cases the underlying cause was the failure to perform specific procedures, execute a proper decision, communicate, or adequately plan".[1]

They identified the following three most common types of accidents caused by performance management issues:

a) Practice autorations during when main RRPM was allowed to decay beyond a recoverable point.

b) Hover, takeoff, and landing accidents where a tailwind component was either not identified or underestimated.

c) Effects of density altitude on required power were underestimated.

Our own data show a situation almost identical to the IHST result: of a total 264 helicopter accidents since 2000, 116 involved a significant loss of control/performance – 44%.

This bulletin now moves on to the three key components of power availability.

Density altitude

The denser the air, the better the performance of the helicopter will be. Generally as altitude increases, the density of the air decreases. There are three key variables affecting this: pressure, temperature, and humidity. Our analysis found 11 out of the 49 accidents had density altitude as the principle cause of the performance reduction that led to the accident. Here is a typical example:

November 2007. R22 near the Rangitikei River.

The aircraft crashed through a tree canopy after it descended for a closer look at some deer. RPM decreased and the helicopter was unable to be controlled. The helicopter crashed into trees and was destroyed. The loss of RRPM was found to be due to the high altitude and the high temperatures that prevailed, which further reduced the performance of the helicopter.

The accidents and their investigations highlight the importance of considering the full range of variables that affect density altitude, particularly weight considerations when operating in areas with high elevation:

December 2006. Hughes 500 at Mt Ruapehu Crater Lake.

Whilst engaged in air transport operations the aircraft moved sideways during lift off and impacted with the side of the Mount Ruapehu Crater Rim. The aircraft was destroyed during the subsequent roll-over. The subsequent TAIC investigation revealed that the takeoff weight was 18 kgs over the maximum allowable. When this was considered along with the altitude, the helicopter did not have sufficient power to achieve a safe takeoff.

Weight

11 of the 49 accidents were caused directly by helicopters carrying loads that exceeded their performance capabilities for the conditions. Many other accidents saw the load the helicopter was carrying exacerbate the conditions that were encountered by the pilot, leading to accidents. These cases show so clearly that the closer a machine is loaded to its limit, the less margin there is for an escape when wind or DA start to affect performance. They also show that setting up procedures to establish gross weight, ascertain density altitude, and consider wind conditions are essential to avoid these accidents.

[1] Burgess, Scott, and the U.S Joint Helicopter Safety Analysis Team. '*The Reality of Aeronautical Knowledge: the analysis of accident reports against what aircrews are supposed to know*'.

Accidents where performance deteriorates due to the load carried are particularly prevalent in agricultural operations. Below are two typical examples:

August 2008. R44 near Hawera.

On lift off for the first load of the day the pilot experienced low rotor rpm and attempted to regain flying speed and RRPM by diving into a small gully area. This did not prevent the machine striking the ground and colliding with a power line. The helicopter was written off, although the pilot was uninjured. Subsequent investigation found that there had been no assessment of aircraft operating weight prior to flight.

December 2004. Hughes 300, Te Karaka.

The helicopter's skid hit the ground during a spray run when the pilot found the aircraft had insufficient power remaining to climb clear. The aircraft came to rest on its tail section. It was substantially damaged. It was found that the accident was caused by the pilot not reducing load sufficiently to allow for the prevailing density altitude: the operation was carried out at 2,100 ft AMSL and it was described as 'a hot day'.

But it is a mistake to think that the issue is isolated to ag ops. Skipping power checks in flight or failing to consider performance charts when operating close to the margins have caused accidents in all types of operation. The Hughes 500 accident on Mt Ruapehu mentioned above provides a classic case:

Ranger A asked the pilot if he could lift 5 people from the lake, or whether he might split the load and "shuttle" them to a higher site from which they could fly off the mountain together. The survey team recalled that the pilot said he would load them and their packs and "see how it goes", or words to that effect. The pilot said later that he had been operating all day with similar or greater loads without any performance or engine problems.

Wind

New Zealand is one of the windiest countries in the world. Not surprisingly, wind is a major factor in many accidents, both fixed-wing and helicopter. In 17 of the 49 accidents, the effect of wind was the main cause of the reduction in performance that led to the accident. A major problem is rapid shifts in wind speed and direction that go undetected by pilots, as in the example below:

August 2002. Bell UH-1 Iroquois, Waitomo.

While the helicopter was being loaded for its next run, the wind changed direction. The change went undetected by the pilot, who performed the take-off in the same direction as he had previously. With the tailwind, the helicopter did not reach translational lift, and the pilot aborted the take-off when he thought the helicopter would not clear the fence ahead. The helicopter did not stop in time and collided with the fence, damaging the skid landing gear, the "chin bubbles", and some ventral structure. The pilot was uninjured.

The accidents show this is as much of a problem on descent and landing as it is on takeoff, particularly in mountainous and bush-covered areas where windshear is common:

April 2011. R22 at Maungawera Valley.

On final approach the helicopter encountered down-drafting air causing main RRPM decay. The pilot determined that the landing site was good so elected to continue forward and down into ground effect and land as the RPM decay was minor. Upon landing he caught the skid on snow tussock, the aircraft rolled so he introduced collective to try and control. Further RRPM decay due to the introduction of collective caused helicopter to roll backwards.

February 2007. R44 Kaweka Forest Park.

On approach to a peak in the park, the pilot misjudged the wind direction and encountered a higher than expected rate of closure with the intended touchdown point. He attempted to retrieve the situation by running the helicopter on to the ground then taking off again. However there was insufficient space for this manoeuvre and the helicopter nosed over. The pilot received minor injuries and the two passengers were seriously injured.

Other factors involved

While this bulletin has concentrated on weight, wind, and DA affecting helicopter performance, two other critical issues cropped up. Although not as common, they can have equally disastrous effects. The first is how the application of carburetor heat can rob power – leading to accidents when the machine is on the edge of its performance envelope:

"The helicopter crashed into terrain as it could not maintain sufficient RRPM. Cause: The pilot had applied carburettor heat for the conditions. The application of carb heat reduces available power by 2-3" MAP".

The other issue is loss of performance due to overpitching – this is especially problematic in training and private operations. Familiarity with the 'normal' performance characteristics of the helicopter is key: there are many examples both in New Zealand and internationally of experienced turbine pilots getting into trouble in small piston machines due to unfamiliarity with their performance characteristics.

Resilience against the risk

- Whilst you can't control density altitude or wind, you can control helicopter weight. Know the performance capabilities of your helicopter and "Limit your load, don't load to your limit".

- The wind can be your friend and your foe, some flight manuals contain guidance on the effects of wind direction on hover performance and at low wind speeds (below 8 knots) a change from head wind to tail wind decreases aircraft capability by 7-10%. Tie a tape to the fence or use the smoke from the thermette as on-site wind indicators, and always brief your ground crew to speak up if they feel the wind shift.

- Even if you are in and out of a landing site regularly, always ask yourself "What has changed since last time?" Maybe the day is a bit warmer, maybe the QNH is lower, maybe the wind has shifted, maybe the machine you are in today has the engine with 100 hours to run whereas the bosses machine you were in last week had 100 hours since new.

- Is it worth slinging some of your payload? The rules contain some flexibility in this area and it gives a last resort option of reducing AUW and improving performance if things go awry.

- Calculating helicopter performance capability used to be a confusing paperwork exercise with multiple graphs on a page and much rubbing out of pencil lines. This is no longer the case with smartphone apps available for most helicopter types that let you calculate IGE and OGE performance with relative ease.

- If your calculated performance is such that you can't hover OGE at the intended operating site this should be a warning flag. Think long and hard about what other steps you are going to take to ensure that you don't put yourself in a position of exceeding power available. And, if the numbers show that you can't hover IGE … do you really want to risk becoming another case study for future publications like this?