



A Risky Business

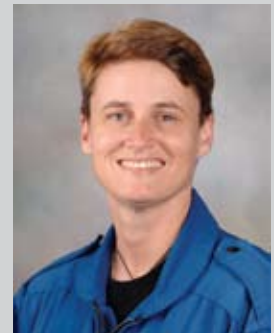


In my last article (Vol. 19 No. 2, 2007) we discussed looking carefully at yourself and ensuring you are ready to fly before you set foot on the flight line. One reader wrote me and suggested I refer to the flight events as “flights” vice “missions”. He gently reminded me I am no longer in the military and pilots outside the military go for “flights” not “missions.” He proceeded to tell me his family probably wouldn’t let him go on “missions” since that sounded more like something from which one might not return. Whereas, a *flight* is something routine and more easily accomplished. After much thought I decided to stick with the term “mission” because I believe every time we get into the helicopter we should take it very seriously and consider it is indeed something from which we might not safely return. Sadly it happens every day. Your job is to ensure you have prepared properly to give yourself the best opportunity to return in the same shape you departed. People fly in helicopters thousands of times a day and return safely without much in-depth thought. I believe we need to give it more thought and consider just what could go wrong. This way we prepare for the unforeseen and the potential emergency or a change of mission plans. This will be a column of questions to ask yourself about your mission.

Every military mission is briefed in depth. Crews discuss each mission and delineate responsibilities. This tool allows crewmembers to consider just what they were getting themselves into, such as weather, fuel requirements, crew make up, and other possible risks. This is probably a good idea for everyone planning a “mission” of any sort. It doesn’t mean one needs an hour long formal briefing before every mission. However, it would be a good idea to take a look at the types of missions you fly and really address what you are doing, how you are doing it as well as when and where you are flying. What is the biggest risk during the course of that mission and will it change from day to day? What are additional risks that might surface along the way? What can you do to mitigate

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A Risky Business Continued . . .

these risks and are you doing those things regularly? One must try to ensure that no unnecessary risks are taken. Face it, the only way to mitigate all risks in aviation is to remain on the ground.

Since I know you aren't going to remain on the ground, let's begin with the hazards. The first step in risk management is to identify the hazards. We can't reduce risk if we don't understand what the hazards are. Examples of potential hazards may be the skill or proficiency of the pilot, weather, density altitude, outside air temperature, aircraft limitations, improper (or lack of) equipment, improperly trained personnel, or a lack of operational experience. Wow, that seems like a lot of stuff which could be working against a successful outcome! Remember to ask yourself the important questions: what can go wrong and what can I do about it? Lastly, if you can't do anything about it, who should you make aware of the situation?

Another issue which is a direct result of mission preparation is pilot experience, currency, and proficiency. When was the last time you flew this particular type of helicopter? Despite an industry attitude, helicopters are not "one size fits all". Flying an R-22 last week doesn't mean you're ready to perform a mission in an S-76 or a BH-412 today. Procedures in one aircraft can result in 'negative habit transfer' in another. Thus, a proper response to an emergency in one helicopter might actually get you into trouble in a different type. One can't rely on muscle memory all the time. Hence, try making sure you are proficient in the helicopter you are to fly before taking off for an intense mission.

The next question needing an answer, which goes along with currency and proficiency, is when was the last time you flew this type

of mission? Landing on a platform in the Gulf of Mexico isn't the same as rescuing someone from the top of their car in a flood, or chasing bad guys at night. Some of this you can't change. It will be up to the latest contract, your boss, the "bottom line" and a host of other things beyond your control as to how often you fly a particular mission. Please realize when called to do a mission you haven't done in a while, you should give the hazards associated with it some extra thought, and take things slowly and check yourself—twice, if need be.

Let's look at a few types of hazards helicopter pilots face every day.

Altitude

How high do you fly and for how long? Have you ever received training on recognizing symptoms of hypoxia in yourself? It's difficult to see your own lips turning blue, so how do you know your body is low on oxygen before it becomes debilitating and how do you mitigate this risk? Do you have a personal time limit for high altitude exposure or does your company have limits for altitudes at which you are required to operate? Do you carry supplemental oxygen and know what the requirements are for its use under the Federal Aviation Regulations?

This is from the *FAA's Aeronautical Information Manual*, Chapter 8-1-2, about the effects of altitude. "... a deterioration in night vision occurs at a cabin pressure altitude as low as 5,000 feet...." and "From 12,000 to 15,000 feet of altitude, judgment, memory, alertness, coordination, and ability to make calculations are impaired, and headache, drowsiness, dizziness... occur." Do you ever fly single pilot above 5,000 feet at night? It seems that may be a risk one needs to give some thought. Additionally, some factors decrease your blood's ability

to carry oxygen, such as smoking, anemia and certain medications. This means the effect of altitude will overtake you more quickly and more profoundly, something else to think about.

Operations Near Or Approaching The Design Limits Of Your Helicopter

How often do you operate at or near maximum gross weight or near the center of gravity limits? What can you do about that? Should you make two trips instead of one? I know management loves that answer. How about taking on less fuel, does that make sense for your particular mission? Does your cameraman/Tactical Flight Officer/copilot or you need to go on a diet? I know some of this is beyond your control but it can have an enormous effect when trying hover out of ground effect over a crime scene or the lead story for tonight's broadcast. Does your helicopter have the power available to do this mission today? What is your gross weight capability today? Remember to consider temperature when taking off and it may be very different taking the same load at noon that you did at seven o'clock this morning.

Operating In The Shaded Areas Of The Height Velocity (H-V) Diagram

I know plenty of you out there operate in the shaded H-V area every day. Electronic News Gathering (ENG), Emergency Medical Service (EMS), and Law Enforcement do this as part of standard operations. Do you give it any thought before doing it? Do you have a good place to autorotate in the event of an engine failure? Did you look at the Hover Out of Ground Effect (HOGE) / Hover In Ground Effect (HIGE) charts before concluding you could hover under the current conditions? Do you try to keep a little forward motion, realizing that a little speed is

better than none in the event of an engine failure? Do you take off over a runway or taxiway to leave yourself a place to go if there is a problem?

Ambient Conditions Less than Ideal

How often do you take off on a clear “standard” day at sea level? I don’t do it very often either. It seems like most missions fall into the “high, hot or heavy” category. We’ve already addressed temperature and power scenarios, so let’s ask ourselves some questions about the place we are getting into trouble so often in our industry; inadvertent Instrument Meteorological Conditions (IMC). Because so many accidents happen in deteriorating visual conditions, it’s imperative to obtain a good weather briefing and be willing to say no to a mission or know when to turn around or land. For those of you who are owners / managers it is equally important to respect your pilots’ authority to say no or turn around if, in their judgment, it is unsafe to continue. For pilots it is imperative to have a plan for deteriorating conditions. Are you aware of safe landing areas along your flight path? In the preparation category, do you have your instrument rating so you could at least have a rudimentary ability to fly safely in IMC should you find yourself there? Don’t think you’ll never end up there because it happens too often to be that overconfident. If you do go into clouds, do you know the highest obstacles in your area of operation so you can climb to a safe altitude? The chart folks make it really easy by denoting (with a very big number) the highest obstacle altitude in each sector of the chart. Do you have the current chart? Are you aware of that new 300 foot tower along your route?

Proper Equipment

This can cover anything from the proper helicopter for the mission to the mission planning documents. Is the helicopter designed to do the mission your company wants to do with it? I know there are management groups who think helicopters can hover at any weight or altitude and terms such as HIGE and HOGE mean nothing to them. They mean something to you and I hope you can help your management team understand these concepts and the safe margins that go with them.

Remember, risk management is never static and it requires continuous effort and observation. If the situation changes, you will have to reevaluate your course of action. Is the weather deteriorating? Has the mission duration become extended? How’s your fuel? What is the physical condition of you and your crew? This is where complacency is your enemy. Just because this has always worked doesn’t mean it will work today. What’s different today? Are you paying attention as well as you should? Are the controls you put in place to reduce previously identified risks working as you thought they would? Do you need to change or alter any of these controls for the conditions today or in this moment?

Debriefing is the final step in risk management. It’s a good idea to debrief missions, evaluating what went right, or wrong, and how you could do things differently or adjust better next time. After an honest review and assessment we can learn and grow as pilots and be better and safer in our profession. The best (and least expensive) way to learn is from someone else’s mistakes. So don’t be afraid to share your experiences and listen to those from others. It’s a good way not to repeat something which has already proven to be a bad choice. Review accident reports, talk to other pilots, get annual training from the factory and be open to listening

and learning continually. When you are finished learning in this industry, it might be time to start considering another line of work.

Time you spend planning your mission and examining how it went after you land might just make the difference between life and death on another day. If the way your company does business needs to be changed to enhance operational safety, then be an advocate for change. Everyday, as professionals, we should be looking out for each other to help make our industry as safe as we can for pilots, crews, passengers and our missions. We must identify the risks inherent in our jobs and help minimize those risks through training, awareness, and high standards. We know aviation is intrinsically risky, the question is: will we intelligently manage that risk? Are you operating as safely as you can under the given circumstances today? Should you go on this mission today? What factor might prevent you from coming home safely? What will you do about it? Please do *something* about it.

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Heliprops

Helicopter Professional Pilots Safety Program

The HELIPROPS HUMAN A.D. is published by the Training Academy, Bell Helicopter Textron Incorporated, and is distributed free of charge to helicopter operators, owners, flight department managers and pilots. The contents do not necessarily reflect official policy and unless stated, should not be construed as regulations or directives.

The primary objective of the HELIPROPS program and the HUMAN A.D. is to help reduce human error related accidents. This newsletter stresses professionalism, safety and good aeronautical decision-making.

Letters with constructive comments and suggestions are invited. Correspondents should provide name, address and telephone number to:

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Accounts from our Readers

Flicker Vertigo

Imagine you, as a pilot, taking three passengers for a ride in your JetRanger. This flight appears at the outset to be no different than any other local passenger ride, but suddenly things change rapidly. After being cleared into position for takeoff, and commencing to move the ship forward, you are distracted by the left front seat passenger pointing up and forward, and emitting a guttural gasp. Looking up through the turning rotor blades you observe another helicopter on a distant approach. Nothing appears to be out of the ordinary since the ship is quite a distance from you, but on returning your attention to the front-seat passenger, you are startled to see that his face has turned blue, he is gasping, and eyes are following the blade passage at a phenomenal rate. He is becoming very rigid in his arms and legs, with his arms bent at his waist, and his hands curled up under his chin, white-knuckled tense, like a small baby. His legs, bent at the knees, encompass the copilot's

cyclic stick and as he squirms in the seat, the control is being involuntarily displaced considerably to the right. Being unable to bring the cyclic back to neutral, you issue a "MAYDAY" to the tower doing the best to manage an emergency landing. By the time the ship is on the ground, the cyclic is displaced full right and both of his feet are firmly wedged between the pedal bars and the floor. His eyes still followed what appeared to be each blade passage, and he is commencing to froth at the mouth.

After removing him from the ship, wedging something between his teeth and covering his eyes from the slowing rotor image, he shows signs of calming down. The prompt arrival of First Aid personnel completed caring for the man while you finished securing the ship. Suddenly you are very relieved that this had not occurred in a flight condition other than a hover, for surely you could not have further restrained his involuntary control displacements. Sound weird? Well, I was the pilot on this aborted flight, and wish to pass on to you some further information.

This particular man had a long past history of seizures with his last one being many years before in an airliner that was skim-ming thru the tops of clouds. What he had apparently experienced on the airliner, and again in the JetRanger, was a "strobe—effect induced seizure". This condition, according to knowledgeable doctors and flight surgeons, can apply to pilots and persons who fly in aircraft, but most predominantly in helicopters. Most persons may only be mildly discomforted by the flicker effect of strobe lights in-cloud or haze, or the effects of the blades turning between them and the sunlight, but occasionally the results are more graphic, such as was described in the above mentioned experience. Expect

this phenomenon of opti-kinetic vertigo to be disorienting to say the least, or incapacitating under the worst conditions. It may also manifest itself in some individuals who become entranced merely by driving past evenly spaced fence posts, picket fences, tree rows, telegraph poles, or other such rhythmic references. If discomfort arises from these visual cues, knowledgeable physicians will tell you to look away, close your eyes for a short time and do not look back through the distracting area when you open your eyes again. If your ship is strobe-equipped, make sure that you obey the placard referring to turning off the strobe-light in fog, clouds, rain, snow, etc. That placard means business!

The Whisky Flask

By Lloyd D. Knight

The closest I ever came to crashing in Vietnam was not because of enemy action. Neither was it because of equipment failure or even crew error per se. It was one of those little, unforeseen events that do not have the usual checks and balances one finds when applying the *Reason Model** to accident prevention. It was one of those occasions when a bit of luck, and some coarse handling overcame the problem.

A four-ship formation was flying into a fire support base in the tall timber. We were number three. Space was restricted and the approach area tricky. So I took over from the young pilot in the right seat and flew the approach myself.

Number one had terminated in the middle of the landing area and taxied forward to park near the edge of the pad. Number two was about fifty feet up and just

What's Your Story?

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about to terminate. He would then move forward and set down next to number one. I was about fifty metres behind him and was just starting to increase power to complete the approach.

Unlike an aeroplane, in which the pilot takes off all power (closes the throttle/s), as it touches down, a helicopter gradually increases power as it terminates in a hover. The power required is approximately the same as that used for take-off, and is often higher, depending on the type of approach and the termination area. The pilot increases the power by pulling up on the collective pitch lever. That's the one in his left hand.

As I raised the lever to about half travel, it jammed. I lowered it slightly then raised it again with the same result.

I yelled out, 'Collective jamming,' and looked for somewhere to put down with a run-on landing. This requires less power. There was nowhere to go and we were coming down on top of number two.

I hit the radio button and called something like, 'Numbers two and four go around (climb out again), number three has jammed collective.'

I think number four behind me got the message and went around. However, number two just continued with his termination. He hadn't heard my call, or was slow to respond.

I pumped the lever one more time as I tried to steer clear of the helicopter beneath me. I pulled up real hard and something gave as the obstruction was overcome, and I had full control again.

We were descending quite rapidly now so I just about stood the bird on its tail and pulled maximum power to terminate in a high hover. We were too low among the trees to

go around. Number two taxied off, and I descended to a respectable height, moved to our pre-planned parking area at the back of the pad and landed.

I wiped the sweat from my brow and yelled, 'What the hell was that?'

I looked over at my copilot, as he sheepishly held up a rather mangled silver whisky hip flask. I think it may have been a family heirloom that he used as a water bottle.

We probably all could have done with a swig of the real stuff.

He had carried it in the left hand thigh pocket of his flying suit. This normally sits on top of the leg in the seated position. During the flight, the weight of the flask had caused the pocket on the baggy overall, to slip down the outside of his leg. This placed the flask just in front of the armour plate extension on the side of his seat, and directly above his collective lever. When I raised my lever his followed and jammed the flask against the armour.

That was a lucky escape from what would have been a nasty accident.

For aviators, it's a timely warning to always be aware of the possible outcomes, when non-standard practices are adopted. Nothing should be placed so that it can become an obstruction to the flight controls, given that in flight, things can move about.

I suppose the same principle can be applied to handbags and briefcases, placed between a car driver's legs. They could slip forward on braking and obstruct the foot pedals.

I know someone who had that happen to them.

* James T. Reason's Model can be further explained at http://en.wikipedia.org/wiki/Swiss_Cheese_model

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The History of Helicopter Safety Part Two

In this issue, part two of four on "The History of Helicopter Safety" is featured. The original version in its entirety was presented by Roy G. Fox at the International Helicopter Safety Symposium in Montréal, Québec, Canada on September 26-29, 2005. A complete download of the full article is available on the www.heliprops.com website.

REFERENCES

1. MIL-STD-882D, "Standard Practice for System Safety," U.S. Department of Defense, February 2000.
2. Fox, R. G., "Relative Risk, True Measure of Safety," 28th Corporate Aviation Safety Seminar, Flight Safety Foundation, April 1983.
3. MIL-T-42722B, "Tank, Fuel, Crash-Resistant, Aircraft," U.S. Department of Defense, 1971.
4. Gabella, B. "No More Crash Burn Fatalities," Flight Operations Magazine, June 1976.
5. Knapp, S. C., et al., "Human Response to Fire," U.S. Army Aeromedical Research Laboratories, NATOAGARD, May 1982.
6. Coltman, J. W., et al., Aircraft Crash Survival Design Guide, USAAVSCOM TR 89-D-22, 5 Volumes, (U.S. Army Aviation Research & Technology Activity), 1989.
7. MIL-STD-1290A, "Light Fixed and Rotary-Wing Aircraft Crash Resistance," U.S. Department of Defense, September 1988.
8. Fox, R. G. "Helicopter Crashworthiness," 34th Corporate Aviation Safety Seminar, Flight Safety Foundation, April 1989.
9. Fox, R. G. "Realistic Civil Helicopter Crash Safety," National Specialist's Meeting on Crashworthy Design of Rotorcraft, Georgia Tech and American Helicopter Society, April 1986.
10. Coltman, J. W., et al. "Analysis of Rotorcraft Crash Dynamics for Development of Improved Crashworthiness Design Criteria," DOT/FAA/CT-80/11, U.S. Federal Aviation Administration, 1985.
11. Rotor Roster 2005, Air Track.
12. Fox, R. G., "Helicopter Accident Trends," American Helicopter Society, September 1987.
13. Fox, R. G., Measuring Risk in Single- and Twin-Engine Helicopters, AHS 2nd Asian Vertiflite Seminar, Singapore, February 24, 1992.
14. Fox R. G., "The Path to the Next Helicopter Safety Plateau," American Helicopter Society 61st Forum, June 2005.
15. Vice President A. Gore, et al., "Final Report to President Clinton by White House Commission on Aviation Safety and Security," February 12, 1997.
16. Fox, R. G., "Measuring Safety Investment Effectiveness Relative to Risks," AHS 54th Forum, May 1998.
17. Fox, R. G., "Civil Rotorcraft Risks," 2002 China International Helicopter Forum, Chengdu, People's Republic of China, August 2002.

Crash Survival

The last safety protection level is to provide means of occupant survival if a crash occurs for any initiating cause.

There are four requirements to survive a crash in any type of vehicle (Ref. 2). They are as follows:

1. Maintain a livable volume for the occupant throughout the crash sequence.
2. Restrain the occupant.
3. Keep the crash loads experienced by each occupant within human tolerance.
4. Provide time to escape. Primarily, this is time to escape a post crash fire fireball.

There was considerable research by various Government-sponsored agencies into various aspects of airplane crashworthiness, but the U.S. Army was the primary force behind crash survival actually being introduced into helicopters. In the mid 1960s, the post crash fire threat was the primary threat to the survival of U.S. Army helicopter occupants. The Army decided that a Crashworthy Fuel System (CWFS) should be developed and installed in all Army helicopters. Severe drop tests and material puncture/tear tests were developed, with the result being MIL-T-42722B (Ref. 3). The US Army introduced the CWFS into production helicopters and retrofitted them into existing helicopter fleets (Ref. 4). The first CWFS delivered was installed in a new production UH-1H in May 1970. This was to become the most significant single improvement for crash survival in helicopters. Table 1 from Ref. 5 shows the effectiveness of CWFS in preventing thermal fatalities in CWFS-equipped Army helicopters compared to non-CWFS equipped Army helicopters for about the same number of accidents.

The U.S. Army pulled information and ideas from different crash survival research areas together into the Crash Survival Design Guide. This became the initial handbook on how to include crash safety features into a helicopter design. There were several updates of the Crash Survival Design Guide, with the latest being TR89-22 in five volumes (Ref. 6). The Army then required these crash survival requirements in their new generation of helicopters (e.g., UH-60 and AH-64) from the beginning of the design. MIL-STD-1290A (Ref. 7) was basically the key Crash Survival Design Guide criteria, but placed into a requirement type of document that could be mandatory on military helicopter contracts.

Introduction of crash safety features into civil helicopters lagged the military by a few years. There were no certification requirements specifically to improve crash safety (other than "everyone needs a lap belt"). This is important, as there are significant weight penalties to include crash survivable features. This places the operator at a payload disadvantage with his competitors who use helicopters without the safety features. In 1980, Bell introduced the Model 222 with shoulder harnesses for pilots and passengers, energy attenuating crew and passenger seats, and a Crash Resistant Fuel System (CRFS) as standard equipment. Reference 2 discusses these safety features and Bell introduction into different models and their respective weight penalties. The CRFS was a lighter-weight version of the military CWFS, but provided protection to 56 ft/sec impacts as compared to 65 ft/sec with a CWFS. Since impact survival

(disregarding any post crash fire) was not likely at speeds above 50 ft/sec, the need to go to higher impacts speeds of 65 ft/sec of a military CWFS only adds aircraft weight with no additional survivors. The weight penalty on a helicopter with 13 passengers to include a CRFS and passenger energy attenuating seats with shoulder harnesses as standard equipment was 157 lb over the FAA certification requirements at that time. This in essence, was lost payload equivalent to one passenger compared to a comparable size helicopter by other manufacturers that only met the FAA requirements. That is quite significant in the competitive world of commercial helicopter operators. Bell introduced these crash safety features 10–14 years before the FAA changed the regulations to require these same safety features.

It became apparent that the industry needed the appropriate crash protection level for civil helicopters to be in realistic FAA regulations. If all manufacturers are required to provide the same crash safety features to the same level, the resulting weight penalty is common to all, thus eliminating 5 the competitive disadvantage of having crash safety features. Further, if the designer knows in the beginning that he needs to plan on an additional 200 pounds or so of weight for these features, he can plan on more rotor and power to compensate. The Aerospace Industries Association (AIA) had a Rotorcraft Airworthiness Group consisting of the Vice President of Engineering from the four primary helicopter manufacturers (Bell Helicopter, McDonnell Douglass Helicopters, Sikorsky Aircraft, and Boeing Helicopters). This AIA group assigned a crash survival engineer from each company to determine what crash safety features were needed and the appropriate criteria

Table 1 –CWFS Effectiveness (1970-1976)

	No. of Accidents	Post Crash Fires	Thermal Related Fatalities
Survivable – No CWFS	1,160	43	159
Survivable – With DWFS	1,258	16	0

for civil helicopters. As a result, criteria were developed and briefed to the FAA as a potential level that industry could support. That effort was discussed in Refs. 8 and 9. At the same time period, the FAA had a research contract to determine the crash safety criteria based on analysis of civil helicopter accident data, which resulted in DOT/FAA/CT-80/11 (Ref. 10.). The crash safety criteria from these two efforts was comparable and was to later become regulations, specifically amendments:

- 27-30 and 29-35, Crash Resistant Fuel Systems.
- 27-28 and 29-32 added a passenger shoulder harness on helicopters produced after 1994.
- 27-25 and 29-29 Energy Attenuating crew and passenger seats (e.g., dynamically tested) for new Type Certificate applicants.

Reference 8 discusses helicopter safety and all of these changes and their relationship to comparable new crash safety related regulatory changes of Part 23 and Part 25 airplanes. The military is still leading in some new areas of crash survival, such as Cockpit Air Bags systems (similar to automotive air bags). On the civil side there is promising research work on external air bags mounted to the fuselage belly. Inflatable belts are also being developed.

Where To Concentrate Efforts

Airworthiness causes are separated by certification responsibility (e.g., the Type Certificate Holder). Thus

the engine manufacturer certify their engines under Part 33 and are responsible to the FAA to keep the fielded engines to the same certification level. Similarly, the helicopter manufacturer certifies his helicopter to either Part 27 or Part 29 and is responsible for those parts. Basically, the helicopter manufacturer is responsible for the entire helicopter except for the engines. Other companies may get Supplement Type Certificates (STC) and are responsible to the FAA for their parts/systems, which modify an aircraft. STCs vary and are not on all models. Since part failures are very rare events and there are difficulties in dealing with STC variability, all airworthiness (AW) failures are considered as either Engine AW or Non-Engine AW to simplify accident analyses. For the Bell civil turbine helicopter fleet worldwide, the annual accident rates for the last 20 years (1985–2004) are shown in Fig. 5. This accounts for 50 million flight hours and includes all of Bell’s civil certificated models with a turbine engine. It does not include U.S. military models, military surplus on civil registries, Model 47s, or any helicopter produced by a licensee (e.g., Agusta). The annual accident rate for all causes is coming down. Note the accident rate of the lowest line, due to non-engine airworthiness (Bell’s responsibility for the aircraft certificated to Part 27/29 requirements), is quite low, with sporadic increases due to a helicopter part (other than engine) failure. Accident investigation would

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The History of Helicopter Safety Continued...

identify the component failure. Field inspections or restrictions would be used while engineering analysis/tests were determining the root causes, and correction. Replacement parts are introduced to the field as quickly as possible. Thus the non-engine airworthiness rate drops back quickly.

The distance to the next line up on the figure is the accident rate due to engine failure/malfunctions, which are the engine manufacturers' (Part 33) responsibility. The engine manufacturers continue their effort to decrease their engine caused accident rates. Some of these accidents attributed to the engine are "claimed power loss," but the engine runs fine during the accident investigation. They are counted as an engine airworthiness failure, since it cannot be proved what actually happened. These "claimed power loss" accidents will continue to occur until recorders can be used to document what really happened. Thus the accident rate for all airworthiness failures (Engine and Non-Engine) is the red line on the Fig. 5, which is quite low—0.53/100,000 hours for 2004. Airworthiness failures are minor contributors to the overall accident rate.

The distance between the center red line (all airworthiness) and the top blue line is the human and unknown causes. Primarily, the human cause is the pilot. Thus the total accident rate is the blue line or about 3.9/100,000 hours in 2004. This chart also shows that the total elimination of all airworthiness failures could not reduce the overall accident rate by more than about 15.7% for the last 5 years). Said differently, 84.3% of the accidents would still occur if an aircraft or engine never failed. We must address the human and unknown side to significantly reduce accidents. Bell, and others, have made major efforts to address the human error accident causes with success in some areas. The reason for the overall Bell accident rate reduction of Fig. 5 is due to many efforts by different people, including the Bell training pilots at Bell's Customer Training Academy. Documenting and then understanding all of the various human errors and what really happened in the cockpit is the challenge to make significant improvements in safety. Bell helicopters (civil models and military surplus on civil registries) accounts

for 8,310 helicopters or 36.7% of the 22,865 helicopters worldwide per Rotor Roster 2005 (Ref. 11). Thus it is highly likely that helicopters of other airframe and engine manufacturers have similar accident cause distributions to those of Bell models and less than one third of their accidents caused by airworthiness failures. We all need to find a way to document and understand human error accidents and those unknown causes. Serious accidents to any model helicopter affect adversely the manufacturers of other models.

Accident Causes

Airworthiness failure causes contribute little to all causes. Civil helicopter models and military surplus helicopters on civil registries are tracked by Rotor Roster (Ref. 11). This 206 fleet has flown 51,633,000 hours worldwide in the 30-year period of 1975 through 2004. The civil 206 series accounted for 19.5% of all 22,647 civil models registered worldwide at the end of 2004. Likewise, the 206 accounts for 20.1% of the 11,973 helicopters registered in the USA. Overall, Bell has produced 6,151 civil Model 206s since the 1966 introduction to the civil fleet. The percentages of 206 accident causes are shown in Fig. 6 for three 10-year periods worldwide. The lower two values are airworthiness (AW) failure initiated accidents. Accidents caused by aircraft failures, other than engine, are labeled as Non-Engine AW, 30 Years 206 Accident Causes Worldwide accounting for about 4% of accident causes. The Engine AW (including confirmed failures and suspected/claimed power losses) has been reducing and presently accounts for 11.2% of accident causes. Thus about 85% of all accidents causes are not airworthiness related. What can we do about those 85% causes?

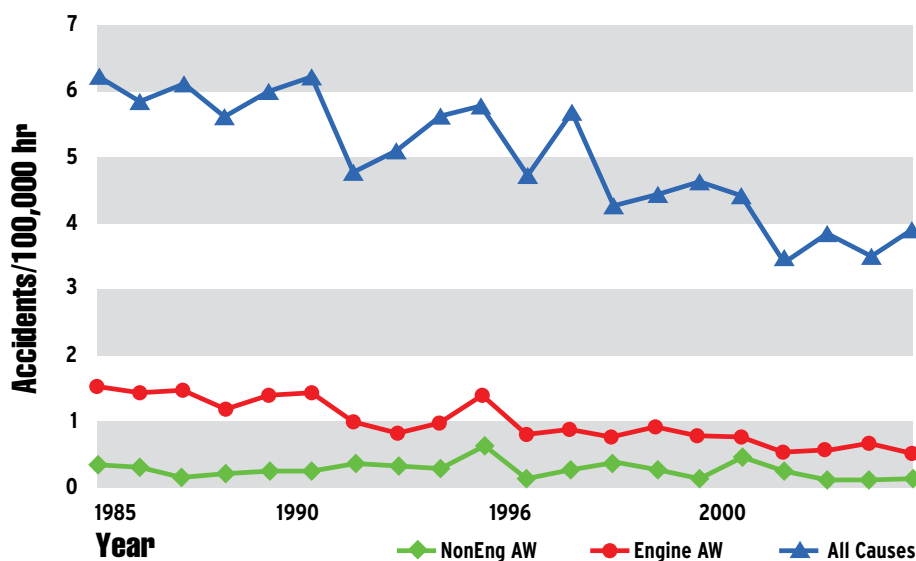


Figure 5 – Bell Civil Turbines 20-year History Worldwide (1985-2004)

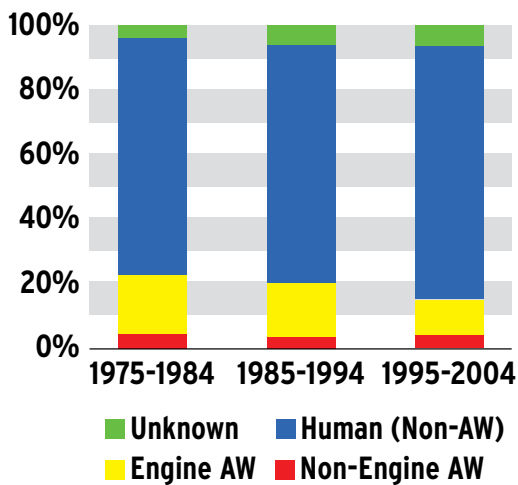


Figure 6 - 206 Accident Cause Trends of 30 Years

Human Judgment

Bell studies of accident causes always end up with roughly three fourths of the accidents being somehow pilot related (e.g., human error). In 1985 and 1986, a special safety study was done on human error related accidents of all civil Bell models around the world. The purpose of the study was to identify the root causes of these human errors, which could hopefully lead to improved helicopter design. The result of this study (Refs. 12 and 13) was not what was anticipated and set Bell on a different course. Although there were many root causes found, there was one that was present in every accident sequence: that was poor pilot judgment. Thus in early 1987, Bell investigated several means of improve pilot judgment and ended up with two basic paths. One approach was the individual pilot teaching approach. This included the development of an individual pilot training aid with software that a pilot could use on a PC. This became Cockpit Emergency Procedures Expert Trainer (CEPET), which included pilot interaction (judgment) in the sequence based on actual accidents. It basically was a fault tree approach, which incorporates Bell pilot staff/engineering staff knowledge, where the pilot could make a good or bad decision. A bad

decision got the pilot into a worse situation and would be faced with another decision point. CEPET was developed for the 206B, the 206L, and eventually the 212/412. Bell developed a Human AD document to discuss different pilot issues and decision making. This booklet is distributed free several times a year and is available on Bell's website (www.bellhelicopter.com/).

The other direction was to provide face-to-face judgment training briefing in groups. A three-hour safety course was developed with judgment training embedded among other safety subjects. This course was part of the Bell 206 pilot ground school starting in March 1987 and was presented by the Chief Safety Engineer. This safety briefing was also given offsite to customers, agencies, organizations, and FAA seminars. The Chief Training Pilot also developed and gave safety briefings with different safety-related subjects, which included embedded judgment training. The whole safety effort was funded and considered the Helicopter Professional Pilots Safety (HELIPROPS) program. A full-time HELIPROPS Manager was hired to coordinate the safety efforts as well as do customer safety briefings. After seeing significant positive feedback in that first year, Bell spread the HELIPROPS approach to three other manufacturers who developed their

own approach. Helicopter Association International (HAI) also supported the HELIPROPS approach. Did the HELIPROPS effort started in 1987 have any significant effect on accidents?

Bell believes it did. The number of fatalities per year that occurred in U.S. registered helicopters (from NTSB data) is shown in Fig. 7. Also included in that figure is the number of fatalities in 206s. Although it is impossible to do special Annual U.S. Fatalities: All Helicopters vs 206 (1980-2004, NTSB) training for all pilots quickly, it is possible to start with briefing attendees who further spread ideas of a new safety culture, which applies to pilots of all types of helicopters. Note the sudden drop in fatalities in 1988 and 1990 for all helicopters and a corresponding drop in fatalities in the 206.

The 206 fatalities curve is shown in Fig. 8 and the number of HELIPROPS safety briefings (in the 206 pilot ground class and to external meetings that included pilots of all types of helicopters) are included as bars. Note the concentrated training effort of 1987 through 1993 and the number of fatalities. The average number of fatalities/year for the 7-year period (1980 to 1986) was compared to the fatalities for the 7-year HELIPROPS period (1987-1993), which shows a

CONTINUED ON PAGE 11

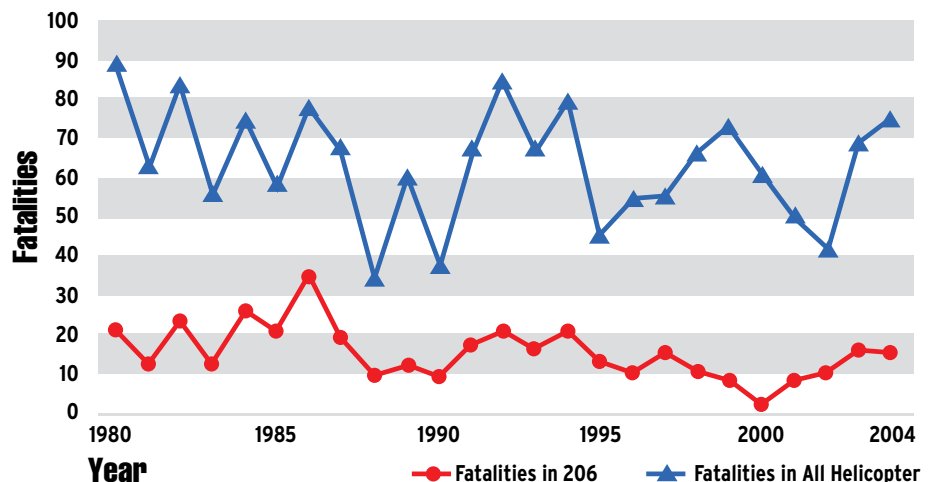


Figure 7 - Fatalities in U.S. Registered Helicopters

The History of Helicopter Safety Continued...

significant drop in the later period. Is this drop statistically significant or just due to randomness?

A Student T test, with one-tailed test, was applied to several metrics for these two time periods to see if the HELIPROPS period change from the prior period was statistically significant at the 0.05 level. If it is statistically significant at the 0.05 level, that means that 95 times out of 100, the value in the two periods are different and not just due to randomness of rare events. Table 2 shows the results of the statistical significance tests for three different metrics. Metrics shown as the average over the time period but the actual annual values are used in the calculations to account for scatter. In 1987, there were 2,362 Model 206s on the registry and in 2004 there were 2,404 Model 206s on the registry, so the fleet continued to grow.

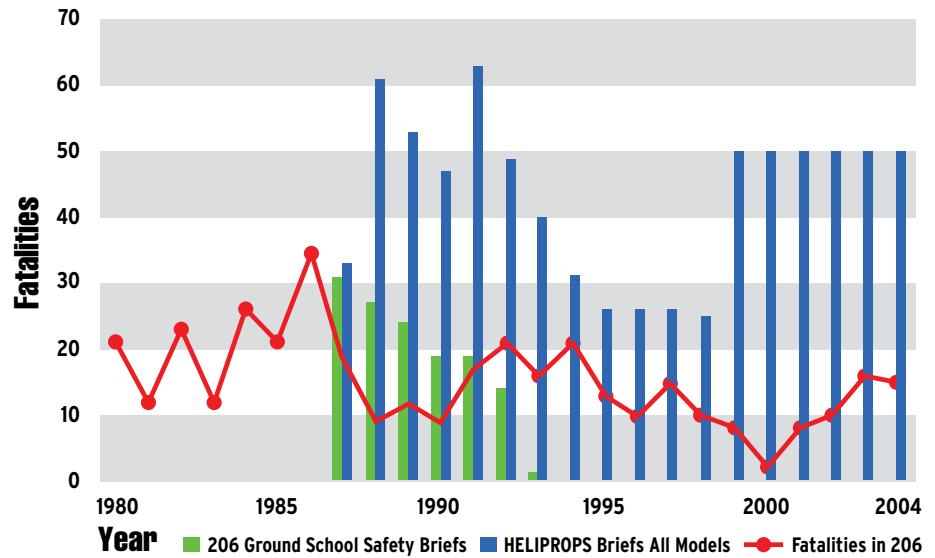


Figure 8 - HELIPROPS Safety Training Effects On Number Of 206 Fatalities

Bottom line: there was a statistically significant difference for the 7-year period of concentrated HELIPROPS activities as compared to the prior 7-year period.

Look for Part 3 of this story in Vol. 20, No 3. For download of complete article go to www.heliprops.com.

A Routine Test Flight?

Sometimes, It's The Little Things That Will Get You!

The following is taken from a message I received from Carl Bertrand, a Bell Helicopter Senior Test Pilot, located in Mirabel, Canada.

It is not too unusual that flight testing involves a constant change of configuration, flight profiles and environment; so basically, every flight is a new adventure. You would think that falling into a *routine* would be the last thing that could happen...on a test flight.

I just came back from an attempt to do a "*routine*" flight test. And after attending one of our "*routine*" pre-test flight briefings it seems that, were it not for the fact that we *didn't* consider the aircraft vibrations as unusual at ground idle as being "*routine*," then something more serious could have happened during the actual flight test once we had taken off.

Previously, the aircraft had some minor work performed on the rotor instrumentation harness. It is a package of sensors used to detect rotor vibrations, both

good and bad. The inspection to verify security of the work had been done and checked off as satisfactory, then the helicopter was released for flight. The aircraft was pulled out, refueled, and the pre-flight briefing carried out. All of this process was part of the "*routine*." The fact that the critical rotor balance measurements had changed significantly, was missed by all. Fortunately, nothing was wrong with the aircraft. But, it made me stop and think how "*routine*" things had become. Others may know this as complacency.

My point is; we may have a system in place with professionals running it. *Attitude* plays a big part in the level of scrutiny we exercise in our every day work environment. Even if we check all the boxes in the squares, that doesn't mean something important hasn't been discovered. Therefore, we rely on experience and professionalism to ensure safety. So remember, don't fall into the "*routine trap*." In the end, people's lives depend on it.

Your Flight Safety Program How Does your Operation Measure Up?

The ultimate aim of any Flight Safety Plan or Safety Management System within an organization is the elimination of costly accidents which directly affects the operational capability of any given company. Personnel and equipment losses, resulting from any accident, constitutes an unacceptable drain on the resources on which an organization depends for its existence.

The primary concern of a Flight Safety Program is not safety for safety's sake alone. It is recognized that there are certain inherent hazards in commercial helicopter flying which must sometimes be accepted in the interests of job accomplishment. However, recognition of these hazards does not dictate their blind acceptance; rather, their recognition should serve to indicate more exactly just where the major flight safety preventative effort should be directed.

Because operational effectiveness and job accomplishment is the operator's prime responsibility, the burden for flight safety must rest personally with them. Flight safety is thus a function of the operator's direction. The operator, in turn, because of the complexities of modern helicopters and the unusual environments in which it is capable of being worked, must rely on its executive, technical and administrative staffs for expert advice. These supporting personnel also should become directly and very closely involved in all aspects of the Flight Safety Program. It follows then, that flight safety (accident prevention) is not the

responsibility of one person alone; rather, every person connected in any way, however remotely, with the helicopter operation and must share in this responsibility. The manufacturer, parts suppliers, vendors, users and their related personnel, all contribute their own specialty to the end that accidents do not occur.

The causes of accidents originate in a variety of ways, ranging from an incorrect statement regarding the operational requirement, through design, testing, manufacturing and operating usages, and environments. Maintaining (or lack of maintaining) the helicopter properly, as well as flying techniques and knowledge are also contributing factors. Other causes come from the training of air and ground crews and the operational risks which are inherent in the sometimes unusual conditions under which helicopters are asked to operate. The great majority can be traced to human fallibility. In most cases this can be countered by higher professional standards in flying, servicing, planning, administration and staff work, and by maintaining a high morale; all of which are products of inspired leadership. It is, therefore, the supervisors at all levels who can do the most for flight safety. Furthermore, the operator is responsible for operational efficiency, so he must be responsible for the implementation of flight safety.

Experience has shown that the establishment of a Flight Safety Program is necessary to keep accident numbers to a minimum. Flight safety is a means of achieving

operational efficiency and is not an end in itself. To be most effective, a flight safety organization should be independent and have right of access to the operator.

It must have an adequate system of reporting, investigating, collating, study and analysis, and for exchange of accident data. It must be able to advise on accident risks, seek potential causes, suggest remedial action and publicize accidents and their causes so that all may benefit from the experiences of the few. Thus, flight safety does not run against the business aims of the operator, rather, it enhances the performance capability of the operation with a big plus...a built-in safety factor.

How does your organization stack up with regards to an effective Flight Safety Program? If you have a hard time answering this question there are ready made solutions. For assistance you may contact: The Helicopter Association International Safety Committee led by Committee Chairman Al Major. Contact information:

HAI Safety Committee
Al Major, Chairman
Bonneville Tower
9120 N.E. 47th Ave.
Portland, OR 97232
Email: aamajor@bpa.gov
Telephone: 503-230-4107

For non-HAI Members simply go to: www.ihst.org. You can download vital information that may make the difference when it comes to a safe helicopter flight operation. Not part of an organization or corporation? Information at this site is for you too. Take a look.

Awards & Recognitions



BELL HELICOPTER AWARD PROGRAMS

Many Bell pilots and operators have requested information on what type of Bell Helicopter wings and safety awards are available to them. There are two ways to obtain recognition for pilots who fly Bell helicopters. The first recognition is a Pilot Safety Award issued on the basis of safe flying hours in Bells. The second is a wings award based on the pilot's flight hours in Bell helicopters. It is possible for a pilot to obtain both awards.

Bell Flight Time Wings Award

The second recognition is for a pilot's flight time in Bell Helicopters. The Bell Training Academy issues this Certificate of Achievement and a Wings Lapel Pin in the following flight time hours:

- 1,000 hrs.** plain wings pin + certificate
- 5,000 hrs.** 5,000 hr. wings pin + certificate
- 10,000 hrs.** 10,000 hr. wings pin + certificate
- 15,000 hrs.** 15,000 hr. wings + certificate
- 20,000 hrs.** 20,000 hr. wings + certificate

Example: If a person had 6,500 hours in Bells he would receive a 5,000 hour pin, although the certificate would read 6,500 hours. Their next opportunity for a higher hour level pin would be at the 10,000 hour level.

For the hour level recognition to be awarded, the pilot (or company) must provide the following: Name of pilot as they would like it printed on a certificate, a verified flight time in Bells by either the Chief Pilot or a Company Administrative Official. In the case of an individual pilot making the request, a signed copy of the page in the pilot's log book that verifies the hour level for the wings requested.

Mail or email the information (including copy of documentation) to Rosalind Larmer at: rlarmer@bellhelicopter.textron.com. Bell Helicopter Textron Inc., P.O. Box 482, Rosalind Larmer, Dept. 9S, Bldg. 61, Fort Worth, TX 76101 USA

Pilot Safety Award

Recognizing an individual pilot for flying safely is far too rare. Most pilots only hear of mistakes made by another pilot in an accident. Bell provides a Pilot Safety Award certificate for hours flown without an accident in a Bell helicopter. This can be achieved in either military or commercial aircraft. The award is given in thousand hour increments to recognize those pilots with a proven commitment and history of safe flying. To apply for this recognition certificate, please send a request letter from the chief pilot, CEO, military commander, or other individual who can confirm how many accident-free flight hours you have flown in Bell helicopters. If you are an individual pilot / owner, you can write the statement yourself. Let us know how you would like the name to appear on the certificate. If you want to include a military rank, you need to indicate that.

The award is maintained through the Bell's Flight Safety Department within Bell Engineering; Lee Roskop (ldroskop@bellhelicopter.textron.com) is the Bell point of contact. His mailing address is: Bell Helicopter Textron Inc., Attn: Lee Roskop, Dept. 81, Group 60, P.O. Box 482, Fort Worth, TX 76101 USA

The pilot's name and safe flight hours are posted on Bell's Flight Safety web page www.heliprops.com. Follow the link to the Heliprops Pilot Safety Award Program.

Bell Cockpit Information Recorder (CIR) Camera Prototype

When installed this CIR captures digital images of the cockpit that are recorded into a small, crashworthy hard drive. Along with ambient cabin noise, the images would give accident investigators accurate knowledge of events leading to a crash.



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