HELICOPTER GASIL

GENERAL AVIATION SAFETY INFORMATION LEAFLET

A CAA Accident Prevention Leaflet **December 2002**

Helicopter GASIL Special

This special edition of GASIL specifically for helicopter pilots has been produced as a result of the deliberations of the Small Helicopter Action Group which was formed in 2000 from CAA and industry in an attempt to reduce the disturbing number of accidents, especially fatal accidents, suffered by small UK registered helicopters in the previous few years.

The Group considered that the information which they had been examining, and which is contained in the main article on 'Accidents to Small Helicopters' in this issue, should be made more widely available. It also considered that the CAA should give guidance on the most common factors identified as causes in that analysis, so the other articles in this issue are intended to add to the advice already contained in the helicopter section of GASIL published each quarter, and Safety Sense Leaflet 17 "Helicopter Airmanship", both of which are available on the CAA website www.caa.co.uk. It is hoped that helicopter pilots and owners will get benefit from the leaflet and will also encourage others to do so, either by lending them their copy, or by directing them to the copy on the CAA web site and following the buttons through "safety" "general aviation", and "GASIL".

CONTENTS

Civil Aviation Authority

Disorientation in bad weather

Originally referred to in an earlier GASIL and taken from an AAIB report

A few years ago, the pilot of a Robinson R44 took 2 passengers on a day out. Before returning at dusk, one passenger suggested that the weather looked rather poor, but the pilot, who was an assistant flying instructor, said there would be no problem. There were no mountains to be crossed, but the ground along the route rose to over 500 feet, with some areas over 800 feet.

The forecast issued in the morning was for a slow moving occluded front to lie virtually along the route in the late afternoon. At that time, the general visibility was forecast to be 10 km with broken cloud at 2000 feet, but (as might be expected in that weather situation) visibility was expected to deteriorate occasionally to 6 km in rain, with broken cloud at 800 feet above sea level. However, as the wind reduced during the late afternoon and evening, visibility reduced further and the cloudbase became even lower than the earlier forecast had expected.

In darkening conditions, the pilot seems to have entered low cloud and lost visual reference. Whilst attempting to turn away from the cloud and descend, he lost control of the helicopter and it crashed. The AAIB suggest that factors contributing to the loss of control probably included his attempt to refer to a hand-held map and GPS using the interior light. This would have considerably degraded his ability to maintain visual contact with the ground under the prevailing outside conditions of darkness and poor visibility.

CAA Comment

It seems that the cloudbase over the low ground at the departure site was adequate. However, frontal conditions are notoriously unpredictable, and hills, even those a few hundred feet high such as those in the area over which the route was planned, generate vertical obstructions not only for the aircraft but also for weather. Any low cloudbase which may be suggested in an area forecast is likely to be found on or above sloping ground, and there is also a greater likelihood of visibility deteriorating in rain.

In addition, weather patterns often change after forecasts have been issued. If the pilot had obtained recent actual weather reports (METARs) along or in the vicinity of his route, or even telephoned his destination, he would have discovered that the weather had deteriorated. In fact it had deteriorated to such an extent that the FISO at that destination was concerned about the returning helicopter's safety. While most pilots understand that they must not use an invalid forecast, we must also be aware that aerodrome forecasts (TAFs) may be amended even during their period of validity. The list of METARs published by the Met Office includes updated forecasts if any have been issued.

Although the pilot had a night qualification and an IMC rating (for aeroplanes) on his licence, neither of these were of much help when flying this type of helicopter, or any helicopter without a stabilisation system. The skills required to keep such an unstable aircraft in steady forward flight for any length of time without good external cues are too great for a single pilot. Pilots of such aircraft must protect themselves and their passengers from the perils of darkness and bad weather by careful pre-flight planning, and not rely on sorting their problems out when they encounter them.

Hand-held GPS receivers have been the subject of comment before. Apart from the danger of over-reliance on an electronic aid in poor weather, they can distract pilots from their task of flying the aircraft, which in darkness and poor visibility is difficult enough already. Good route planning, including planning for alternatives, allows a pilot to spend almost all his time with his eyes outside the cockpit.

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Editorial office:	General Aviation Department (attn GASIL Editor), Safety Regulation Group, Civil Aviation Authority, Aviation House, Gatwick Airport South, West Sussex, RH6 0YR. Telephone (01293) 573225 Fax (01293) 573973 e-mail: david.cockburn@srg.caa.co.uk.
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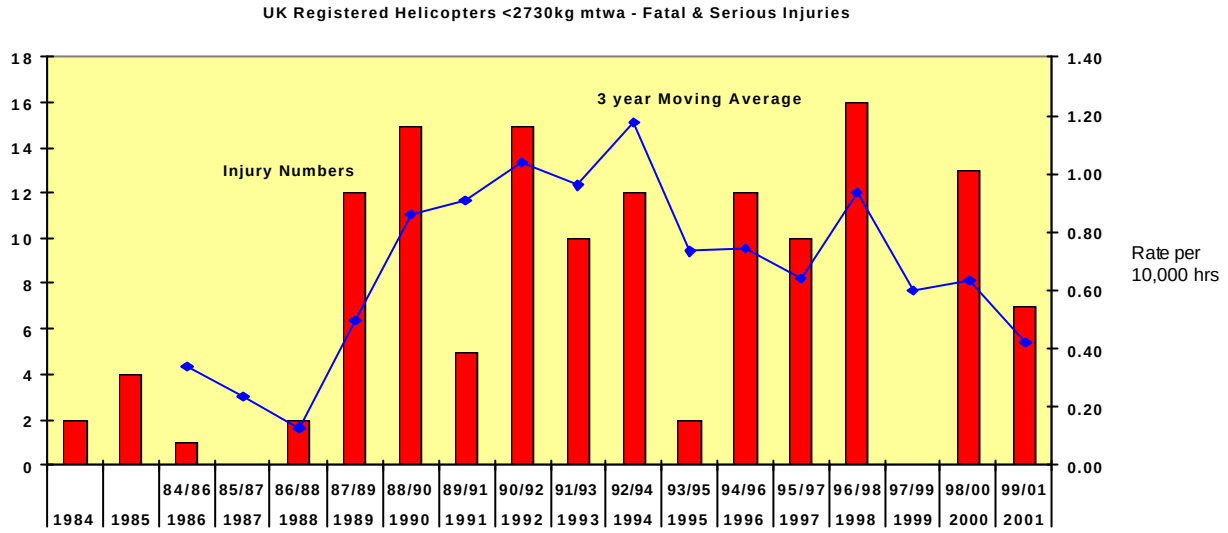
Accidents to Small Helicopters 1997 – 2001

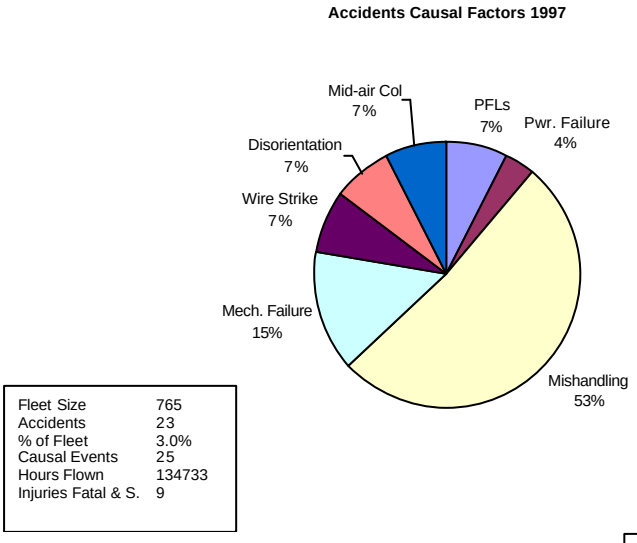
The definition of “history”, so the old joke goes, is, “one damn thing after another”. In a rather similar way, the analysis of accident statistics tends to degenerate into just one accident after another. It is true: there was a sudden increase in the numbers of helicopter accidents during the 1990s which caused the alarm bells to ring.



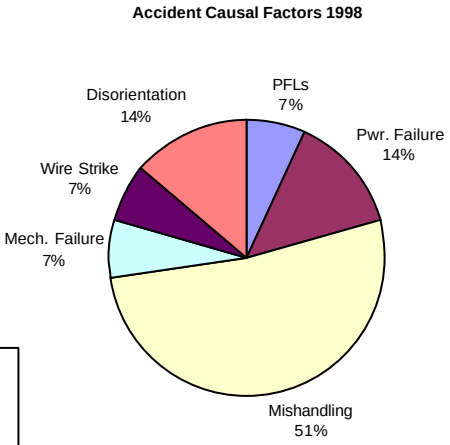
Thankfully, the trend in more recent years has been definitely downwards. However, it might be helpful to know why. If a reason can be found we might all be able to develop safety strategies which will further reduce the accident rate, but how to make sense of the statistics?

Armed with the raw statistics from the CAA database of accidents involving helicopters of less than 2730 kg maximum take-off weight, we tried summarising the causal factors for the years 1997 – 2001. Although each accident was in its own way unique, we found that it was possible to group the accidents under a relatively small number of main causal factors. For example, we assigned the causal factor of ‘power failure’ to accidents where the engine had ceased to deliver adequate power (whether the failure was due to a broken component in the engine, ice in the carburettor, or some other reason). Similarly, when a pilot put a serviceable aircraft into a manoeuvre from which an accident resulted, we assigned the causal factor of ‘mishandling’.

All the accidents have been analysed in this manner and the fall-out has been summarised in the following series of pie charts:

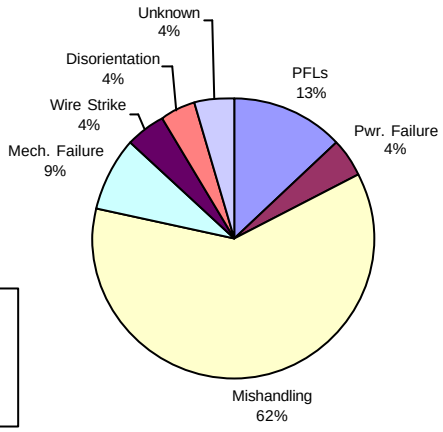


Fleet Size	765
Accidents	23
% of Fleet	3.0%
Causal Events	25
Hours Flown	134733
Injuries Fatal & S.	9



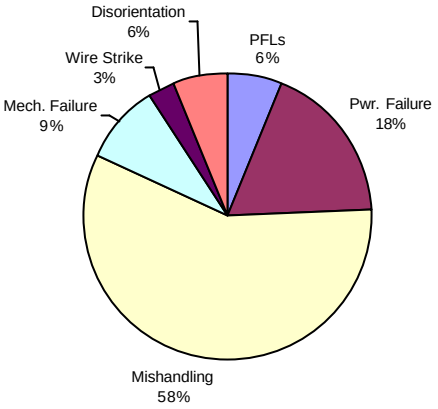
Fleet Size	835
Accidents	25
% of Fleet	2.8%
Causal Events	29
Hours Flown	180193
Injuries Fatal & S.	16

Accident Causal Factors 1999



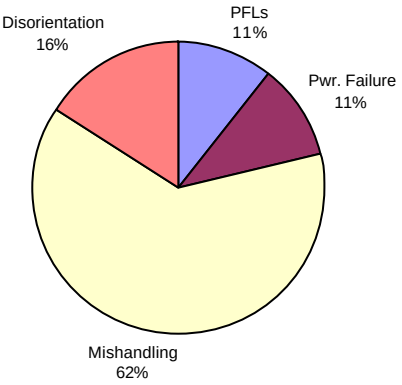
Fleet Size	871
Accidents	20
% of Fleet	2.3%
Causal Events	22
Hours Flown	157935
Injuries Fatal & S.	0

Accident Causal Factors 2000



Fleet Size	915
Accidents	26
% of fleet	2.8%
Causal Events	33
Hours Flown	164239
Injuries Fatal & S.	13

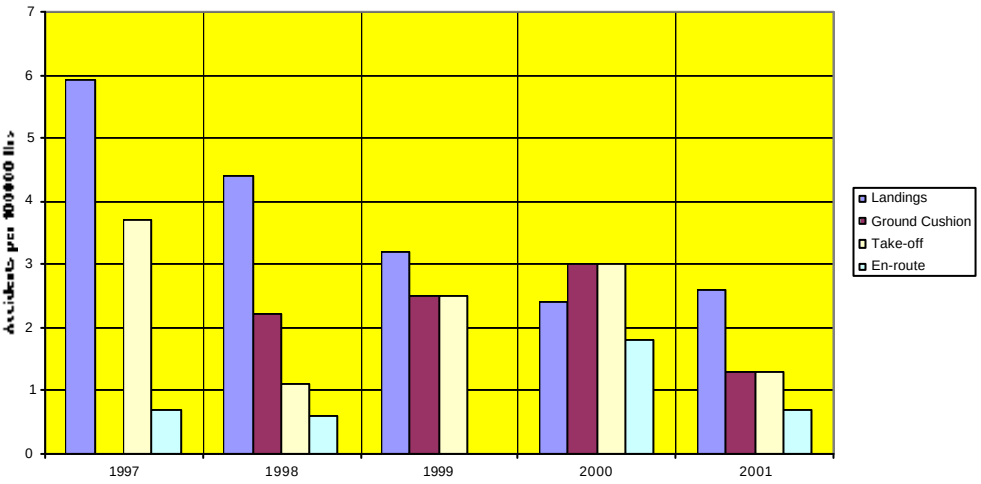
AccidentCausal Factors 2001



Fleet Size	942
Accidents	18
% of Fleet	1.9%
Causal Events	19
Hours Flown	153610
Injuries Fatal & S.	7

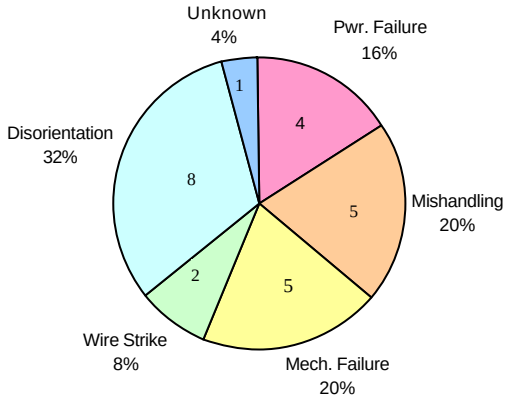
Most strikingly, more than half of the accidents appear to have been caused in some degree by mishandling. Further analysis has produced a breakdown into the phases of flight associated with this causal factor and these are shown in the following bar chart.

Mishandling Accidents 1997 - 2001



The last chart shows a breakdown of the accidents involving fatalities and serious injuries.

Accidents Involving Fatal or Serious Injuries 1997 - 2001



1997 – 2001	
Pwr. Failure	4
Mishandling	5
Mech. Failure	5
Wire Strike	2
Disorientation	8
Unknown	1

Most of the accidents involving mishandling occurred while taking-off, landing, or operating in the ground cushion. These were low speed accidents and although the aircraft were usually badly damaged there were no fatalities resulting from accidents in these phases of flight, although, in one instance, a person on the ground was seriously injured by flying debris.

Accidents due to mishandling probably mean that the attempted task is too difficult. The aircraft may be difficult to fly, the manoeuvre may be too demanding, the pilot may need more training, or the operating environment may be unsuitable. Operations involving landing, taking-off, hovering and air taxiing require a high degree of skill. The high proportion of accidents which involve inadvertent striking of the ground may well result from a selected hover height which is too low, an underpowered helicopter, or over controlling by the pilot. The other type of mishandling accident occurs in the en-route phase and may be associated with another causal factor such as engine failure. In these cases, failure to enter autorotation and accomplish an engine-off landing is much more likely to result in serious injuries.

Pilot disorientation at night or in poor weather, or flying into wires are fortunately rarer types of accident, but these accidents typically result in the loss of the helicopter and multiple fatalities.

A high degree of awareness is required if a pilot is to recognise engine failure and lower the lever quickly enough. Skill is required to carry out the subsequent autorotative landing and there is also a degree of luck involved in any successful outcome. Training for this emergency is essential, but it is not without risk, and this is reflected in the proportion of accidents resulting from actual engine failure and practicing engine failure procedures. Once again, the suitability of the aircraft and the circumstances in which it is being operated will have a bearing on the likelihood of an accident occurring.

To sum up, it might be said that there have been a lot of silly accidents for silly reasons and a few serious accidents which occurred in circumstances that sometimes could have been avoided. What do you make of it?

Small helicopter safety seminar

The CAA's General Aviation Department, in conjunction with the Air Accidents Investigation Branch of the Department for Transport, and the Confidential Human Factors Incident Reporting Programme, held a seminar on small helicopter safety at Farnborough on November 19th.

The topics covered were similar to those of the previous year. There was a short description and analysis of recent fatal accidents, then the subject of the safe and practical use of GPS in GA aircraft was introduced by a presentation from David Broughton, Director of the Royal Institute of Navigation. AAIB inspectors then hosted a guided visit to the hangar containing the evidence from recent accidents. In the afternoon, a CAA helicopter test pilot described the certification process for small helicopters and the pilot behaviour expected by that process. He also gave insights into helicopter handling in problem areas, a subject continued in discussion afterwards.

It is proposed to hold a further seminar on 18th November next year. It will again be aimed primarily at private pilots of small helicopters, and all who would like to register their interest in attending are encouraged to contact Safety Promotion at the General Aviation Department, Aviation House, Gatwick Airport South, RH6 0YR.

Helicopter training – Ready for anything

The general thrust of this publication so far is to highlight the many factors surrounding the causes of accidents to small helicopters and the theme is to guide the helicopter flying fraternity towards safer flying. It is already clear that 'mishandling' is the primary causal factor and if we look more closely at some of the other portions of the chart, it would be true to say that mishandling may well have influenced the outcome of those as well.

Accepting that some accidents caused by mishandling may have been the result of factors outside the immediate control of the pilot, I think we must conclude that most would not have occurred had the pilot been prepared and ready to cope with the situation as it developed.

Preparation is a word that rolls of the tongue easily and can be interpreted in a variety of ways: *"I did the course and passed the test – I must be prepared"; "I arrived in good time, checked the met and pre-flighted the aircraft – I must be prepared"; "I've got qualifications coming out of my ears and I am the ace of the base – I must be prepared."* The list could go on but would it ever touch on the real business of being 'prepared and ready to cope'?

When we walk we usually do it without conscious thought and when we have to negotiate the puddles, step on the escalator, step off the curb, etc, we hardly have to consider where we are putting our feet. We rarely have to stop and think, because we've been doing it for most of our lives, we are in continuous daily practice and we are 'familiar' with the procedures. However, when something unusual happens, for example the person in front stops unexpectedly, the escalator reverses direction or the car we assumed would stop doesn't, we are suddenly confronted with a situation requiring quick thought and action. This may appear a fairly basic analogy but let us compare it with flying.

For most of us flying is an expensive leisure activity which we cannot enjoy as often as we would like. Frequent and regular flying is pretty uncommon for the PPL(H) holder so it is definitely not something we could do without conscious thought. There is usually a lack of continuity and often 'poor familiarity.' It is a rare Brit who will readily and openly declare a lack of experience. We might admit it as students but not when we are steely-eyed aviators, perish the thought!

Well, how do we achieve and maintain the familiarity necessary to be safe pilots? Yes! You got it in one! We have to have regular and frequent training and practice. But helicopter flying is expensive and we are already doing as much as we can afford. We can't do more training! Well, maybe we can't do more training but we can make the most of the training we get and we can also adopt a mind-set to use all the flying we do to perfect our piloting skills and improve our preparedness for the unexpected.

As the Chief Helicopter Flight Examiner I get to see candidates from across the whole spectrum of aviation and I can quickly tell apart those who have been taught *'what it says in the book'* and those who have been taught *'to be an aviator.'* Therefore, our first consideration is to ensure our instructors are giving full value for money: *'that they are filling every minute of the lesson with sixty seconds worth of quality instruction.'* Their demonstrations and fault analysis must be good and they must instil a desire for perfection in their students. Supervisory instructors must take a direct interest in the quality of their staff and students must not be afraid to question if they don't think they are getting their money's worth.

Our next and equally important consideration is to use every opportunity whilst we are preparing for flight, and while we are flying, to get maximum value from the experience. Don't accept scrappy preparation, don't rush it and ensure you prepare thoroughly. Of course you will check the met but what if it turns out different from your expectations? Will you be ready for that deterioration on the way or that sudden and unexpected gust of wind as you hover out to the departure point? Of course you will check the NOTAMs but will you keep a look out for that unexpected parachutist, military jet, or that other aircraft whose pilot is too busy with the instruments or map to notice you? Of course you will check the aircraft but will you be ready for that unexpected rise on the temperature gauge or sudden flash of the warning light? Will your cockpit administration be tidy and ergonomic so that you don't have to panic over that forgotten check or unexpected frequency change?

Once into the aircraft and ready to go for that glorious flight will you concentrate on your flying accuracy? Will you just raise the collective and get it in the hover or will you raise the collective and ease it carefully off the ground with no sideways or backwards movement, then thoroughly cover the after take-off checks? Will you strive to maintain the precise hover height, keep it straight over the ground, spot turn smoothly with total control, transition with consideration for the avoid curve, concentrate on maintaining your climbing speed, cruise height, speed and heading? Will your approach be steady and precise and will you maintain your flying accuracy until you are safely on the ground at the end of a well-flown and satisfying flight?

Of course you will, but I think you will agree that, if we really prepared thoroughly, planned and executed every manoeuvre carefully, took full advantage of every flight to strive for perfection and refuse to accept second best, there would be considerably fewer accidents due to mishandling and aircrew error. You know it makes sense!

Rotor downwash

The CAA receives reports fairly often from aeroplane operators complaining that downwash from rotors of hover-taxying (or low flying) helicopters has affected them. These effects range from blowing foreign objects into their path (or their passengers), to damaging the flying controls by blowing them around. Such damage to flying controls may be expensive to repair, and if not noticed at the time may have more serious consequences.

The problems may be even more serious than that. Turbulence caused by rotor downwash can affect the control of aeroplanes during take-off, landing, and in flight, with possible fatal consequences. In 1992, a PA 28 was rolled over just before touchdown by the wake turbulence from rotor downwash. This possible loss of control especially applies to the ever-increasing number of microlight aeroplanes, as reported in GASIL issue 3 of 2002, but certainly not exclusively. Hang gliders and para-gliders are also particularly at risk, possibly of their canopies being deflated. Damage on the ground may also affect flight, as demonstrated in a recent occurrence concerned an aeroplane whose stabilator (pitch) control jammed during take-off, which the pilot believed was the result of it being previously deflected harshly by downwash from a passing helicopter; the control cable had "jumped" its run and become wedged against its guide washer.

As operators of aircraft which can cause genuine problems to humans and aeroplanes, it is up to us to ensure that we helicopter pilots keep our downwash well away from anything which might be adversely affected (or endangered!) by it. This is after all not only common courtesy, but common sense.

Night flying

Night flying is often especially rewarding. It is also a particular skill. Night flying in helicopters requires training and constant practice. It is often described as a combination of visual and instrument flying.

Except on very clear moonlit nights far away from built up areas, the only external references which a pilot can use are lights. Lights on the ground and lights in the air (stars, aircraft and satellites) can be easily confused, leading to spatial disorientation and possible loss of control. If cloud is present, it will blank off some of these lights. Gaps in previously seen lights, either in the sky above or the ground below, will add to the possible confusion, so pilots must cross-refer to their flight instruments at frequent intervals.

In general, visibility appears greater at night. It is easier to see lights at a distance than to see an unlighted object during the day. However, in light winds under a cloudless sky, radiation fog often forms as the earth cools at night. Apart from a possible landing hazard, any fog covering ground lights can also lead to disorientation.

The visual flying technique of "lookout – visual attitude – check a gauge – visual attitude – lookout – visual attitude" has to be modified to something like "lookout – visual attitude – instrument attitude – check a gauge – instrument attitude - visual attitude – lookout – visual attitude – instrument attitude etc".

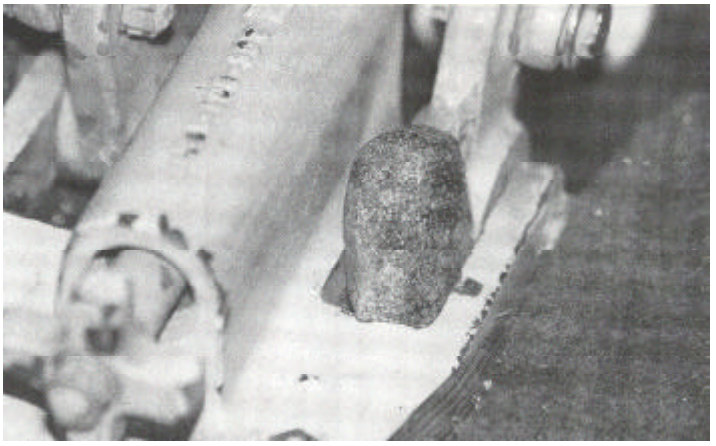
A major hazard at night is the difficulty of seeing cloud ahead. A pilot has to make deductions from the information available to him. Over land in the UK, except in fairly uninhabited areas, if there are no lights ahead of him, it is quite probable that they still exist, but are hidden by cloud which he will enter if he maintains his flight path. A careful night flyer always tries to track towards lights which he can see both above and below the horizon (as confirmed by his instrument attitude).

Of course, many helicopter pilots fly under cloud cover, which in the UK is the rule rather than the exception. In that case, no stars will be present to guide the pilot, and there is always the possibility of unsuspected cloud suddenly surrounding his aircraft. Apart from a last minute loss of the ground lights just in front of the aircraft, his only warning will be the weather forecast. Cloudy skies make pre-flight weather study vital.

A night landing is the final worry. Landing in darkness (as for example into a field when running short of fuel) is a total gamble. A landing light will illuminate the ground below, but gives no perspective for a safe touchdown. Properly lit landing pads are necessary for night landings in helicopters, and the guidance in the CAA's "Helicopter Site Keepers' Guide" available through the British Helicopter Advisory Board web site at www.bhab.demon.co.uk should be followed.

As stated earlier, practice is much more important in night operations than in daylight.

Stone me!



We are grateful to a reader of the Bell Helicopter Textron “Heliprops” for the photograph and accompanying information. The pilot of a Bell 206 had flown several trips with passengers during the day, and on the final trip was demonstrating a pedal turn from the hover at 600 feet to those on board at the time.

Having yawed through almost 360 degrees he applied left pedal to stop the yaw, but the pedal would not move and the aircraft continued to yaw rapidly. Having lowered the collective lever and closed the throttle, the pilot was having to adjust the position of the cyclic stick to make the aircraft travel towards the safest available landing area during its gyrations.

Eventually (and with his passengers screaming loudly that they were all going to die) the pilot managed to raise the collective at the correct point to make a landing in a level (but still yawing) attitude. There was no significant damage to the helicopter apart from the tail rotor drive shaft cover which had been hit by one of the main rotor blades during the gyrations.

The cause of the loss of control was a stone which had been carried into the cockpit with a previous passenger. The pilot continues ”It had lodged in the hole where the tail rotor pedal shaft comes up through the floor plate because the little foam rubber block, which is to prevent FOD from getting into that hole, was missing. I never before knew that those foam blocks are supposed to be there.”

That last comment from the pilot sums up the loose article hazard. However, we are concerned that he chose to even hover at 600 feet, with the attendant risk of an unintended descent and vortex ring generation, let alone perform this very uncomfortable “pedal turn” with passengers on board. Hopefully none of our readers would attempt such a thing!

Tail rotor loss

Thank you to “Heliprops” for this first hand description of an incident which concentrated the pilot’s mind more than somewhat.

I was in the cruise at just over 500 feet and 100 knots, with 65 to 70 psi torque selected, when I felt a high frequency vibration coming through the tail rotor pedals. The vibration became excessive.

I heard a loud bang, the aircraft suddenly yawed right and the nose pitched down. The tail rotor pedals had no effect. I lowered the collective and returned the pitch attitude to level, which required almost full aft cyclic. The yaw rate slowed but did not stop until I closed the throttle.

I turned south to the only obvious suitable landing area within autorotational glide distance and into the wind. It took full aft cyclic to maintain a level attitude. I kept my airspeed up to 80-90 knots to help keep the aircraft from spinning.

I performed an autorotational landing in a level attitude. The aircraft yawed approximately 180 degrees after I raised the collective lever. I touched down without forward movement and spun another 20 degrees after touching down.

Having shut the aircraft down and secured it, the pilot was able to inform his base that he was safe. The tail rotor blades, tail rotor gearbox, vertical fin, horizontal stabilizer and 18 inches of the tailboom were all missing from the aircraft. These lost items accounted not only for the yaw control problems but a reduction of 58 pounds in weight from the tail, which produced a centre of gravity position 2 inches forward of the forward limit.

The earlier article “ready for anything” asked “will you be ready for that unexpected rise on the gauge or sudden flash of the warning light”. A sudden loss of the tail rotor is rather more extreme than a warning light, but if we have considered the possibility of such a failure, and what we would do about it in a variety of situations, while we are on the ground, we should be better placed to cope with it if it does ever happen to us.