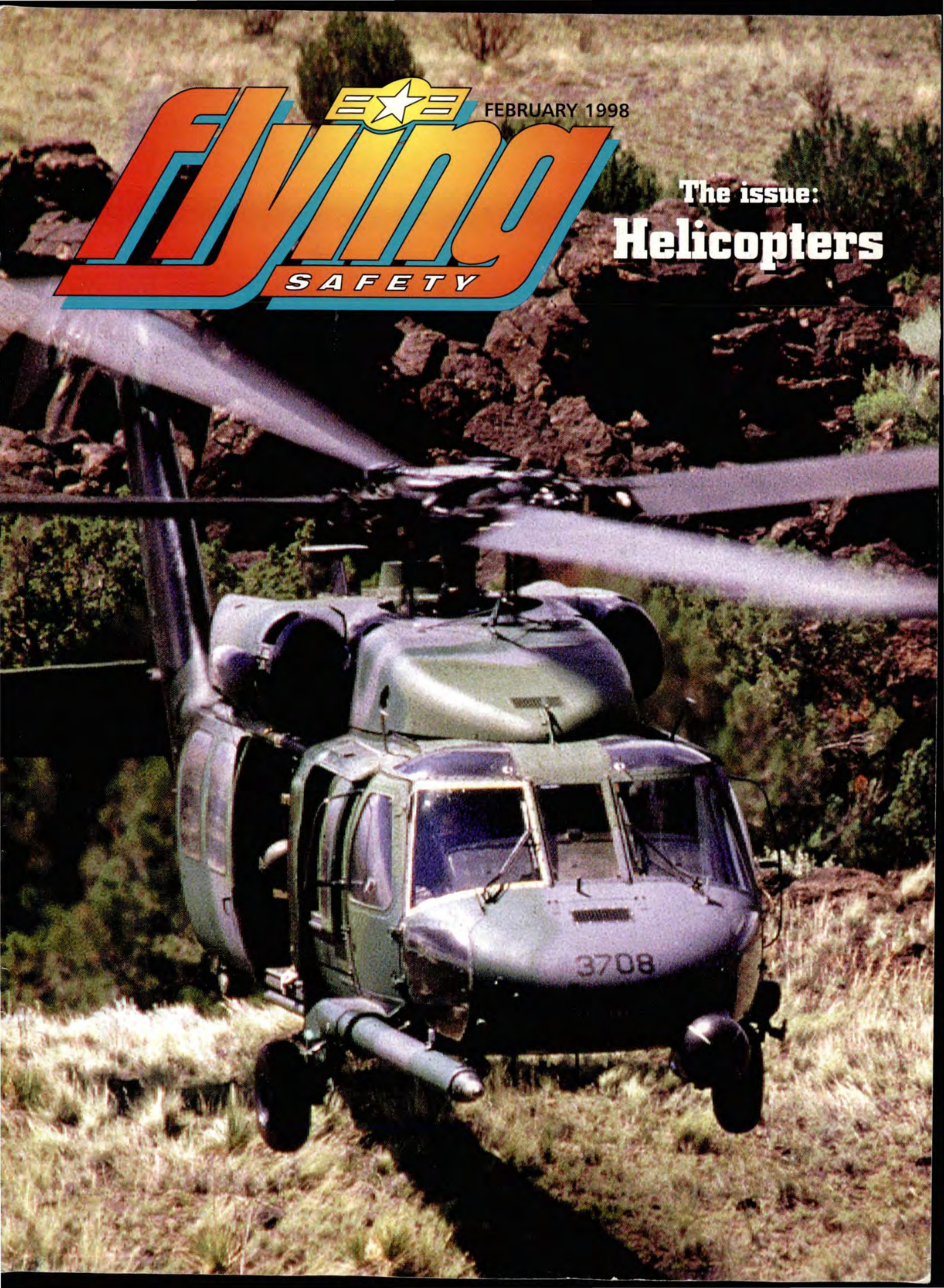
flying SAFETY

FEBRUARY 1998

The issue: Helicopters



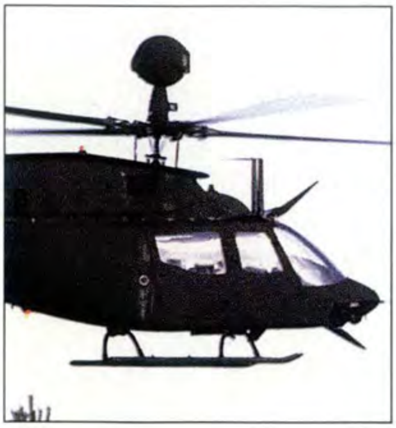
UNITED STATES AIR FORCE

AIR FORCE RECURRING PUBLICATION 91-1

Flying Safety

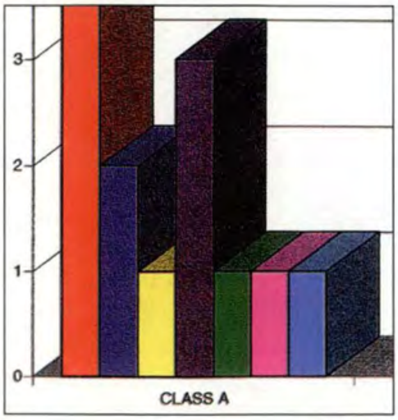
FEBRUARY 1998, VOL 54, NO 2

IN THIS ISSUE:



Page 4

Page 6



Page 23

4 I Have the Controls
A helicopter "There I Was"

5 Wires, Drugs, Hills & Helicopters
A helicopter and crew in some real trouble

6 Mountain Flying: Skill and Know-How
A bird's-eye view of problems with mountain flying

8 Helicopter Mountain Flying
What you must consider at higher altitudes and mountains

14 What You Don't Know About Low Vis Departures Can Kill You!

19 Crash Survival Concepts
Understanding the mechanics of crash injuries

23 FY97 Engine-Related Mishap Summaries
Engines still remain a major contributor to your mishap rates

27 Familiarity Can Breed Overconfidence
Take nothing for granted

28 All in a Night's Work
Some lessons learned by H-3 pilots

30 Maintenance OOPS$!!!
Some maintenance problems and what we can do

Cover Photograph: USAF photo by MSgt Perry J. Heimer

GENERAL MICHAEL E. RYAN
Chief of Staff, USAF

MAJ GEN FRANCIS C. GIDEON, JR.
Chief of Safety, USAF

GERALD C. STRATTON
Acting Chief, Media Affairs Division
DSN 246-0936

PEGGY E. HODGE
Managing Editor
DSN 246-0950

CMSGT MIKE BAKER
Technical Editor
DSN 246-0972

DOROTHY SCHUL
Editorial Assistant
DSN 246-1983

DAVE RIDER
Electronic Design Director
DSN 246-0932

MSGT PERRY J. HEIMER
Photojournalist
DSN 246-0986

Web page address for the Air Force Safety Center:
http://www-afsc.saia.af.mil
Then click on Safety Magazines.

Commercial Prefix (505) 846-XXXX
E-Mail — hodgep@smtps.saia.af.mil

24 hour fax: DSN 246-0931
Commercial: 505-846-0931

DEPARTMENT OF THE AIR FORCE — THE CHIEF OF SAFETY, USAF

PURPOSE — *Flying Safety* is published monthly to promote aircraft mishap prevention. Facts, testimony, and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. The contents of this magazine are not directive and should not be construed as instructions, technical orders, or directives unless so stated. **SUBSCRIPTIONS** — For sale by the Superintendent of Documents, U.S. Government Printing Office (USGPO), Washington D.C. 20401; send changes of subscriptions mailings to the USGPO. **REPRINTS** — Air Force organizations may reprint articles from *Flying Safety* without further authorization. Non-Air Force organizations must advise the Editor of the intended use of the material prior to reprinting. Such action will ensure complete accuracy of material amended in light of most recent developments. **DISTRIBUTION** — One copy for each three aircrew members and one copy for each six direct aircrew support and maintenance personnel.

POSTAL INFORMATION — *Flying Safety* (ISSN 00279-9308) is published monthly by HQ AFSC/PA, 9700 "G" Avenue, S.E., Kirtland AFB NM 87117-5670. Periodicals postage paid at Albuquerque NM and additional mailing offices. **POSTMASTER:** Send address changes to *Flying Safety*, 9700 "G" Avenue, S.E., Kirtland AFB NM 87117-5670.

CONTRIBUTIONS — Contributions are welcome as are comments and criticism. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning.

FSM notams

It has been a while since we talked about CAT—clear air turbulence. CAT is something nonseasonal, so it can always be a problem. It is especially troublesome because it's often encountered unexpectedly and frequently without visual clues to warn pilots of the hazard. This month in NOTAMs, our new feature, we pass along some good guidance from the FAA. —Ed.

Clear air turbulence has been defined in several ways, but the most comprehensive definition is "turbulence encountered outside of convective clouds." This includes turbulence in cirrus clouds, within and in the vicinity of standing lenticular clouds and, in some cases, in clear air in the vicinity of thunderstorms, low-altitude temperature inversions, thermals, or local terrain features.

One of the principal areas where CAT is found is in the vicinity of the jetstreams. A jetstream is a river-like flow of high-altitude wind following the planetary atmospheric wave pattern, with speeds of 50 knots or greater. There are three jetstreams: the polar front jetstream, the subtropical jetstream, and the polar night jetstream.

Some Rules of Thumb for Turbulence Avoidance

The following Rules of Thumb apply primarily to the turbulence associated with the westerly jetstreams.

1. If jetstream turbulence is encountered with direct tailwinds or headwinds, the pilot should consider a change of flight level or course since these turbulent areas are elongated with the wind and are shallow and narrow.

2. If jetstream turbulence is encountered in a crosswind, it's not so important to change course of flight level since the rough areas are narrow across the wind.

3. If turbulence is encountered in an abrupt wind shift associated with a sharp pressure trough line, establish a course across the trough rather than parallel to it.

4. If turbulence is expected because of penetration of a sloping tropopause, watch the temperature gauge. The point of coldest temperature along the flightpath will be the tropopause penetration. Turbulence will be most pronounced in the temperature-change zone on the stratospheric (upper) side of the sloping tropopause.

5. If possible, when crossing the jet, climb with a rising temperature and descend with a dropping temperature.

6. Weather satellite pictures are useful in identifying jetstreams associated with cirrus cloud bands. CAT is normally expected in the vicinity of jetstreams. Satellite imagery showing "wave-like" or "herringbone" cloud patterns are often associated with mountain wave turbulence. Pilots should avail themselves of briefings on satellite data whenever possible.

7. Last, but not least, monitor your radio—pilot reports can be invaluable—and if you get caught by "the CAT," file a PIREP!

For more information on clear air turbulence, see "CAT—Clear Air Turbulence," *Flying Safety* magazine, March 1995.

"I Have the Controls"

USAF Photo by MSgt Perry J. Heimer

CW5 BILL RAMSEY
Aviation Section
Army Safety Center

There I was in the left seat of an OH-58D(I): 80 knots and 200 feet AGL, not a worry in the world, VFR, and not a cloud in the sky. A simple training mission—go out, burn a fuel load, and do some ATM training. Nothing could be easier. Or could it?

It started with "You have the controls," something you hear all the time. Of course, being a crew-coordination graduate, I had all the right responses. "I have the controls," I replied calmly—calmly, that is, until the aircraft started to make an abrupt right turn and began to dive for the ground.

As hard as I tried, I could not stop the turn nor could I get the nose of the aircraft out of the steep dive. I looked over at my right-seater. A brand-new OH-58D(I) pilot fresh from flight school, he was looking at me, trying to figure out why I was trying to impress him with my flying skills. I mean, we were only 200 feet above the trees and making a run for the ground. Of course, by this time, 200 feet was only a far distant memory. About this time, it struck me that the cyclic was not moving like it should. In fact, the cyclic was not moving at all.

All at once, it came to me like a bad meal. My stomach began to churn as I realized what was going on. I had not checked the flight controls on my side during preflight, and guess what? The cyclic was locked out.

A thousand times I had preached to pilots: Whenever you go flying, check to make sure the cyclic is not locked out. Now, here I am, running out of altitude and ideas with no place to run, and my cyclic is locked out. Thanks to my right-seater's ability to recognize fear in the eyes of his left-seater, he was able to take the controls, maneuver the aircraft right side up, and keep us out of the trees.

Of course, we didn't come away completely unscathed. We overtorqued the engine and transmission, and maintenance may have to replace the seats.

I have come to realize that complacency can strike anyone at any time and warnings in the Operators' Manual are there for a reason—to save lives. If I can leave you with one thought, it is this: *Check the flight controls before you fly.* It sure is hard to keep a helicopter upright with only the collective and pedals. ✈

Wires, Drugs, Hills & Helicopters

CAPT DAVE PENTON
5 Avn Regt
Townsville, Queensland

Courtesy *Spotlight Special*
Operations in Tropical Mountainous Areas
Third Edition, Feb 97
Directorate of Flying Safety, RAAF

A long time ago in a far-off land, I was flying an Iroquois helicopter in support of police drug operations.

Due to the growers camouflaging their crops, our visual searches would invariably be a low-level "contour" search. Wires and high terrain were always uppermost in our mind, so we developed a local SOP to:

- Recce the area (fuel permitting).
- Fly down valleys rather than up into higher terrain.
- Divide the crew duties so that the aircrew kept a thorough lookout for terrain and obstructions, while the police concentrated on finding the drugs.

This system worked well enough and seemed a good compromise between getting the job done and safety. The flying rate was high—8-10 hours per day—most of it low level or at the hover hoisting.

A few days into the task, all the crew were starting to feel fatigued, but we all felt we could handle the pace.

The incident occurred on the fourth day. We were operating in a particularly isolated area, and the police wanted to raid a farmhouse that could not be approached over land. For this task we added four more police to the load to search the buildings while we conducted an aerial search of the area. Fuel was critical. Even with the auxiliary fuel tank fitted it could only be half-filled due to maximum AUW considerations.

Just before engine start, the police indicated that they wanted to do a quick search up a valley on the way out. I didn't particularly like this idea, but in the end I agreed. We thus departed and tracked out to search the valley. Due to fuel/time constraints, no recce could be done. And due to the orientation of the valley, it would save time if we flew up the valley towards the high terrain rather than down it.

The incident chain of events had well and truly started.

Now the Iroquois is not a great performer at its maximum AUW, particularly when on the back end of the drag curve. Unfortunately, we *had* to remain slow and low to conduct the visual search. The valley was steep-sided, winding, and rising towards a substantial high feature. Just as we rounded a bend, a police observer said he thought he saw a dope plot out the left side of the aircraft. For some unknown reason, I decided to look over my left shoulder and out the open left cargo door to see the plot. (I later discovered *all* the other crewmembers did the same thing at the same time!)

The next thing I remember was the calm and casual voice of one of the other policemen asking me if I could see the wires in front of us! All of the aircrew snapped their heads to the front. It took a split second to acquire the wires, and it was hard to judge the distance immediately. All of us realized at about the same time that they were very close. I remember the crewman calling *"Fifty meters and closing!"*

The wires were slightly higher than my seating position, about main rotor height. The three-wire hazard spanned right across the valley with little sag, hanging about 200 feet above the valley floor. Both sets of support poles were buried amongst thick forest along the top of the ridge lines. Given our weight, speed, and the distance to the wires, I had no choice but to fly *under* them!

We cleared the wires above us and bottomed out at about 100 feet AGL. The feeling of relief was welcome but short lived, as we now realized that we were still far from safe. The ground was rising steeply towards the high feature at the head of the valley. There was no place to land, and we now could not turn around due to the wires and our large turn radius in the narrow valley.

I remember the copilot "helping" me pull in the collective (I think he started pulling it first) and selecting 50 psi (maximum torque). I then flew IAS for the best climb angle. We were prepared to overtorque the transmission, greater than 50 psi, if necessary. Luckily, we cleared the terrain by about 100 feet without having to resort to this. After a short crew conference, we continued on the task.

That evening, after many beers and a lot of soul searching, we tried to figure out how I managed to nearly kill 11 people and destroy a perfectly serviceable helicopter. We came up with some sobering points:

- We were trying to do too much in one trip—we should have made that valley search a separate task at a later time.
- Having made a poor decision, I then compounded it by disregarding my own rules (i.e., wire recce and terrain flying).
- In a high workload situation, we all were distracted, breaking down the crew work cycle at a critical moment.
- We had been saved by a policeman who was very lucky to see the wires in the first place and thought twice about bringing it to our attention.

This still didn't tell ***why*** we did it. Fatigue, "can do" attitude, and complacency all played a part, but the fact was that I, one of the most experienced aviators in the squadron, had let a situation develop from which we nearly didn't survive. ✈

Mountain Flying: Skill and Know-How

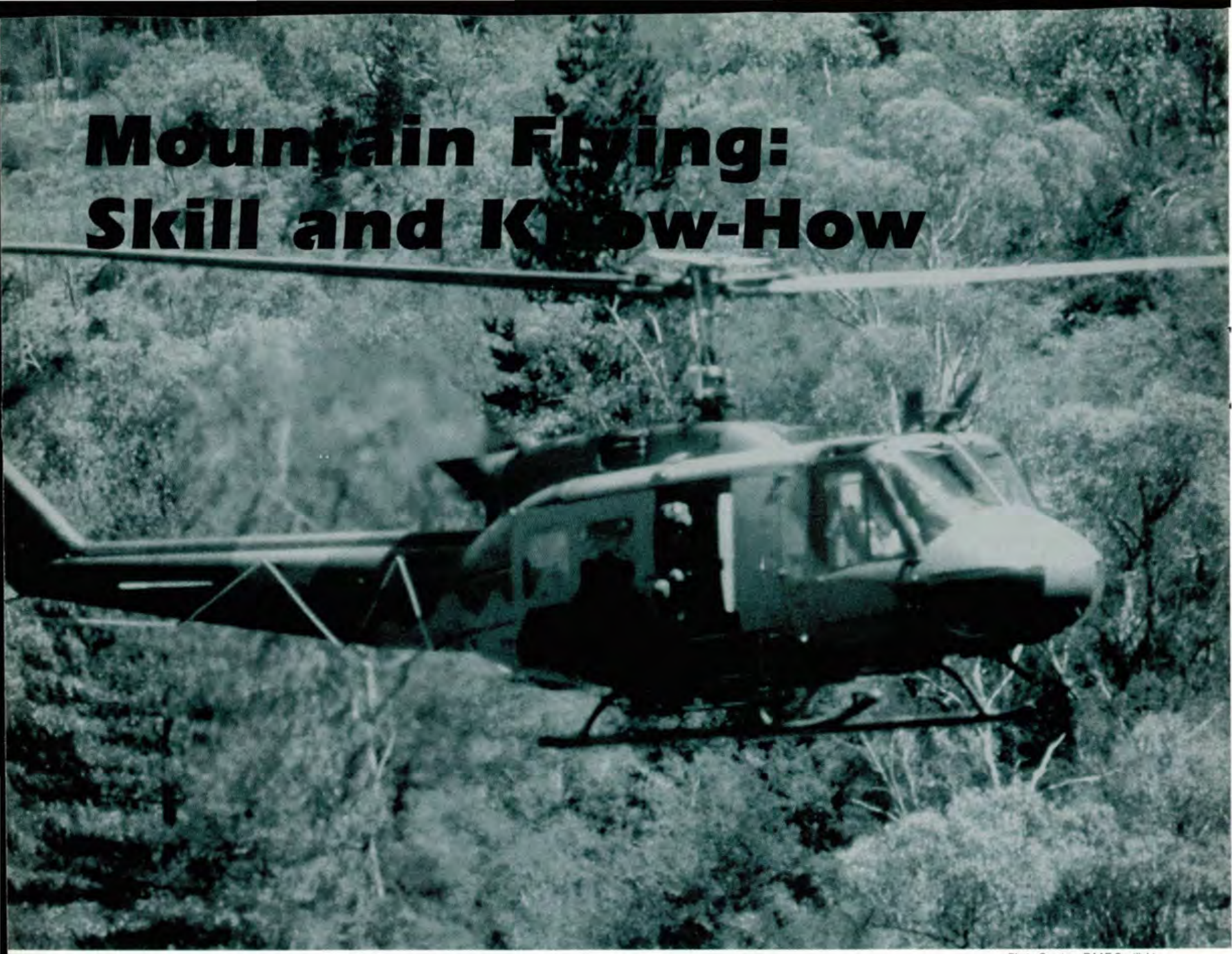


Photo Courtesy RAAF Spotlight

Courtesy Spotlight Special
Operations in Tropical Mountainous Areas
Third Edition, Feb 97
Directorate of Flying Safety, RAAF

A circus performer walking a tightrope, an artist trying to produce his best work, an athlete attempting to win a race, and an aviator flying in remote mountainous areas are all under strain. The only difference is that an aviator is under more than mere stress because his life and aircraft are at stake. While a circus performer, an artist, and an athlete are tops in their fields, the aviator must top them all when he pits his skill and aircraft against the mountains. The following accident gives a bird's-eye view of some of the problems aviators face when flying in the mountains.

Before taking off in a Huey on a photographic mission in mountainous terrain, the pilot estimated his gross weight to be between 9,100 and 9,200 pounds. Although concerned about the amount of equipment and number of personnel on board, he performed a go-no-go check and felt he could still fly the mission safely.

When the aircraft reached the mountain range, which was about 10 miles from the takeoff point, a high recon was made, and a suitable drop-off site was selected for the photographers. The copilot attempted an approach to the southeast but aborted at 50-feet AGL due to insufficient left pedal. He then made an approach to the southwest but also had to abort because of a fast rate of closure. The pilot then took the controls and landed in a westerly direction on the mesa at an altitude of about 6,200 feet MSL. Two photographers got off, and the pilot then flew west about 5 miles to locate positions for two other aircraft.

During an approach into a proposed site, the UH-1 spun about 360° to the right because of insufficient left pedal. At this time, the aircraft was 20-50 feet above the ground and spinning at approximately 15° per second. The pilot lowered collective and flew out of the area. Just before the spin, it was estimated that the aircraft was pulling 45 pounds of torque.

The crew then decided to burn off fuel to reduce aircraft weight. After flying for 30 minutes, they returned to the mesa to pick up the two photographers who had completed their filming. They remained on the ground for 15-20 minutes, and the pilot kept the operating rpm at 6,600 to burn off more fuel. A pre-takeoff check was made, and the aircraft was brought to a 2- to 3-foot hover. Torque was just below 40 pounds, N_1 was well below the red line, and EGT was slightly over 500°C. Therefore, the pilot decided not to perform a complete go-no-go check.

A normal takeoff was made, and transitional lift was reached after about 10-15 feet of forward flight. The pilot then applied forward cyclic and increased power to 42 pounds of torque to gain airspeed. The aircraft began to settle, so a small amount of aft cyclic was applied. By this time, the aircraft had travelled 50 feet and had attained 10-15 knots of ground speed.

On approaching the edge of the mesa, the pilot felt a weak gust of wind, and the nose of the aircraft started to move right.

The pilot added left pedal, which hit the stop as the aircraft reached the edge of the mesa. The aircraft started to turn right, and the pilot tried to compensate for the situation by adding left cyclic. The aircraft failed to respond and spun 90° right. The nose dipped downward, and the pilot applied left aft cyclic to level the aircraft. As the aircraft completed a 360° turn, the pilot tried to reduce power but could not as he was over a slope and a drop-off. The aircraft continued to spin and began to pitch and yaw violently. The pilot rolled off throttle, and the aircraft crashed left skid low and bounced forward on the right skid.

Fortunately, neither the crew nor passengers were injured, and the aircraft sustained only minor damage. However, similar accidents have had catastrophic results.

At the time of the accident, the gross weight of the aircraft was 8,796 pounds, density altitude was 6,100 feet, and pressure altitude was 5,900 feet. The UH-1 Operator's Manual cautions about left pedal travel limitations above 5,000 feet. The caution states that at high altitudes and weights where directional control is marginal, simultaneous climb and acceleration takeoffs may result in loss of control at a height and airspeed from which recovery is not possible. In addition, it states there is insufficient left pedal to maintain directional control when hovering or making takeoffs or landings in adverse winds at weights above 8,300 pounds at 5,000 feet and lower weights at higher altitudes. The manual also describes where directional control problems may occur when gross weight and density altitude are high. In this instance, the directional control problems associated with the UH-1 at high gross weights, high altitudes, and in adverse winds detracted from its suitability to perform its mission.

A qualified weather forecaster said that with the prevailing winds and topographical features at the crash site, the winds may have been as strong as 20-30 knots at the edge of the mesa, and wind eddies, both crosswind and downwind, probably existed. The winds at the edge of the mesa would have been approximately from the west-northwest or from 30°-80° off the nose of the aircraft, which was on a departure heading of 205°. The Operator's Manual states that under these conditions, marginal tail rotor control of less than 10 percent may be available depending on wind velocity, density altitude, gross weight, and rotor rpm.

There were several causes for this accident, but the more prominent ones were inadequate training and improper supervision. Neither pilot had adequate mountain-flying training or experience to fly this mission. The pilot had no mountain-flying experience, and the copilot had not flown in the mountains for 8 years. Although they operated in mountainous terrain, the commander failed to provide his pilots with mountain-flying training and briefings. In addition, their SOPs did not address high-altitude or mountainous-terrain operations in accordance with prescribed procedures. Neither pilot had read or been briefed on the cautions and warnings in the Operator's Manual concerning left pedal limitations under certain gross weight, density altitude, and wind conditions. They disregarded these limitations during flight planning, then used poor judgment by continuing to fly without sufficiently reducing their gross weight after experiencing left pedal problems on the first two approaches to the mesa.

Because of the inadequate training, the pilot added unnecessary power to gain forward speed when taking off from the mesa which caused loss of directional control due to insufficient left pedal.

Aircraft performance is affected by varying altitude, temperature, wind, and aircraft load. In addition to knowing the direction and velocity of the wind, an aviator must vary his aircraft load to correspond with altitude, temperature, and wind conditions. Because winds are extremely tricky and dangerous in mountainous areas, every effort should be made to determine existing conditions before takeoff and while en route. Weather forecasters can provide general information, but accurate information for the specific area of operation is not available through this source. In areas of operation where ground communications exist, aviators should contact those on the ground to determine the existing wind conditions.

Windsocks are the next best avenue for determining wind conditions and should be installed at LZs where repeated operations are conducted. Unfortunately, these sources are not always available, so the aviator must use visual cues to estimate wind direction and velocity.

Next to the windsock, smoke grenades provide the most accurate indication of wind direction and velocity. In light wind, smoke will rise vertically with very little horizontal movement, whereas in strong winds, it will disperse horizontally with very little vertical movement.

Unusual atmospheric conditions in mountainous areas are the rule rather than the exception. An aviator who operates in the mountains must know the capabilities and limitations of the aircraft being flown, must have acquired precision in handling the controls, and must have mastered the basic techniques of flying to the extent that they are instinctive. ✈

Helicopter Mountain Flying

Courtesy Spotlight Special
Operations in Tropical Mountainous Areas
Third Edition, Feb 97
Directorate of Flying Safety, RAAF

For all of its excellent qualities, the helicopter is a relatively fragile machine in certain situations. Operating in high mountainous areas is one example. Landing on irregular surfaces is another. Many pilots who are accustomed to flying at sea level say that the helicopter is a completely different machine at higher altitudes.

The first thing you must determine is whether your helicopter is capable of completing the mission. Consider the cargo: What does it consist of and how much does it weigh? Next, formulate some idea of your destination by taking more into consideration than merely direction and distance. Often a direct course is not the most suitable one for high altitude flights. It is better to opt for the most comfortable route, one that follows the valleys. By taking advantage of these mountain passes, you immediately overcome the inherent problems of flights over mountain ranges. Study the map of the area carefully, but make sure you do it before you set out.

Once more, estimate the altitude of the area you are about to enter. Wind and temperature are important factors for good planning, but consider yourself truly fortunate if the readings at your disposal are updated. If they aren't, assume zero wind conditions and the standard temperature of your intended destination's altitude in your calculations. Be sure to make the proper adjustments for seasonal variations in temperature and then allow yourself a safety margin by adding a few degrees to the expected figure.

The landing terrain must also be kept in mind. Is it to be a smooth, soft meadow or a tight, irregular ridge?

The purpose of this careful planning will be self-evident if it reveals a somewhat difficult operation. Many people immediately think of a helicopter when there is a special task ahead. Indeed, the flexibility of the machine permits it to perform certain missions in a less costly, time-consuming and cumbersome manner than would be possible by employing any other means. Consequently, there is a tendency to believe the helicopter can accomplish almost everything.

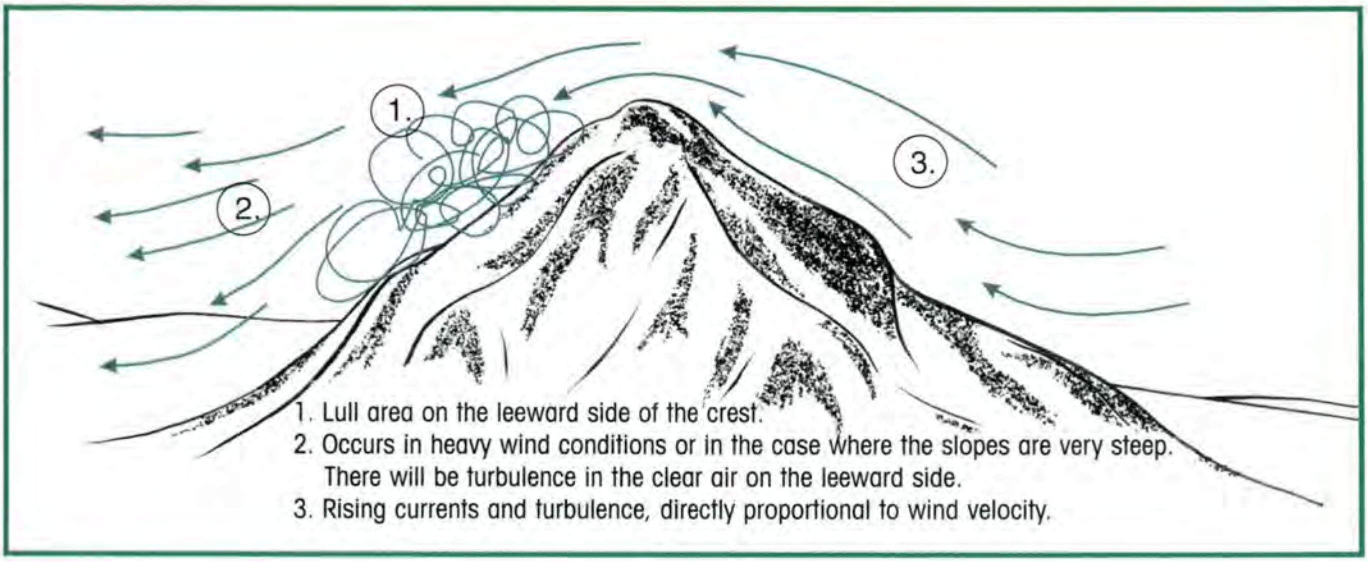
To a certain extent, this is true. The helicopter can do everything, providing it falls within the range of its operating standards. Therefore, if you are a helicopter pilot, it is your responsibility to dampen this enthusiasm, to think in terms of acceptable cargo loads and necessary fuel.

You should also be wary of the landing site proposed by others. You are the one who must determine having seen it with your own eyes. The enthusiasm or excessive trust of the uninitiated can later prove to be a source of grief. Even a perfectly level area may not be suitable for landing if it doesn't allow an escape route or enough room to maneuver.

It is true that a helicopter, already in flight towards a mission at low altitude, can, without advance notice, sometimes be called upon to operate in a mountainous area. In such a case, it is unlikely that you will have time to consult the flight manual, and you must therefore be cautious and undertake at least a minimum of planning with the few factors you have at your disposal.

Even though planning is important, it is not everything and, by itself, does not guarantee the success of the operation. When entering the area from which the request for assistance originated, one must use one's head. From statistics regarding accidents, one can conclude that often the pilot is not flying at the altitude dictated by the particular abnormal situation, said situation not having been anticipated in the planning process. Variations of air density at high altitudes, vertical air currents, turbulence, and uneven landing surfaces are all unforeseen factors which come into play with a certain regularity.

As an example, consider a case where the planning was supposed to have been accompanied by a generous amount of insight on the part of the man at the controls. The pilot in question had a total of 1,200 hours, of which



1,000 were in helicopters. He was supposed to unload passengers and material at a 3,000-foot altitude. The air density corresponded to that at 5,000 feet, and the pilot assumed he could hover outside ground effect. The cargo, however, was such that the helicopter could not hover within ground effect, and therefore the helicopter's predicament was similar to that of a normal aircraft. In other words, to hover, it was necessary to maintain a minimum translational velocity. The pilot, however, was well acquainted with the proposed landing area, and upon entering it, saw that clouds had covered the surrounding high ground. He was about to turn back, as per instructions, when the cloud cover broke, leaving a corridor-like opening. The pilot hurried to execute a long straight approach pattern. The slight break in the cloud cover, however, closed again. The pilot, in the meantime, was slowly reducing his horizontal velocity in the hope that the clouds would shift and allow visual access to the clearing chosen for the landing.

When the pilot finally decided to terminate the approach, it was already too late. The translational velocity had been reduced to the point where the helicopter began to fall through. Even full power was not enough to keep the helicopter aloft, and it more or less set itself down gently among the trees.

The accident investigators who looked into the accident established that the helicopter could not remain in flight without the lift resulting from either the translational movement or from the ground effect. When the horizontal speed had been excessively reduced, the fall through was inevitable. Lacking a sufficient ground clearance, an escape maneuver had proved impossible. In boxing terms, the pilot, quite simply, found himself on the ropes.

The chairman of the investigation team stated in the official report: *"It is an example of a typical situation in which the experienced pilot is not capable of acting in proper fashion in an unforeseen flight situation, which nonetheless occurs quite frequently in mountainous areas. Wind, a sparse and shifting cloud cover, and variations in temperature and humidity are all too rarely covered adequately by meteorological reports before the flight. These are the unknowns which most often endanger the normal execution of a helicopter mission. Only ability and flight technique enable a good helicopter pilot to safely take advantage of his machine within the full range of its flexibility and its operating standards."*

These are not idle words. Heed them and try to understand their value, because in light of what has been said, it is possible to glimpse yet another aspect of flights in mountainous areas. It is normal for every pilot to want to take full advantage of his helicopter's flexibility. It is also human for a pilot who is accustomed to flying at sea level to feel a sense of challenge upon reading the instructions regarding mountain flights in his flight manual.

Do you recall the story of David and Goliath?

There was a challenge. David was a young lad, brave and pure of heart (like you and me, naturally), whereas Goliath was as tall as a skyscraper and wicked. What did David do? Did he throw himself at Goliath, flinging stones and shouting threats? Most certainly not! He took his time, calmly and carefully choosing five small polished stones from a nearby brook before facing Goliath. David knew that technical preparation was just as important as purity of heart. Advancing the clock of time a few centuries, let us return to our helicopter pilot who challenged the mountain but was unable to conquer it.

The reason for this failure was simply the pilot's lack of preparation and his sketchy knowledge of the helicopter's operating capability at high altitudes. On a sultry midsummer afternoon, not long ago, an Air Force radio station located near the sea received a request for immediate assistance from a helicopter on a search mission. The request was calmly forwarded to various more-or-less important officials, but when it finally reached the pilot of the rescue craft, it had already been cleared for takeoff, and it was in flight only 16 minutes after the order had been received. On board with the pilot were four other persons.

The pilot had a total of 2,000 hours of which 150 were

continued on next page

in a helicopter, and this was his first mission in a mountainous area as pilot in command. He had previously participated in a mission at 3,000 feet above sea level in the capacity of a copilot.

The task was to locate certain supplies which had fallen into an inaccessible area. The pilot spotted the material and requested further instructions from his base superiors. He was asked to land, if possible, and send two men to recover the cargo. The closest accessible landing site seemed to be a clearing near an Alpine Shelter at 5,000 feet altitude. The pilot radioed headquarters that he was initiating landing procedures. Here is an excellent opportunity to review a helicopter pilot's so-called ten commandments for flights in high mountain areas and landing on irregular surfaces:

• Maintain constant awareness of the direction and estimated speed of the wind.

• Take into account the temperature, keeping in mind the fact it may increase as you approach ground level.

• Plan the approach in such a way that you retain the option of discontinuing it at your convenience—the approach should be along a slope and preferably into the wind, so as not to gain altitude.

• If there is little wind, choose, again if possible, a summit or an elevation as your landing site in order to be able to anticipate and counteract every possible wind activity.

• To obtain a clear idea of the landing site, if you are not familiar with it and providing you are not on a war mission, it is wise to execute a minimum of two passes over the area.

• Verify any obstacles near the landing site, possible shadow areas (usually below the heights, where the effect of the wind is minimal), and the direction in which it may be possible to take off again.

• The landing site should not be chosen solely as a function of the convenience of unloading cargo but by considering many other factors as well.

• Check your power rating to determine how much will be necessary to maintain hover out of ground effect.

• When possible, the approach to a mountainous summit should be made along the summit and not from the perpendicular.

• On the final approach, use a soft touch on the controls as overcontrolling can lead to a loss of rotor rpm.

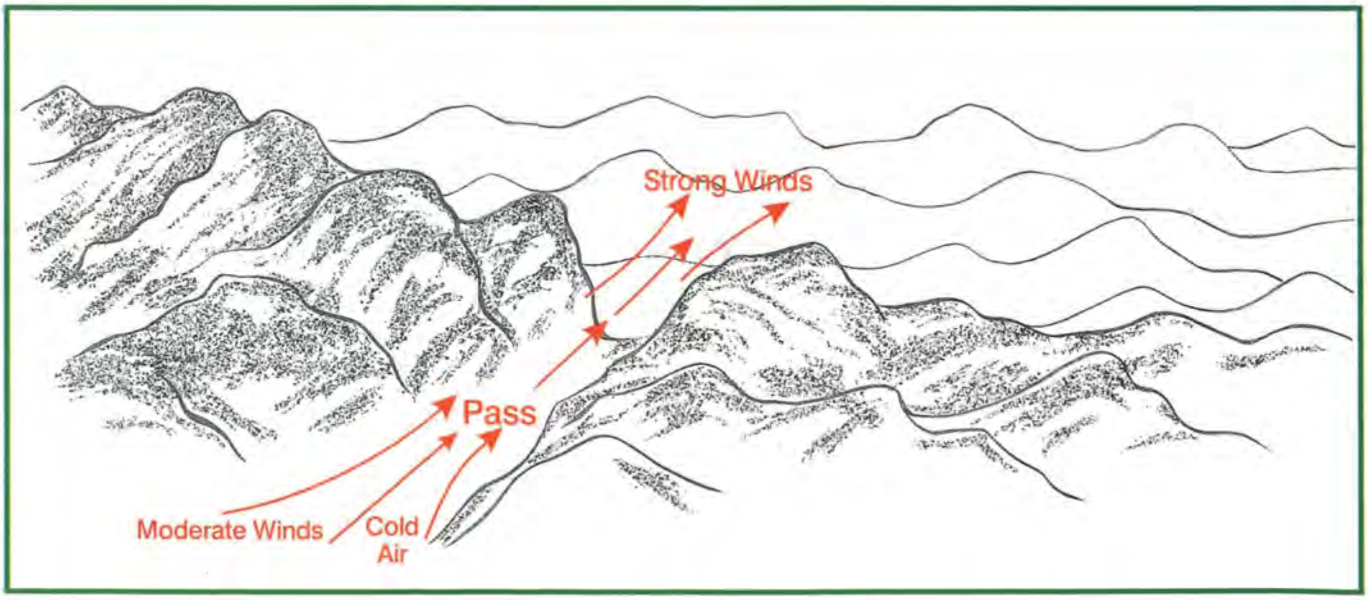
Let us now see what finally happened near that Alpine Shelter. The pilot made two ample passes over the chosen area, verifying the wind speed and the nature of the terrain. He then opted for a flat approach pattern toward a point where he could have hovered with sufficient power. The velocity decreased to 30 knots, 50 to 100 feet above the ground just before the landing site.

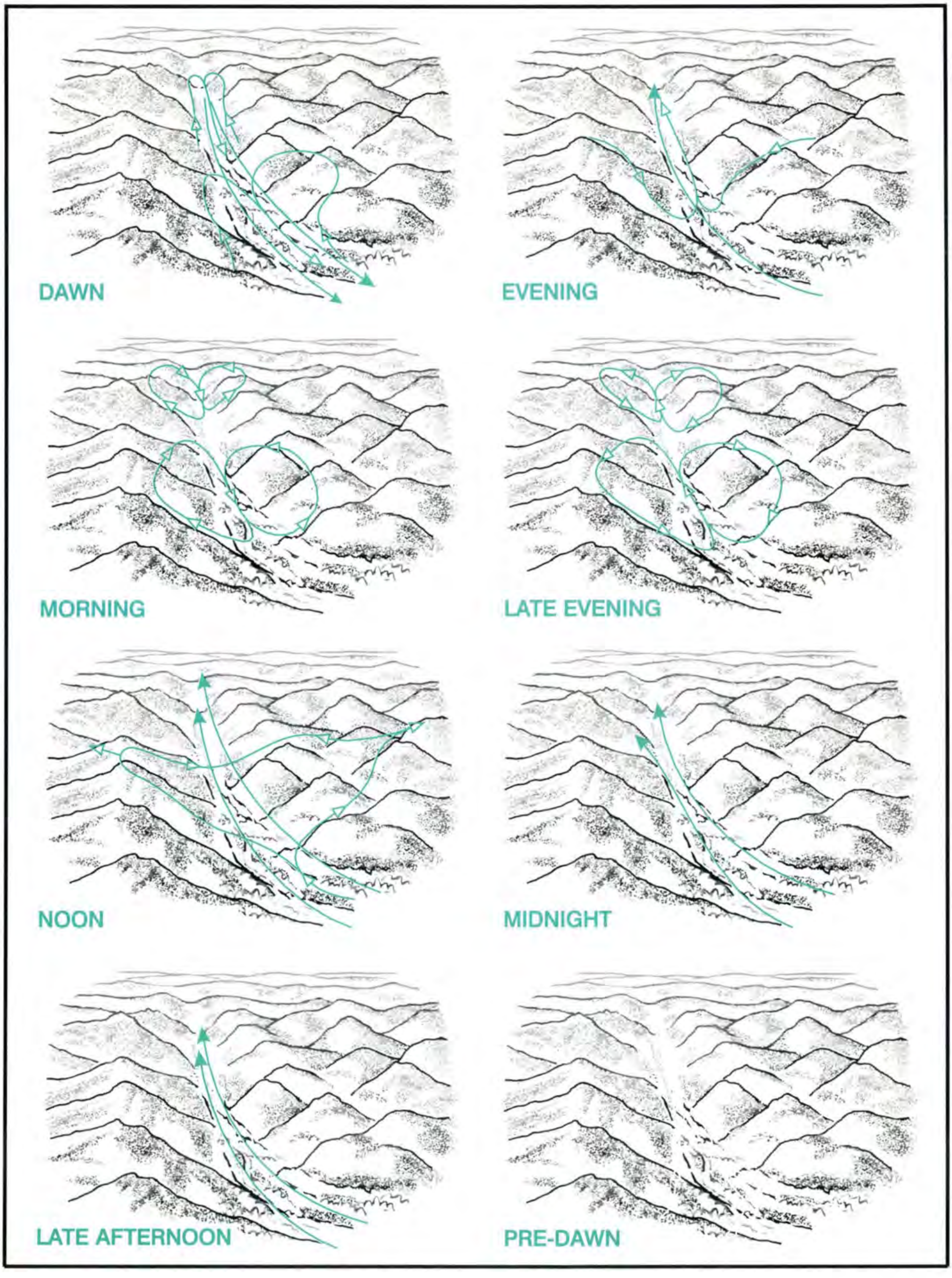
As soon as the helicopter transitioned almost to the hover, the pilot increased power, and the machine began to settle with the rotor rpm beginning to decay. The pilot informed his passengers of the imminent landing and raised the collective pitch to its maximum.

The helicopter touched down rather violently, almost 200 feet before the chosen site, and came to rest on a 15° incline. The Alpine Shelter proved to be abandoned.

At first glance, it may seem that the pilot did not commit any glaring blunder. Something, however, was not executed as it should have been. This becomes apparent if the technique adopted by our pilot is compared to the ten commandments for mountainous landings. Circling above the area, the pilot estimated calm wind conditions but did not take the temperature into consideration, noting merely that it was rather warm. Subsequent calculations revealed that the density altitude was in fact 8,000 feet. Nor did the pilot check the power. Had he done so, he would have realized that the conditions during the approach pattern dictated a power rating which was very close to the maximum available. The approach flightpath was too flat to permit a resumption if any un-

continued on next page



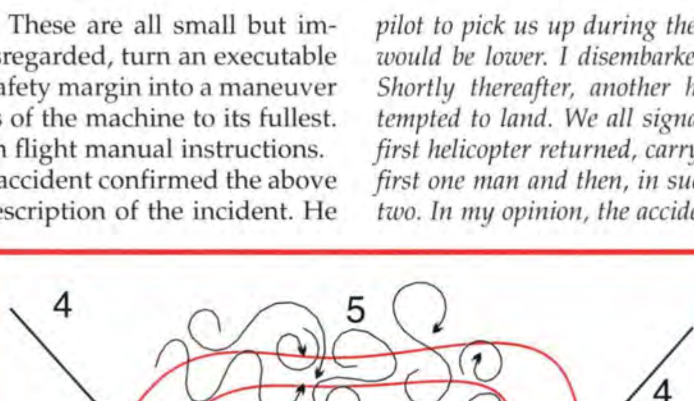

DAWN
EVENING
MORNING
LATE EVENING
NOON
MIDNIGHT
LATE AFTERNOON
PRE-DAWN

expected difficulties arose. These are all small but important details which, if disregarded, turn an executable landing with an adequate safety margin into a maneuver which taxes the capabilities of the machine to its fullest. All of this is consistent with flight manual instructions.

The pilot involved in the accident confirmed the above comments with his own description of the incident. He stated:

"After the accident, two helicopters arrived in the area. A southerly 10-knot wind had come up, and one of the helicopters flew over the area a few times and then executed an approach pattern from the north. I set off a smoke charge to give the pilot further indications of the wind intensity. The helicopter came to a hover above us and lowered a recovery harness. My passengers expressed anxiety about being pulled up by a helicopter similar to mine. To set an example, I consigned the flare to the care of one of the men and hurried to slip into the harness. Just as I entered the cabin, the craft began to fall through gently and then crashed rather heavily.

"For my troubles, I acquired a nasty lump on my head, courtesy of the cabin roof. I then told the pilot to pick us up during the evening when the temperature would be lower. I disembarked, and the pilot took off again. Shortly thereafter, another helicopter arrived and also attempted to land. We all signalled him to go away. Later, the first helicopter returned, carrying a lighter load, and took up, first one man and then, in successive trips, the others two by two. In my opinion, the accident could have been avoided had I refused to land. Once the material had been spotted and localized, the urgency of the operation was reduced. Unfortunately, this was not communicated to me by headquarters. I thought I had carried out all the necessary operations, without knowing that I was, in effect, operating at the limits of the helicopter's operating capacities. Had I effected a simulated approach at a higher altitude, I would have realized how much power I really lacked for an eventual approach and landing."



1. Wind
2. Strong rising currents
3. Rising currents of medium intensity
4. Good approach angle
5. Leeward turbulence

The approach to the summit should be made from the side if there is leeward turbulence.

As a helicopter pilot, you can learn something from this accident, especially if you have never contributed to a flight manual's chapter on missions in mountainous areas.

First, if you look closely through the manual, you will find a note informing you that the figures quoted in the Appendix regarding helicopter performance are neither indicative nor 100 percent reliable. Furthermore, of the many variables which limit the stated performance standards, the only one the pilot can directly influence is weight.

The weight of the aircraft must be such as to leave a healthy margin for error. If your cargo allows only a modest safety margin during a landing procedure, as a seasoned mountain pilot, you should split the cargo in half and make two trips. Then, decide if it is absolutely necessary to include a flight engineer or some other passenger on your mission. Even question the usefulness of a tool box, especially if it is heavy and cumbersome. Mountain flights are for trained and experienced personnel only. Remember that you aren't doing anyone a favor by taking anyone along on the flight, to later subject him or her to a landing which takes place rather violently and earlier than expected.

It is true that a helicopter, already in flight towards a mission at low altitude, can, without advance notice, sometimes be called upon to operate in a mountainous area. In such a case, it is unlikely that you will have time to consult the flight manual, and you must therefore be cautious and undertake at least a minimum of planning with the few factors you have at your disposal.

Many charts for flights at high altitudes deal with wind conditions. Consequently, verify the direction and intensity of the wind. Obviously, this is not advice applicable exclusively to this type of flight but is valid for flights at sea level as well. The only difference is that the problem becomes more pronounced for flights at mountain altitudes because the wind often changes direction without warning. Generally, however, even the wind obeys certain physical laws.

If, in a valley, the wind is not blowing parallel to the valley itself, nor quite from a perpendicular, then at ground level the wind will follow the valley. Winds of weak intensities generally become very strong when forced through mountain passes.

There are other anomalies if the wind is blowing in a gorge or along a hilltop. Local winds also have their own peculiarities. During the day, the air covering mountain heights is warmer than air at the same altitude but over valleys. When this air moves upward, it creates a rising current over the heights. At night, the opposite holds true, and cold air descends from the heights into the valleys. Then, during the day, the air in the valleys gradually warms up, rises, and is replaced by air from the plains. During the night, the reverse process occurs once more, and the airstream moves from the valleys into the plains. This wind activity, created by variations in temperature, gradually subsides as you climb, to disappear altogether at the top of the mountain ranges which circumscribe the valleys.

Another exceptional case occurs when only one side of a valley is heated by the sun while the other remains in the shadows. Movement of air will occur in a rotative manner. Warm air will rise from the exposed side while cold air descends on the unexposed wall.

Unfortunately, however, the above-mentioned patterns do not always hold true, and one must always be prepared to deal with the seemingly illogical. A helicopter pilot attempted a landing on uneven ground inside a gully, and as he was closing in on the chosen site, the aircraft touched down unexpectedly. Later it was possible to determine that, as the helicopter was descending into the gully under light wind conditions, there was a rapid increase in temperature. The resulting temperature around the helicopter was as much as 7 or 8 degrees higher than outside its immediate vicinity.

Then there is the story of the helicopter pilot who tried to land near a flaming wreckage after having made a previous attempt. The landing failed because of one small detail. The heat given off by the fire had caused an increase in the temperature of the surrounding air to a point beyond the operating capacity of the machine.

Therefore, if we take mountains, hills, helicopters, wind, temperature, and charts and mix them all up, the result cannot fall under the definition of "normal." ✈

Been there? Done that? Got the T-shirt?

wanted!

If you have experienced your own *There I Was* situation, please share it with us here at *Flying Safety*. It's our number one requested feature and we'd love to print yours. All entries are confidential, unless you want us to blab. Write, type, call, fax, E-mail, or send your cassette to:

Flying Safety Magazine
HQ AFSC/PA
9700 "G" Avenue, S.E., Suite 282B
Kirtland AFB NM 87117-5670

E-Mail: hodgep@smtps.saia.af.mil
Commercial: (505) 846-0950
FAX: (505) 846-0931

What You Don
Low Vis Depar
Can Kill You!

CAPT J. C. FINDLEY
AF Advanced Instrument School
Randolph AFB, Texas

A few years ago, everything I knew about IFR departures and SIDs I had learned from my Tweet IP in UPT—400 feet and departure end before turning on course. A 200-foot/NM climb would always keep me clear unless there was one of those pesky IFR departure procedures in the front of the approach book. If there was, then I had to meet the climb gradient (if there was one), but the rest didn't apply to me as an Air Force pilot. What else did I need to know?

It's not that he was wrong—he was just incomplete. The problem is, the part he left out can kill you if you don't know the procedures. This series of articles is meant to clear up a few misconceptions that exist out there in the USAF.

Let's start with IFR departure procedures—the least understood way to depart IFR. In NOAA and DoD publications, airfields with an IFR departure procedure will be annotated with a ▼ on the IAP—the old trouble "T." On Jeppesen approach plates, you *have* to look at the airfield diagram page for the IFR departure procedure. There will be *no* indication on the approach plate that one exists for that field!

At airfields with a published IAP, IFR departures have been evaluated. If an obstacle interferes with you departing at 200 feet/NM, then the approach builder will design an IFR departure procedure. The approach designer has three options for this procedure: (1) specific instructions to avoid the obstacle; (2) a climb gradient greater than 200 feet/NM to clear the obstacle; or (3) a ceiling and vis so that the obstacle can be seen and avoided (or any combination of the three). If there is no obstacle, then no IFR departure procedure will be published.

Let's look at some implications of this. Suppose a departure procedure has a ceiling and vis published but no climb gradient. Most Air Force pilots think this doesn't apply to them—that's what the 51-37 used to say. The reality is that if there were no obstacle, then there would be no need for a ceiling and vis! The ceiling and vis "apply" to you, but you aren't allowed to use them.

Look at Birmingham INTL, AL (BHM), RWY 36. The IFR departure procedure requires 800-2 but does not give you a climb gradient to use instead of the Wx minimums. Will 200 feet/NM keep you clear of terrain? If you took off with 2400 RVR and climbed at 200 feet/NM, you would impact a ridge one-half mile off the departure end of the runway! In reality, you would have to climb at 396 feet/NM just to clear the ridge. The IFR departure procedure never mentioned a climb because it gave you another way to avoid that terrain.

While you have the BHM IAP out, look at the instructions under the Wx and climb gradients. IFR departure procedure: RWY 5, climb runway heading to 1700 before turning on course. RWY 18, climb runway heading to 2100 before turning on course. RWY 23, climb runway heading to 2100 before turning on course. RWY 36, climb runway heading to 1700 before turning on course. Do you have to meet the climb gradient or have the Wx minimums if you follow these instructions? Air Force types

't Know About

tures

are not allowed to use the Wx minimums, but the gradients and/or Wx minimums ***do*** apply to the instructions. That same ridge off of RWY 36 is still there. The instructions are keeping you clear from other obstacles farther out.

There is one more thing about climb gradients. The climb gradient starts at the departure end of the runway at 35 feet AGL (0 feet AGL for military fields). The departure design doesn't take into account how your aircraft accelerates and gets to this climb gradient. If you are not at 35 feet and established on the specified climb gradient by the departure end of the runway, you are not in protected airspace.

Suppose you are "cleared as filed." You filed direct to a NAVAID then on a jet route. When can you turn toward the NAVAID? It depends. If there is not an IFR departure procedure published, then 400 feet and departure end is good. If there *is* one published, then you should comply with the procedure *then* proceed to your first filed point. FAA publication 7110.65 governs air traffic control. It says, "If a published IFR departure procedure is not included in an ATC clearance, compliance with such a procedure is the pilot's prerogative."

As Air Force pilots, we must comply with the IFR departure procedures since we are not flying a SID or radar vectors. Even if 11-206 or 60-16 or 11-202 Vol 3 (as I hear it will be called next) changes and says we can do a diverse departure, we should still do the published IFR departure procedure to ensure obstacle clearance.

Have you seen an IFR departure procedure that had a "RWY 18-NA"? Don't confuse this with "Not Applicable" and climb out at 200 feet/NM. NA means "Not Authorized" for IFR departure (usually because of a huge obstacle off of the departure end).

What about SIDs? SIDs are very straightforward, correct? I mean, there shouldn't be anything that can kill me on a SID. The climb gradient is always published in a box, isn't it? Even ATC climbs are given to you—I think (?). Obstacles are always shown. All this is true when you are flying a military SID, or actually, a USAF or USN SID. The Army uses the FAA rules. The FAA rules—therein lies the danger! Most Air Force pilots don't understand the difference between FAA SIDs and USAF/USN SIDs.

First, let's look at how to tell the difference. Remember, since a SID can serve several airports in one area, you can't assume that a military base has a military-built SID. (See figure 1.) You must look at the top of the page and check in the parentheses: (FAA) and (USA) abide by the FAA rules, (USAF) and (USN) abide by the military rules.

You have to cross the departure end off the runway at least 35 feet AGL, but what are the other differences between military and civil SIDs? First, military SIDs will depict obstacles on the plan view and civil SIDs will not. Not a real big deal, but it's "nice to know" information.

Second, military SIDs will show an ATC-required climb gradient if a crossing restriction would require greater than a 200-foot/NM climb gradient. Civil SIDs require the pilot to compute any climb gradients that

continued on next page

(DALL2.DFW) 97086 208 SH-160 (FAA) FORT WORTH NAS/CARSWELL FIELD (NFW)

DALLAS TWO DEPARTURE (PILOT NAV) (HI) FORT WORTH, TEXAS

Figure 1.

You can tell this is a civil SID because it has "FAA" in the parenthesis at the top of the page. You will note that even though you are leaving Ft Worth NAS this is a civil SID.

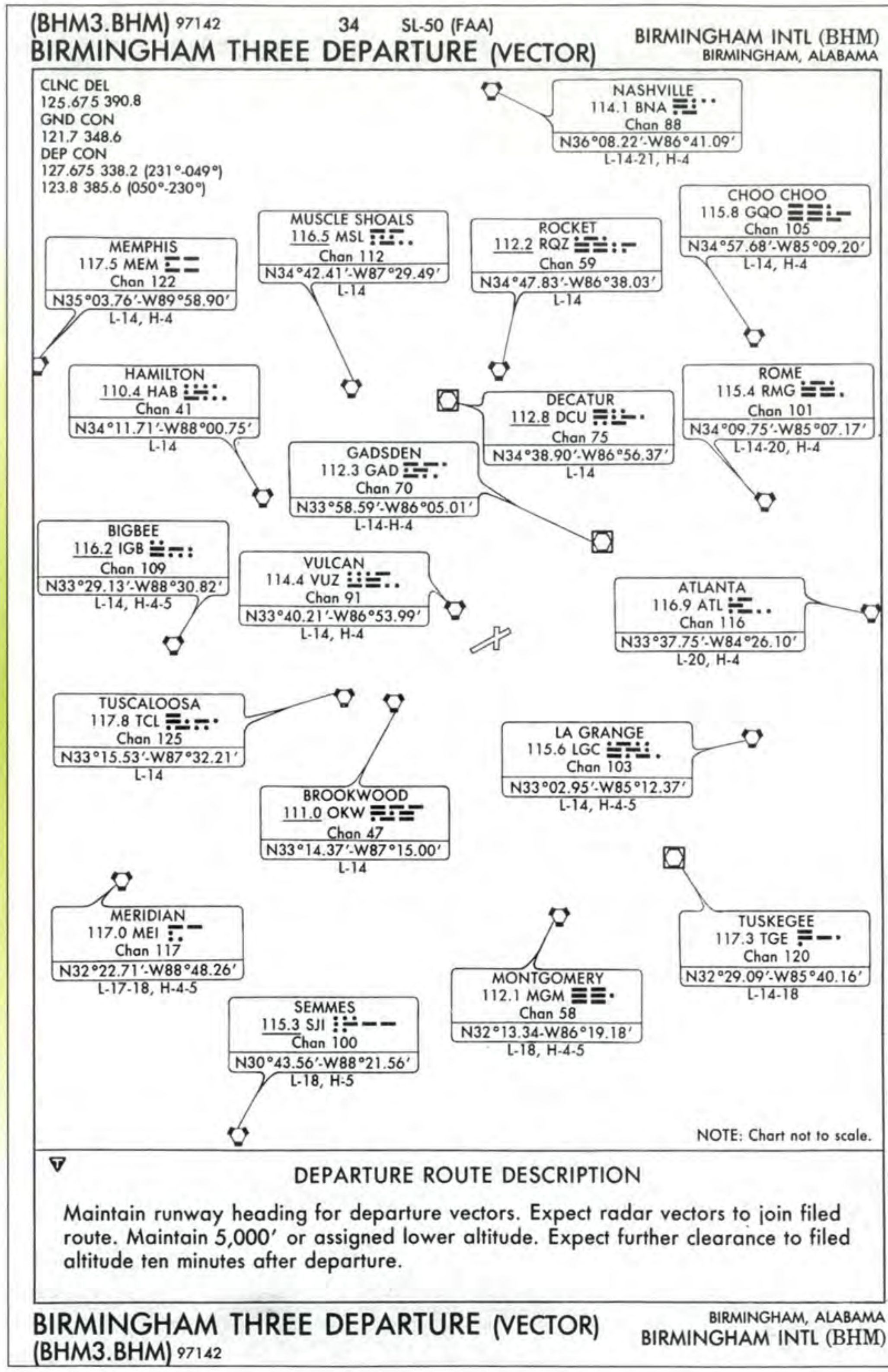


Figure 2

may be required for ATC crossing altitudes. If there is a climb gradient published on a civil SID, it will be for an obstacle. The climb gradient for the crossing altitude may be higher than one for an obstacle. Be careful! Even though you are capable of exceeding the published climb gradient, there may be a crossing restriction that requires an even higher one.

Third, and this is the difference that can kill you if you don't understand it (like it did an EC-135 crew in 1974), if a civil SID has a published climb gradient, it applies to the SID. If the SID does not have a climb gradient published but there is an IFR departure procedure published for the runway you are departing, the climb gradient and/or "see and avoid" weather criteria applies to the

BIRMINGHAM INTL, AL

Rwy 5, 800-6 or standard with minimum climb of 360' per NM to 1700. Air Carrier reductions not authorized. Rwy 18, 800-4 or standard with minimum climb to 340' per NM to 1700. Rwy 36, 800-2.

IFR DEPARTURE PROCEDURE: Rwy 5, climb runway heading to1700 before turning on course. Rwy 18, climb runway heading to 2100 before turning on course. Rwy 23, climb runway heading to 2100 before turning on course. Rwy 36, climb runway heading 1700 before turning on course.

Figure 3

SID as well! For example, see figure 2, the Birmingham Three Departure. There is no climb gradient published on the SID, but there is a ▼.

The SID simply directs you to "maintain runway heading for departure vectors." If you look at the IFR departure procedure section at the front of the SID book, it directs the pilot to climb at 360 feet/NM for RWY 5, or 340 feet/NM for RWY 18. RWY 36 doesn't show a climb gradient but it does have a "see and avoid" weather minimum. All of this applies to the SID! The same mountains exist off the departure ends of these runways, regardless of how you are departing. If you leave BHM via the SID and climb at 200 feet NM, you will fly into a mountain! How about that weather minimum for RWY 36? Does that apply to USAF pilots? You bet your life it does! What kind of climb gradient do you need for obstacles to depart RWY 36? Let's look at figure 3.

The departure designer expects you to have 800-2 so you can avoid these obstacles visually. (See figure 4.) Air Force pilots are not allowed to use "see and avoid" criteria in SIDs or IFR departure procedures, thus we cannot take off IFR from RWY 36. We can take off from any of the other three, but we better make 360 feet/NM for RWY 5 or 340 feet/NM for runway 18. RWY 23 requires

continued on next page

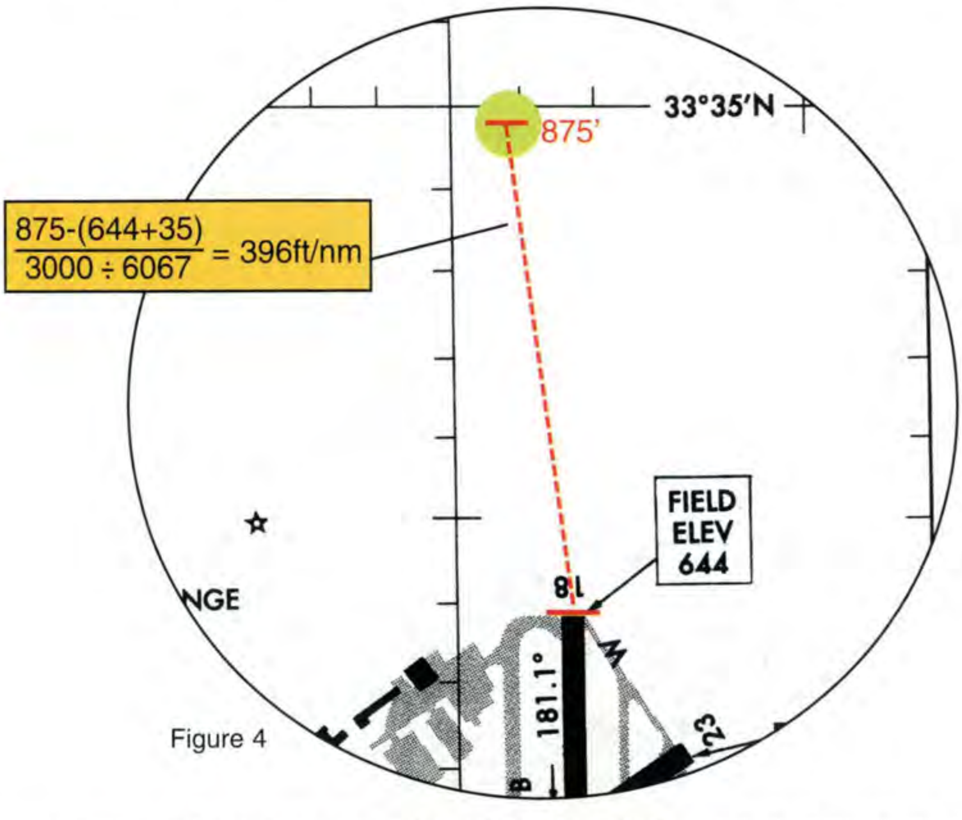


Figure 4

This is a depiction of the departure end of RWY 36 at BHM. A quick look at the math shows us it would require at least 396"/NM just to clear the terrain one-half mile off the departure end.

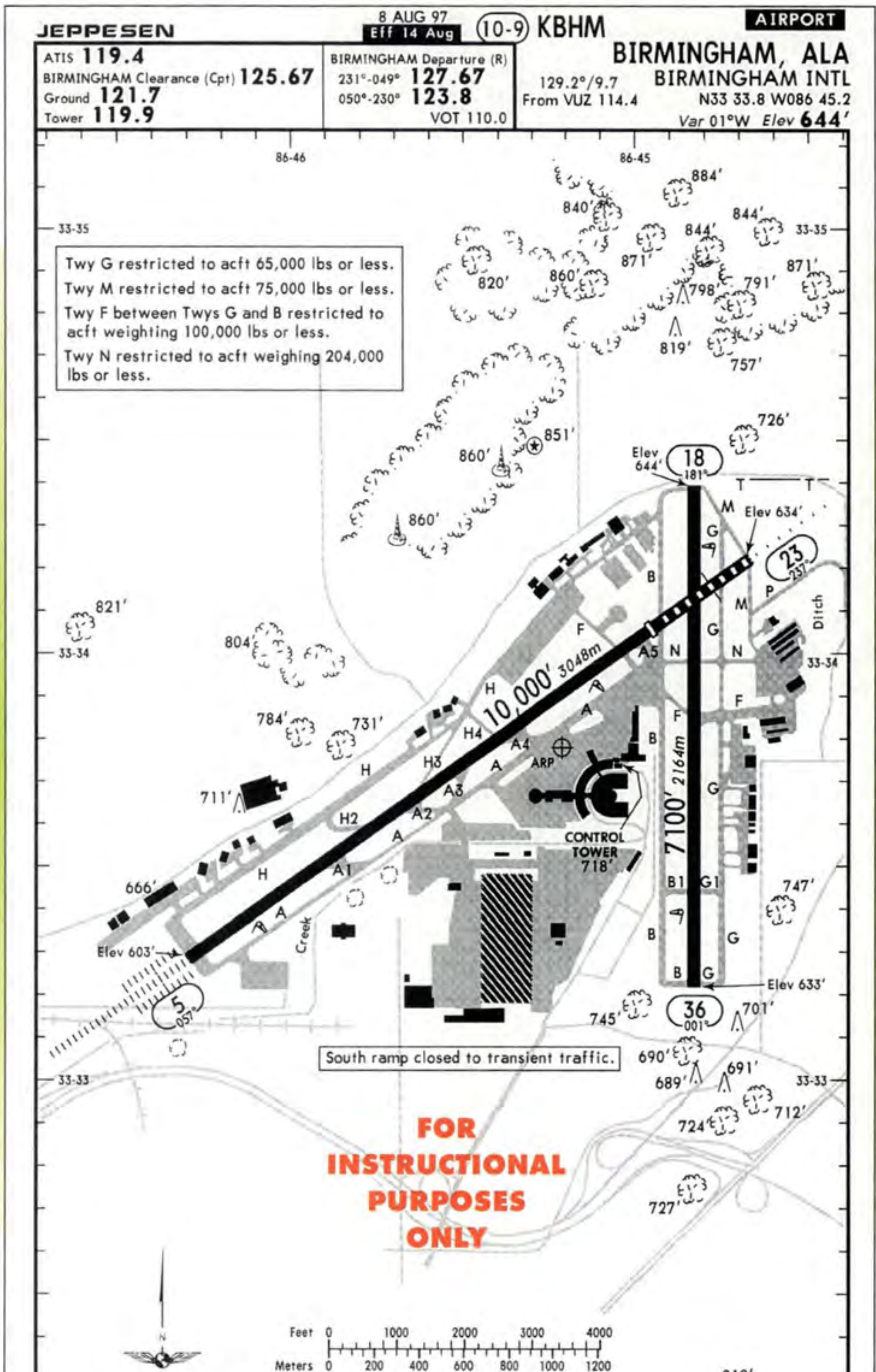


Figure 5

the standard 200 feet/NM.

If you use Jeppesen plates (see figure 5), be aware that the departure plate will not have a ▼. You **must** look at the airfield diagram page to see if there is an IFR departure procedure and a climb gradient/weather minimum that might apply to the SID. Just like DoD plates, if there is a published climb gradient on the SID, it applies to the SID regardless of any gradient in the IFR departure procedure.

Hopefully, we have cleared up a few misconceptions about IFR departure procedures and SIDs. **Fly safe!** ✈

CRASH SURVIVAL CONCEPTS

Courtesy Spotlight Special
Operations in Tropical Mountainous Areas
Third Edition, Feb 97
Directorate of Flying Safety, RAAF

A pilot needs some understanding of the mechanics of crash injuries if he is to make the wisest decision in a forced landing situation that looks grim at best. The following discussion is intended to give this understanding, without getting involved in the medical and engineering aspects of the subject.

Crash injuries, like aircraft damage, are the result of the violence generated by sudden stoppage and fall into two broad categories.

Contact injuries, resulting from forceful contact between occupants and environmental structures. This is the most common form of injury during forward decelerations, when the occupants do not use an adequate restraint system (seat belt and shoulder harness). Injuries caused by loose objects in the cockpit/cabin area also fall into this category.

Photo Courtesy RAAF Spotlight

Decelerative injuries. Although all contact injuries involve a deceleration process, the term decelerative injuries is generally used to indicate bodily damage resulting solely from loads directly applied through the occupant's seat and restraint system. They affect the body internally, and one of the characteristic forms is spinal injury during vertical decelerations (excessive positive G). Internal injuries caused by seat belt impact in the lower abdomen may occur during severe forward decelerations, especially when the seat belt is not properly installed or used. (Note: The seat belt should cross the hips at about a 45-degree angle, and the buckle should be worn as low as possible so that decelerative loads are applied to the hip bones and not the soft abdominal area.)

Injuries resulting from post-crash complications form a separate category. In the event of fire or during ditching, fuselage distortion and final aircraft attitude may interfere with the timely evacuation of the wreckage. Although this hazard can be controlled to some extent by the design of fuel systems and emergency exits, it is often the pilot's landing technique and his knowledge that govern the post-crash survival aspects.

The violence of the stopping force, expressed in Gs, depends on speed and stopping distance. The total energy of motion crash energy is a function of ground speed and varies with the square of the velocity. For example, and assuming a 20-knot wind, an aircraft with a 60-knot stalling speed could be landed with a ground speed of 40 or 80 knots, depending on landing direction. Under normal conditions, the downwind landing would require four times as much roll-out distance as a landing into the wind, as-

continued on next page

suming similar braking action. In a crash situation, the same 4 to 1 relationship holds true for the total crash energy.

Speed in itself is not a killer. The danger lies in how it is dissipated. A common misconception in this respect is that it takes hundreds of feet of obstacle-free terrain to make a survivable crash landing. Theoretically, it would take only 20 feet to stop a 20 -G deceleration, if the stopping force could be applied uniformly over this distance. The same uniform deceleration (20 Gs) would bring an aircraft to a stop from 60 knots in a distance of about 2.5 meters. The arresting gear of aircraft carriers and runway barriers shows how this concept can be applied under controlled conditions.

The problem in some crash landings is that the deceleration process is not uniform. Every time the aircraft strikes an obstacle or digs a gouge mark, a peak deceleration occurs, and it is during these peaks that injury exposure is at its greatest. It should be pointed out, however, that as far as impact survival is concerned, only the forces transmitted to the occupant's area (cockpit/cabin) are critical. The dispensable structure (nose section, wings, main rotor, etc.) should be used (sacrificed) as an energy-absorbing buffer between the point of impact and the cockpit/cabin structure.

Pilots should look at the cockpit/cabin enclosure protective container and try to keep this container reasonably intact by instinctively avoiding direct impact against it. Accident experience and full-scale experimentation show that a reasonably intact cockpit/cabin structure generally means that the impact conditions were survivable, as far as deceleration is concerned. As long as a pilot can avoid collapse or excessive deformation of the protective container, he meets the first requirement for impact survival.

Disregard for this basic law of physics kills thousands of car drivers every year in front-end collisions. Even when using a seat belt, the driver's upper torso and head maintain momentum with respect to his rapidly slowing down car interior, resulting in a sledge hammer-like impact against the steering wheel, instrument panel, or windshield. The obvious conclusion is that the car or aircraft occupant needs adequate restraint—which always includes a shoulder harness—since he has to slow down at the same rate as his environment. This basic requirement for impact survival in any type of vehicular crash is illustrated by the following example.

During the rollout after an emergency landing, an aircraft runs nose-first into a solid obstacle at 20 mph, crushing the nose section and shortening it by 25 centimeters. Assuming the deceleration is uniform, a 25-centimeter stopping distance for the cockpit behind the nose results in a mean deceleration of 13.6 Gs. The pilot who is not using his shoulder harness jackknifes over his seat belt, striking his head on the instrument panel. Assuming that the panel stopped by the time he reaches it, the impact velocity of his head will be 20 mph. Assuming that the panel crushes to a depth of 2.5 centimeters, the effective stopping distance of the pilot's head will result in a head impact of approximately 146 Gs, or 12 times that of the overall cockpit deceleration. This could easily be a fatal blow, depending on the shape and hardness of the head impact area, and whether or not a crash helmet is worn. In addition to understanding the reaction of aircraft structures to crash loads, pilots must have general knowledge of the reaction and tolerance of the human body under these conditions. G-loads imposed by crash-type decelerations and those imposed by flight maneuvers differ in their effects on the body. Flight loads are of long enough duration to affect the blood circulation, for which the body has very limited tolerance. Un-

Photo Courtesy RAAF Spotlight

governed by the vertical velocity (rate of sink), the crushability of the structure under the cockpit/cabin area, and the nature of the terrain. If the structure is rigid—as is the case in most low-wing aircraft—and the terrain hard, very high vertical forces may be transmitted to the occupants, even at moderate sink rates. Under these conditions, an extended—and collapsing—landing gear would definitely assist in reducing the peak vertical deceleration. However, this advantage should be weighed against possible hazards introduced by landing gear failure such as fuel spillage and fire. For single-engine aircraft with fixed, fuselage-mounted landing gear or with radial engines, a hard flat touchdown on soft terrain may cause the digging in of the landing gear bulkhead or the lower half of the engine. This abrupt plowing effect at first ground contact may result in extremely high horizontal decelerations on otherwise unobstructed level terrain.

The horizontal deceleration of freely sliding wreckage is very low. On a smooth hard surface, such as a runway, the stopping force is proportional to the coefficient of friction and, therefore, always less than 1 G. However, at initial impact, this horizontal stopping force has to be multiplied by the vertical G load resulting from the same reduction of the sink rate to zero. This is the same force mechanism that tears off landing gears in hard touchdowns with the brakes locked.

consciousness may occur at about 4-6 Gs. Impact loads are measured in fractions of a second and impose a mechanical shock for which the body has a rather high tolerance—about 20-25 Gs during decelerations perpendicular to the spine when restrained by a seat belt and a shoulder harness. With a seat belt only, this tolerance to forward deceleration drops below 25 Gs. Actually, the human body can take more punishment than the aircraft structures, as long as pilots manage to maintain a semblance of integrity in the occupiable area and avoid forceful contact with their environment.

Fixed Wing Crash Dynamics

There is no need to explain that an emergency landing in an aircraft always involves forward velocity (ground speed). Naturally, the pilot should aim at the lowest practicable ground speed, but never in exchange for an abnormal rate of sink. One of the least understood factors in crash landings is the abrupt dissipation of the aircraft's vertical component of velocity on first ground contact. The severity of this peak vertical deceleration is

Wings and landing gear are the primary "drag devices" to stop forward motion. Long nose sections with collapsible structure can also be used for this purpose, if aft displacement of the nose structure does not immediately affect the cockpit's integrity. Some of the modern, short-nosed, single-engined aircraft are poor examples in this respect. A severe nose-first impact in this aircraft will drive the engine into the instrument panel or the rudder pedal area. This reduction in occupiable area, in combination with the stretch in the restraint system or a failing seat, can easily make this type of accident nonsurvivable for the front seat occupants.

One of the most important axioms for fixed wing pilots is *it is less hazardous to run into an obstacle **after** landing than to hit an obstacle **during** the approach.*

Rotary Wing Crash Dynamics

Where the fixed wing aircraft's dispensable structure is especially suited to arrest forward motion, the helicopter's dispensable structure (landing gear, lower fuselage, tail boom, and main rotor) can be used mainly to al-

continued on next page

Actually, the human body can take more punishment than the aircraft structures, as long as pilots manage to maintain a semblance of integrity in the occupiable area and avoid forceful contact with their environment.

leviate vertical impact. Consequently, helicopter pilots have to be very cautious about forward velocity during excessively hard vertical impacts on soft terrain or during running landings between obstacles. The general rule for helicopters in this regard is *the worse the terrain, the more important it is to reduce the forward velocity of touchdown.* Since a zero ground speed touchdown requires more finesse, it would be unwise to use this technique when terrain permits a running landing.

What are the peak G levels in a typical accident situation? A zero ground speed autorotation in a low silhouette helicopter, touching down on hard-packed terrain at a sink rate of 1,500 fpm would expose the occupants to a vertical load of about 30-60 Gs (based on an effective stopping distance of about 10 centimeters). Spinal injuries are likely to occur under these circumstances, but survival would not be at stake. The cockpit/cabin area would still be relatively intact, although distorted. The helicopter would probably not be economically repairable.

If the same landing was made on hard terrain with forward ground speed, a peak horizontal deceleration in the order of 15-25 Gs would coincide with the peak vertical deceleration due to the increased frictional force while the vertical speed is being dissipated.

A similar touchdown with forward velocity on soft terrain would probably be disastrous. The extremely high drag on the bottom structure, coupled with the forward inertia of the heavy components (transmission, engine, etc.) would tend to destroy the overall cockpit/cabin integrity.

Designers and procurement agencies are reminded that a seat which would provide an additional 15-30 centimeters of stopping distance (energy absorbing distance) would make a 1,500-fpm vertical impact harmless. Such a provision is well within the state of the art and carries negligible weight and cost penalties.

The most important vertical impact attenuator is the main rotor, especially in low-silhouette helicopters such as the UH-1, where there is not enough structure under the cockpit-cabin area to cushion an excessive rate of sink. The ideal way to use the main rotor for this purpose is to make a zero ground speed tree landing. This causes the main rotor to act as a parachute, while the fuselage settles into the trees and loses its excess vertical velocity.

Emergency Landings

From the pilot's point of view, there are two types of emergency landing:

1. A forced landing. When further flight is impossible, but not as a result of catastrophic aircraft control problems.

2. A precautionary landing. When further flight is possible, but inadvisable under certain conditions, such as deteriorating weather, being lost, fuel shortage, or gradually developing engine trouble.

A precautionary landing is normally less hazardous than a forced landing because the pilot has more time for terrain selection, is subject to less stress, and can use power to compensate for errors in judgment or technique.

Unfortunately, too many situations calling for precautionary landings are allowed to develop into immediate forced landings because pilots use wishful thinking instead of reason, especially when dealing with a self-inflicted predicament. On the other hand, experience proves that an emergency situation that demands a quick instinctive reaction, without time for rationalization, is often handled better than a situation that leaves time for meditation and self-pity.

If serious injuries do occur in emergency landings, they generally result from a lack of understanding of the basic mechanics involved, compounded by one or more of the following factors:

1. A reluctance to accept the emergency situation. The pilot who won't face the fact that his aircraft will be on the ground in a very short time regardless of what he thinks or hopes is already handicapping himself. In efforts to delay the dreaded moment, he tends to maintain altitude at the expense of control (loss of speed and/or rotor rpm).

2. A desire to save the aircraft, even when it implies a course of action that leaves no margin for error. If all goes well, the aircraft may sustain little or no damage.

3. If the pilot loses his gamble, the aircraft and the occupants may be lost. Stretched glides and failure to allow for obstacles in the approach path are typical under these conditions.

4. Undue concern about getting hurt in a landing on rough terrain and its adverse effect on the pilot's judgment and technique. To supplant all unnecessary apprehension by a justified dose of self-confidence, it might be best to introduce landing techniques with the following statement:

A helicopter pilot who understands and uses the guidelines presented is not going to expose himself or his passengers to fatal injury during emergency landings under the most adverse conditions.

In Summary

1. Know your aircraft and its structural characteristics.

2. Wear your restraint system and helmet firmly secured at all times.

3. Accept the emergency, and maintain your initiative in the form of positive aircraft control.

4. Your worst enemy is PANIC. This is best overcome by planning and action, not by prayer and wishful thinking. ✈

FY97 Engine-Related Mishap Summaries

BILL BRADFORD
RICH GREENWOOD
BOB BLOOMFIELD

Introduction

For those of you who remember our engine mishap summary article from a year ago, you will recall that engine failures were involved in 44 percent of our Class A mishaps and 36 percent of our Class B mishaps in FY96. While this fiscal year the percentages for both categories have decreased, 28 percent for engine-related Class A mishaps and 35 percent for engine-related Class B mishaps, engines still remain a major contributor to our mishap rates. (See figures 1 and 2.)

If we scrutinize the data a little more (see figure 3), we see that 42 percent of our fighter/attack Class A mishaps were from engine failures. As one might expect, the F-16 was the leader of the pack in this category with six Class A's and one Class B. All six F-16 Class A's resulted in destroyed aircraft. The F-15 placed a distant second with two Class A's and four Class B's. On our nonfighter/attack aircraft, there are no standout systems in that they had no engine-related Class A's and three Class B's all on cargo type aircraft: a C-130H, an EC-135C, and a C-141B.

Looking a little deeper into our Class A and B mishaps, we were able to discover exactly what the root causes of most of the mishaps were. In figure 4, the root causes of each of our engine-related Class A and B mishaps are depicted. Please note that each mishap may involve more than one causal factor. For example, a design deficiency may have existed that required a periodic inspection for which inadequate publications were written.

Looking at the contributing factors for Class A's and Class B's, we see some definite "repeaters." As has been the case in previous years, design problems continue to be a major contributing factor to our engine-related mishap rate. And, as in past years, the vast majority of these design problems were previously recognized deficiencies for which solutions already existed but were not yet introduced to the field. Regrettably, budgetary constraints have prevented or delayed incorporation of many design fixes. Therefore, we end up relying on periodic inspections to keep the fleet safe instead of incorporating the new hardware.

A second major contributory factor in FY97, as it was in FY96, was maintenance error—especially in our Class B engine-related mishaps. These run the gamut from depot level inspections and assembly to field-level complacency and discipline. The field has saved many aircraft by their diligent inspections of many engine components. However, as you will see in the following summaries, the vast majority of these maintenance-related mishaps were easily preventable if the individual involved would only have been alert and vigilant.

The following sections provide a summary of all the engine-related Class A and Class B mishaps this past fiscal year. The information provided here was extracted from Part I of the Safety Investigation Report or from the AFI 51-503 Accident Investigation Report.

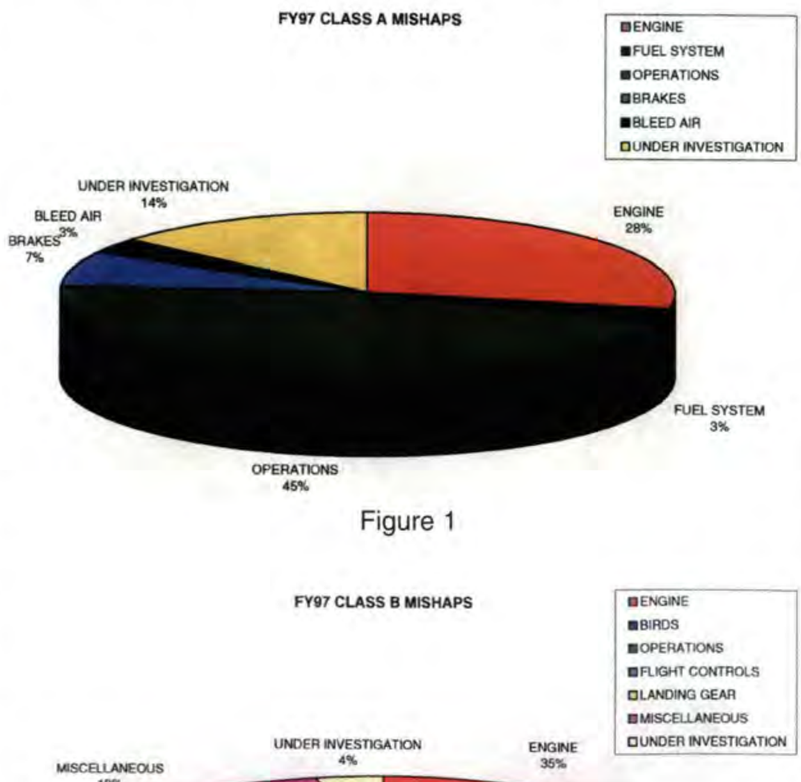


Figure 1

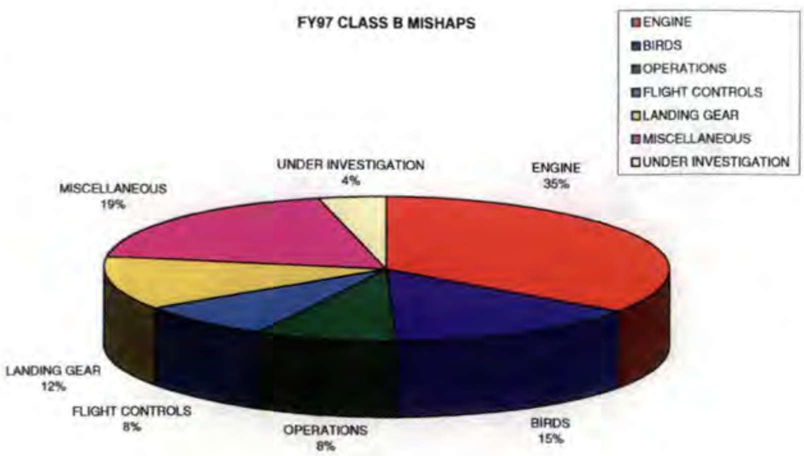


Figure 2

F-16 Summary

Table 1 is a comparison of how we did this year as opposed to FY96. As can be seen from the six-quarter rolling average, our engine-related mishap rates

continued on next page

have had a slight increase this past year. That is a trend we should attempt to reverse in FY98!

F100-PW-200 Engine

There has been one engine-related Class A mishap in FY97 on the F-16/F100-PW-200 powered fleet. The aircrew was low level over the water at 500 feet and 500 knots when the engine quit and restart attempts were unsuccessful. The crew ejected and was safely recovered while the aircraft crashed in 70 feet of water. The cause of this mishap is still under investigation. It should be noted, however, that the low number of flying hours in this fleet (approximately 18,000 hours in FY97) is what drove the mishap rate in Table 1 up for this fiscal year.

There were no engine-related Class B mishaps in FY97 for the F100-PW-200 powered F-16 aircraft.

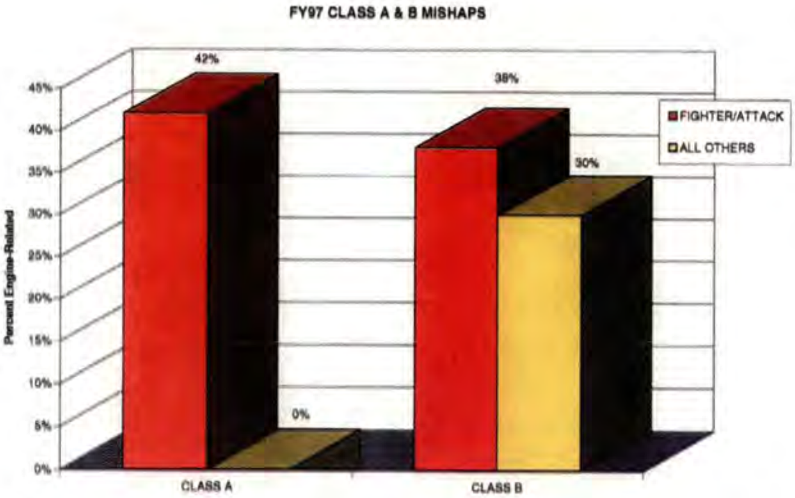


Figure 3

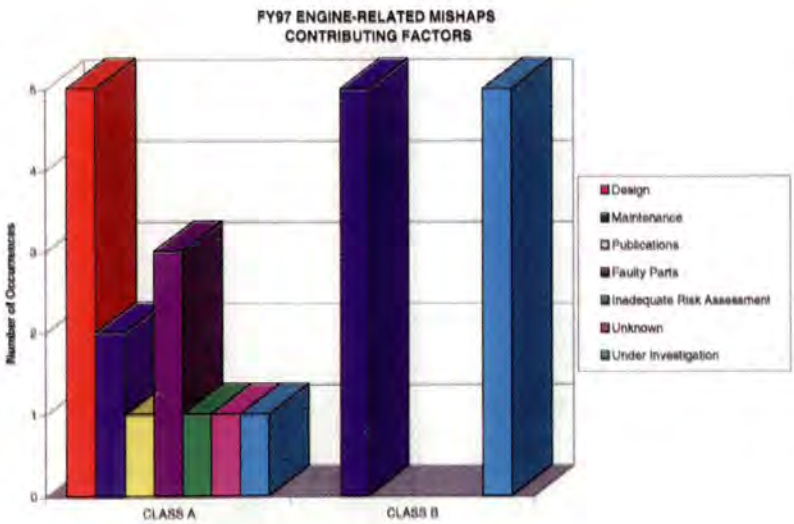


Figure 4

F100-PW-220/220E Engine

There were two Class A mishaps in the F-16/F100-PW-220/220E powered fleet for FY97 and no Class B mishaps. The first Class A was caused by a liberated third-stage turbine blade tip shroud (a known problem) during a night training mission. The liberated shroud caused a failure of the low turbine assembly and subsequent engine power loss. The pilot ejected successfully. Inspections will continue to be used to mitigate the risk until the new hardware is installed at the next depot visit.

The second Class A mishap for FY97 involved an F-16C. The pilot experienced a bang, vibrations, and decreasing engine rpm. Unsuccessful air start attempts were followed by a successful ejection. Investigation revealed a fatigue fracture in the attachment area of a fourth-stage turbine blade, also a known problem. Until redesigned hardware is installed (available in September 1997 for depot installation), risk will be controlled by installation of new (zero time) bill-of-material blades and dedicated Contractor Field Teams performing ultrasonic inspections.

F100-PW-229 Engine

Thanks to aggressive action by the SPO, Pratt & Whitney, and the maintainers, the -229 engine in the F-16 remains Class A free in the U.S. Air Force.

F110-GE-100 Engine

There were three Class A engine-related mishaps and one Class B engine FOD incident in FY97 for this engine. The first Class A mishap occurred when the aircrew heard and felt a series of loud bangs. The crew was unsuccessful in its attempts to restart the engine and was forced to eject. The mishap was caused by one of the following: a material defect, FOD incurred during the mishap flight, FOD which occurred earlier and went undetected, or an improper repair of FOD. Although the exact cause of this mishap is not determinable at present, this is a good time to reiterate the need for a thorough engine inlet inspection, especially of the first stage fan blades, and a review of blade repair procedures.

The second Class A mishap occurred when the aircraft experienced a loss of thrust followed by a flameout. The pilot was forced to abandon his aircraft. Examination of the basic engine revealed no major discrepancies. Examination of the engine accessories revealed no significant findings except for a liberated hydroclone filter extractor tube in the main engine control (MEC), which had bored through the filter screen but had not yet disintegrated, and a small piece of stainless steel debris found at the bottom of the Pc regulator. Both items are capable of obstructing operation of the Pc regulator and causing an engine flameout. The unseated hydroclone filter extractor tube emphasized the need for the ongoing MEC x-ray inspection.

The third Class A was another engine failure, caused when our old nemesis, variable stator vane (VSV) misalignment, reared its ugly head. A first stage VSV arm was found disengaged in the lower connecting ring half. Misassembly was a result of blind maintenance which caused a high cycle fatigue failure of several second stage compressor blades. Establishment of a continuing formal VSV maintenance training program has been initiated, and a review of the maintenance procedures in the technical manuals is under way.

The Class B FOD incident was caused by ingestion of a winter flier's helmet. A crew chief had stowed this piece of cold weather gear in the pocket of his parka. When he removed the EPU pin prior to taxi, the cap came out of his pocket and was blown into the area in front of the inlet. The crew chief saw the cap enter the engine inlet and notified the pilot to shut down. The metal fasteners on the cap caused extensive damage to the engine which necessitated the replacement of all rotating parts. A few extra seconds of attention to detail could have saved this unit over $400,000 in repair costs.

Another FOD incident involving an inspection mirror left in the engine inlet is currently under investigation. This could turn into an additional Class B mishap if it exceeds the threshold amount.

We mention these FOD incidents, not because they are engine-caused, but to drive home the need to remember the basics when working around operational aircraft. Today's engines are made from high value, exotic materials that are designed to deliver peak performance while reducing weight. They turn at almost twice the speed of older engines and operate at significantly higher temperatures than their predecessors. These reduced weight, high-speed blades cannot sustain the same level of damage as their older, slower turning, stainless steel counterparts. So let's be vigilant out there—count your tools, be aware of your surroundings, and watch out for the other guy.

F110-GE-129 Engine

There were no Class A or B engine-related mishaps this year for the -129 engine. The retrofit of the first-stage fan blades with a dampened, improved durability blade was completed in half the scheduled time, thereby eliminating the sole Class A mishap-causing mode for this engine to date.

F-15 Summary
F100-PW-100 Engine

There was one engine-related Class A mishap in the F100-PW-100 fleet this fiscal year. During takeoff roll, immediately after brake release, and with the throttles advanced to MIL, the pilot reported an explosion followed by a fire. The takeoff was aborted, and the pilot safely ground egressed. The large fire caused extensive aircraft damage. The explosion was traced to a first-stage fan disk which fractured due to fatigue in a tie bolt hole. The liberated disk fragments cut both the engine fuel feed manifolds. Sparks ignited the fuel which led to the ensuing fire. The most probable driver for the disk fracture is low cycle fatigue. Corrective actions include enhanced visual, eddy current (ECI), and fluorescent penetrate inspections (FPI), as well as 100 percent replacement of the disk clinch nuts at depot overhaul.

There were four engine-related Class B mishaps for the reporting period. One was related to an in-flight engine fire indication followed by a successful single-engine landing. The specific cause of the fire is still under investigation.

The other three were all FOD incidents—one occurring while the aircraft was being inducted into the depot for PDM and another during a hush house run to trou-

continued on next page

Table 1
F-16 Engine-Related Class A Mishap Statistics

	FY96			FY97**		
Engine	**Class A Mishaps**	**FY96 Rate**	**6 Qtr Rate End of FY96**	**Class A Mishaps**	**FY97 Rate**	**6 Qtr Rate End of FY97**
F100-200	0	0.00	1.68	1	5.49	2.99
F100-220	1	0.87	1.72	2	1.66	1.12
F100-229	0	*	*	0	*	*
F110-100	3	1.98	1.66	3	2.16	2.29
F110-129	1	*	*	0	*	*
All engines	5	1.36	0.88	6	1.76	1.12

*Insufficient flight hours on these engine models to compute a meaningful mishap rate.

**Fourth quarter FY97 hours estimated

Looking back on the year in reflection is sort of like rehashing the Monday night football game on Tuesday morning. Hindsight is always at the very least 20-20.

bleshoot an A/B anomaly. In neither case was the identity of the foreign object determined. The third FOD incident occurred during a performance check run on the ground. An intercom headset cable used by the ground crew had a slip-fit connector installed instead of a screw-type connector. During a high power run, the inlet vortex caused the cable to whip around under the aircraft and pull out the connector. The cable was then sucked into the inlet, and the subsequent flailing of the cable caused the connector end to come off and be ingested into the engine.

F100-PW-220/220E Engine

There were no engine-related Class A or B mishaps in FY97 for the F-15 -220/-220E powered fleet.

F100-PW-229 Engine

There was one engine-related Class A mishap in the F-15 -229 fleet. The mishap crew heard a pop and a bang on the No. 2 engine shortly after takeoff. They then completed a successful return to base and single-engine landing. Upon initial examination, aircraft fire damage and an uncontained compressor failure was noted. The exact cause of the mishap is still under investigation.

F110-GE-129 Engine

There were no engine-related mishaps for this fiscal year. Although in its infancy, this Field Service Evaluation for the F110-GE-129 powered F-15 is off to a good, safe start.

C-130 Summary

A T56-A-15 powered C-130H suffered a low-oil-pressure problem on the No. 1 engine during a routine mission resulting in a Class B incident. The crew shut down the engine, pulled the fire handle, and returned to base as oil continued to leak out of the back of the engine. Severe contamination of the entire engine oil system was discovered by base engine maintenance personnel. Paint stripping operations at the depot were found to be the culprit. Depot-level procedures are being scrutinized to prevent the introduction of foreign materials into engine oil systems.

C-135 Summary

An EC-135C had a catastrophic failure of the No. 4 engine when the engine was placed in reverse thrust during landing. This incident is currently classified as a Class B and is still under investigation.

C-141 Summary

There were no engine-related Class A mishaps in the C-141 fleet for FY97. However, a TF33-P-7 powered C-141B suffered an uncontained compressor disk failure while on takeoff resulting in a Class B mishap. An 8-inch section of the fifteenth stage compressor disk rim was liberated. The fracture was traced to an HCF crack in the disk which had been initiated by aerodynamic disturbances during a previous FOD event when the disk was in another engine. The cracks were not detected during depot overhaul, and the disk failed 110 hours after installation in the incident engine. A new material disk which is more tolerant to this type of damage is being installed at first depot opportunity, and all old material disks have been purged from the inventory. The depot has also gone to a higher sensitivity nondestructive inspection technique to be used when the disks are overhauled.

Final Thoughts

Looking back on the year in reflection is sort of like rehashing the Monday night football game on Tuesday morning. Hindsight is always at the very least 20-20. Here are a few thoughts to ponder while reflecting on last year's events:

- Every decision involving operations and maintenance has the potential to cause a disastrous event, possibly damaging or destroying a scarce asset, or even worse, injuring flight or ground personnel.
- Your technical manuals must be used. Whether you are a pilot with a Dash One, a flightline mechanic with a fault isolation manual, or a back shop technician with an intermediate maintenance manual, your manuals must be used. However, as we all know, the manuals are not infallible. If you see the need for a correction or improvement, submit an AF Form 847 or an AFTO Form 22. Your suggestion might just save the life of a friend.
- Tool inventory, shop cleanup, and FOD walks are not distasteful chores to be avoided whenever possible. These important tasks are part of every quality organization. Participation is not restricted to the two-striper. When was the last time *you* joined in?
- Continuous training is a must. Does your unit conduct organized, meaningful training? Has that newly assigned member of your team received all of the needed technical training?
- The budget crunch is here to stay for the foreseeable future. Parts shortages are being addressed and worked but are not going to disappear overnight. The need to "Inspect-in-Safety" as a risk management tool is a fact of the engine maintainer's life.
- By and large, we have done a lot of things right, but as the statistics on the preceding pages show, there is always room for improvement. Let's strive to make FY98 our safest year ever! ✈

Familiarity Can Breed Overconfidence

Courtesy Spotlight Special
Operations in Tropical Mountainous Areas
Third Edition, Feb 97
Directorate of Flying Safety, RAAF

Moments before a UH-1 crashed in mountainous terrain, it was being flown about 50 feet above the ground at an indicated airspeed of 60 knots. After flying over basically flat terrain, the pilot of the Huey had initiated a right descending turn into a valley. Surface winds, as reported by the tower, were 150° at 30 knots, which created a right quartering tailwind condition for the aircraft just before the descent into the valley.

When the pilot cleared the leeward side of the valley, he encountered a downdraft condition. He had noticed just before he crested the valley wall that the air was becoming a little bit bumpy and the winds were beginning to pick up, indicators that excessive turbulence and downdraft conditions existed in the vicinity of the southwesterly wall of the valley. With the combination of at least a 30-knot quartering tailwind, a planned descent, entering a downdraft condition, and an initiated right turn, the rate of descent increased so rapidly the pilot was unable to keep the aircraft from crashing.

Having flown in the mountain environment for 2 years without difficulty, the pilot believed he was fully capable of coping with the environment. But he was unprepared for the effect of turbulent wind conditions when he began his descent into the valley.

Another pilot experienced in mountain flying placed his UH-1 in a position where power required exceeded power available because he incorrectly computed his performance planning card data, computing a higher available torque for out-of-ground-effect (OGE) hover than the engine was capable of producing. As this pilot was making an approach to land downwind along the right side of a steep valley, the low rpm audio sounded and the light came on. Sensing he was not going to make the selected landing area, the pilot, at an altitude of about 100 feet, began a left 180° turn with the airspeed below effective translational lift. The helicopter crashed and came to rest at the bottom of the ravine.

The pilot, during his pre-mission planning, incorrectly computed maximum torque available,

Photo Courtesy RAAF Spotlight

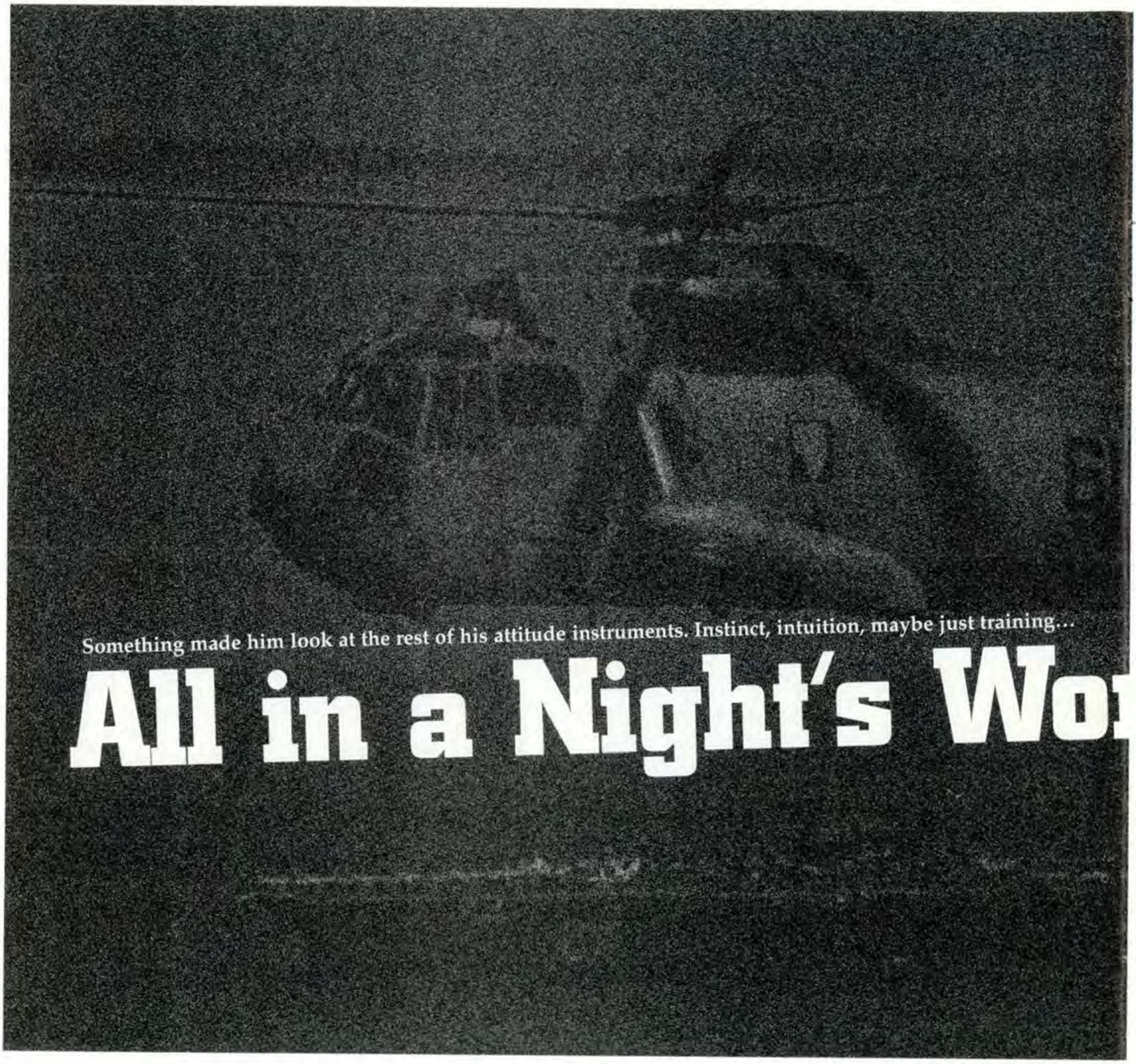
torque required to hover in-ground-effect (IGE) and OGE, and maximum allowable IGE and OGE gross weight. Also, before taking off from his field site, the pilot performed an OGE hover check which indicated more torque available than he had predicted, thus reinforcing a feeling of overconfidence by seeming to verify the erroneous performance data he had computed.

Take Nothing for Granted

Aviators cannot take for granted the capability of their aircraft to perform, even when flying missions that have been routinely accomplished in the past.

If pilots who are trained and experienced in mountain flying can have accidents like these, anyone can.

Where performance planning is concerned, "close" isn't good enough. It must be done carefully and accurately, and it must take into consideration any changes that might be encountered from initial takeoff to final landing. ✈



Something made him look at the rest of his attitude instruments. Instinct, intuition, maybe just training...

All in a Night's Wo

LT G. S. WHITEHEAD
Courtesy *Approach*, May-Jun 97

This story first ran in the March 1988 issue of Approach. *Recent helicopter mishaps show that we need to revisit some of the lessons these H-3 pilots learned.*

Night carrier ops—no moonlight, a glassy sea, intermittent doppler, and the planeguard pattern. The stage was set. These are not an SH-3H pilot's favorite conditions to dip. You would think a pilot would give these conditions their proper respect, but not these two helo pilots on this night. They gave into perceived pressure to maintain their currency of six night doppler approaches-to-a-hover per month.

They waved off their first two approaches because the doppler was not acquiring, but that didn't stop the young warriors from completing their mission.

"Standby alternate," the Helo Aircraft Commander (HAC) announced.

These two pilots were going to beat the odds. After all, third time's the charm, right?

"Coupler," the HAC called as he removed his feet from the pedals.

"Coupler engaged, three lights, alternate," the copilot

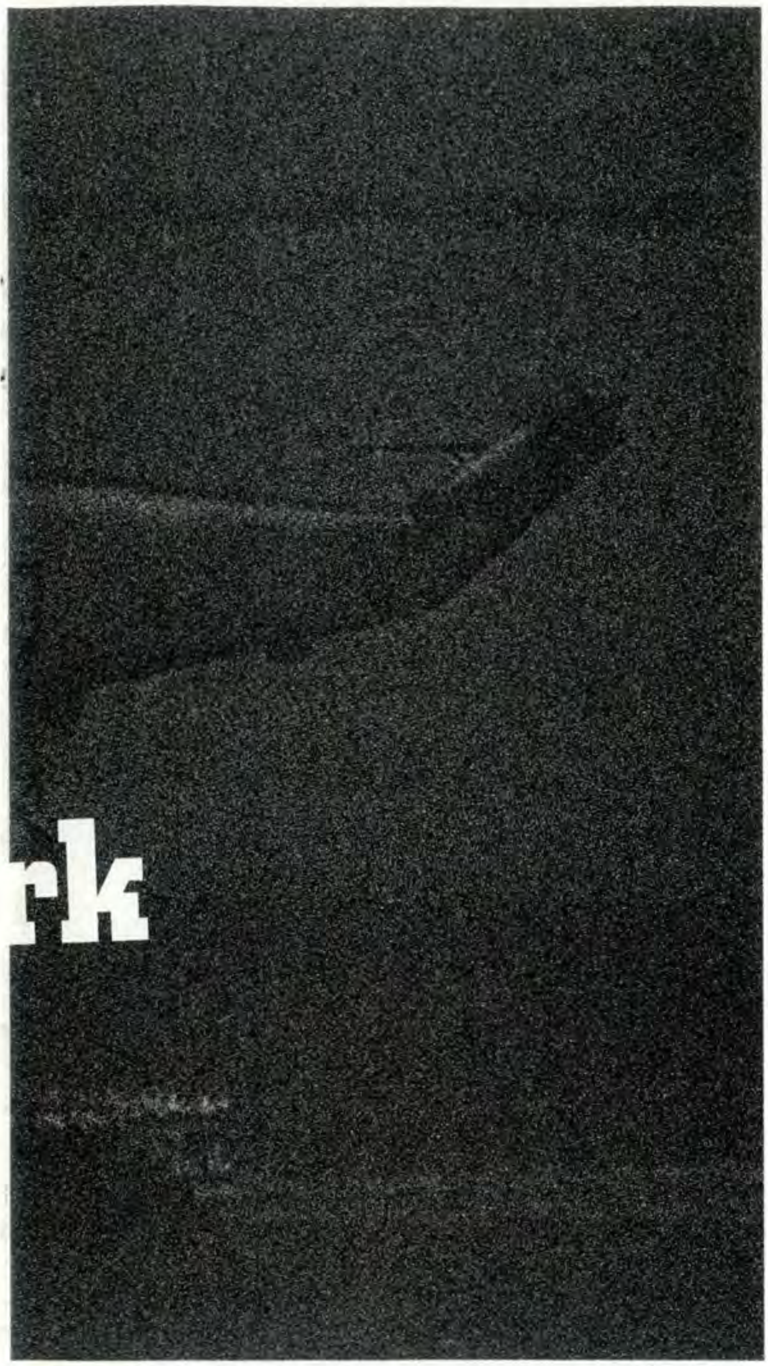


Photo Courtesy *Approach*

replied as he began his instrument scan. The coupler system lowered the collective, and the descent from 150 feet began for the start of what would be the longest 3 minutes of these young aviators' careers.

The helo followed what seemed to be the normal approach parameters, hitting gates at 80 feet and 30 knots. The cockpit lit up. The doppler had gone into memory because of the glassy sea state.

"You have a memory light, probably from the low sea state," the copilot said.

"Roger, we'll just go ahead and continue down until the doppler acquires in the rotor wash. Just back me up."

They reached 40 feet with no problems, and all the pilot had to do was "beep" the nose up to slow the aircraft down so the rotor wash could catch up with the helo. The HAC beeped the nose up until it was uncomfortable for both pilots, but still no acquisition of the doppler. There were no cockpit indications of groundspeed or drift (because of the lack of doppler) and no visual reference (no horizon). But did the pilots wave off and call it a night? Not these two; they were determined.

"I'm going to turn on the spotlight to see if the rotor wash is coming in," the HAC said.

Now, let's stop and examine the situation. We have two pilots in a helicopter at 40 feet. They have no indication of aircraft groundspeed, and they don't know if the aircraft has any drift. They are beeping the nose up, and now they are going to turn on the aircraft's spotlight, which will probably induce vertigo.

The spotlight came on, and the HAC looked out his window. "I can't see the water," he exclaimed, "let alone the rotor wash."

He turned the light off and returned to his scan inside the cockpit when the nose began pitching up and down. The helo yawed to the right. The copilot saw the torque go to max.

"I got it," he said. His scan went immediately to the attitude gyro, and he thought, I've got to keep the wings level."

Something made him look at the rest of his attitude instruments. Instinct, intuition, maybe just training—who knows—but once this happened, he regained control of the aircraft. What had started at 150 feet, 3 miles and abeam the carrier, was now climbing through 500 feet, 6 miles and approximately 45 degrees from the ship.

"Is the ASE (automatic stabilization equipment) on?" the copilot asked.

"Negative," the HAC replied. "It's coming on now! What happened? Where's the carrier? We're at 045 at six. How did we get here?"

"I don't know. Are you okay?"

"I'm okay," the HAC said. He called to the three aircrewmen behind in the cabin, "Crew, are you okay?"

This helicopter with a crew of five was flying plane guard duties for a night recovery. It was doing dips 3 miles from the carrier on what most helo pilots would consider the worst conditions. Nothing new. It happens all the time. But what *did* happen was different. The two pilots didn't consider the environmental warnings and instead kept trying to get a qual that could have waited for another night.

Maybe you can call it aggressiveness, maybe on the first or second dip. But as these two found out, the third time was *not* the charm. They got so wrapped up in getting that check that they completely forgot they were mortal. The H-3 spiraled straight up to 600 feet, went through at least 540 degrees of turn, and traveled from 3 to 6 miles from the ship.

What would have happened if the aircraft had gone 3 miles in the opposite direction?

Editor's Note: How could risk management have helped these two pilots? ✈

Maintenanc

MAJ SHARI L. MASSENGALE
HQ AFSC/SESO

The infamous maintenance gremlins are usually associated with aircraft system problems, but sometimes they get the upper hand outside the aircraft as well. Consider the following scenarios involving benign actions such as failure to install pitot boom covers, remove stands, conduct a complete FOD sweep/assessment prior to engine run, or remove fire bottles prior to taxiing an aircraft.

At approximately 1,500 feet into the takeoff roll, the pilot of an F-16C on an Operational Check Flight noticed zero airspeed indicated on the heads-up display and executed a high speed abort. The aircraft experienced hot brakes with both wheel tire plugs blown. The right wheel experienced a small fire which was extinguished by the fire department.

Subsequent investigation revealed the aircraft had not flown for over a month due to extended maintenance. While in the maintenance hangar, the pitot boom cover was installed approximately 90 percent of the time. The relatively short period of time it was uncovered was sufficient to allow several insects to build a nest in the pitot boom. A nest of bugs deep inside the pitot boom is not normally detectable and, in fact, was not identified during any of the preflight inspections.

How important is installing pitot covers, even while doing maintenance in a hangar environment? In this case the estimated cost to repair the aircraft was over $37,500.

An F-15E tow team was tasked to position an aircraft in a hush house. The tow team supervisor did a check of the hush house for obstacles as required by technical data. The supervisor was aware of a B-2 stand centered in the rear of the hush house. The stand was used in several maintenance actions in the hush house but was not required for the maintenance scheduled for this aircraft. The accepted practice was to leave the stand in the hangar while positioning the aircraft.

While backing the aircraft into the hangar, the aircraft was approximately 1 foot off centerline. The tail walker noticed that the right horizontal stabilizer was low and could strike the stand **BUT** failed to stop the tow and move the stand. **Instead**, he pushed up on the right horizontal stabilizer so it would clear the stand. While pushing up, he lost visual contact with the aircraft tail section. The right vertical stabilizer struck the top corner of the B-2 stand, causing almost $22,000 in damage.

A C-130 engine was on the test stand for a series of test runs over several days. The first three runs were normal, with the test pad swept prior to each run, intake inspections completed, and the inlet covers installed after each run. Prior to the fourth run, an intake inspection revealed FOD to the first stage stator and rotor. Teardown found the cold section case split and out-of-limit damage throughout the turbine section. A small rock was found in the turbine. The incident investigation found the concrete on the test pad was cracked. The corrective action was to replace the engine test stand pad with new concrete. I wonder if the new concrete cost more or less than the $170,000+ it cost to repair the FO damaged engine?

A KC-135 was returning from a $2\frac{1}{2}$-week deployment. The aircraft was parked in a satellite parking area with no obstructions or

☆ U.S. GOVERNMENT PRINTING OFFICE 1998-673-366/43033

e OOPS$!!!

other aircraft within 300 feet. The crew did not request transient alert support. The preflight and engine start were uneventful. After the engine failure assist system check, the aircrew cleared the two crew chiefs to board the aircraft. Prior to boarding, the crew chiefs told the pilot the aircraft was in taxi configuration. Shortly after beginning their taxi out, the crew heard a scraping noise and stopped. Their wingman told them they had run over a Halon fire bottle and it was leaking. The crew shut down the engines and ground egressed the aircraft. The $2,700 in damage was limited to the nose tires and fire bottle.

These four incidents totaled over $230,000 and are the type of events that keep maintenance managers awake at night. They all have a common thread—a breakdown in adherence to basic maintenance practices. These maintenance practices were already learned the "hard" way, but for some reason we seem bound and determined to continue to reinforce the lesson.

Tow teams are taught to stop a tow when clearance is in doubt, not because we want the job to take longer but because we want to avoid damaging the aircraft or injuring one of the tow team members. FOD checks of intakes and ramp areas prior to engine start are designed to prevent damage to the engine, not to add one more meaningless task to the mechanic's day. Ensuring that there are no obstacles prior to taxi is for the safety of the crew, aircraft, and passengers. Installing pitot covers, rather than adding extra work, prevents significant maintenance problems.

In each of the four cases outlined above you can find "wiggle room" that provides a reason for the mistakes made. The crew chiefs were tired, they swept the pad—how could they know the act of running the engine would cause more cracking? The list goes on, but those of us with many years in aircraft maintenance find some of the rationale pretty thin.

Senior maintenance managers (and today that includes just about anybody from a TSgt on up), when was the last time you walked through your maintenance outfit and looked for the "little things"? Power cords not rolled up, trash in the hangar, tool boxes not secured? At my last base, my folks could bet that at least twice a week I'd walk into one of the production supervisors' meetings with a laundry list of things they needed to fix. If you, as the senior maintenance officer or maintenance supervisor, don't think FOD walks and housekeeping are important, why should those who work for you? Once you let the "little" things go, the "big" things are next in line.

The downsizing and reorganization aircraft maintainers have undergone over the last several years have had the net effect of pushing more and more responsibility down to lower and lower levels. We continually ask more and more of our younger troops. They're bright and willing to take on tasks that were unheard of only a few years ago. It's up to us as supervisors to make sure they understand that empowerment does not equate to a disregard of all those lessons we learned the hard way back at the start of our careers. Be involved, pass on your knowledge, and most important, pass on your time. It takes constant **senior level** emphasis to set and enforce basic maintenance standards. ✈

Flying Safety

Your Attention Please!

Do you get *FLYING SAFETY* from your PDO???

If you do, there will be changes in FY98 and FY99. Base Publication Distribution Offices (PDOs) will be closed by 30 Sep 99. So how will you get your copy of *Flying Safety?*

If your Air Force unit receives *Flying Safety* through the PDO via the Base Information Transfer Center (BITC), you may do the following:

Send us your **unit address to include ZIP + four,** and the number of copies of *Flying Safety* required (one copy per three air crew assigned, one copy per six direct aircrew support and maintenance personnel). All customer service areas are encouraged to subscribe also.

Send your request one of five ways:

1. Military e-mail to schuld@smtps.saia.af.mil

2. Fax: DSN 246-0931Comm. (505) 846-0931, Attn: Dorothy Schul

3. Internet: www-afsc.saia.af.mil/magazine/htdocs/index.html
   (find the subscribe page that will be up by the time you see this)

4. Send us a letter:
   Flying Safety Magazine
   Attn: Dorothy Schul
   HQ Air Force Safety Center
   9700 G Avenue, S.E., Ste 283A
   Kirtland AFB NM 87117-5670

5. Telephone: Dorothy Schul at DSN 246-1983, Comm. (505) 846-1983