UNITED STATES ARMY

AUGUST 1967

AVIATION DIGEST

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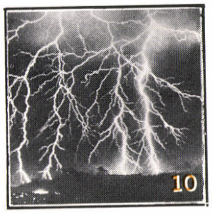
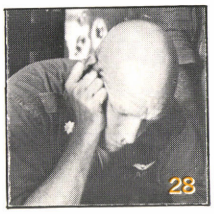
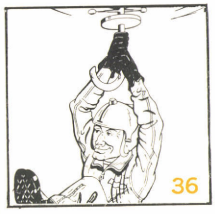






AUGUST 1967 VOLUME 13 NUMBER 8

Letters 1

Find the Enemy—Airmobile Style, LTC Kenneth D. Mertel 2

A Simple Protective Revetment, MAJ Vincent R. Ritts 8

Passing the Weather Buck, CPT Robert D. Kelley and Mr. Cletus N. Youmans 10

Here Comes the CH-47B 12

The Human Factor in Army Aviation, Dr. Wallace W. Prophet 14

Ditching Techniques 17

AVLABS, COL Harry L. Bush 24

Air Mission Commander, MAJ Gordon T. Carey 28

For Aviators On the Way Up 31

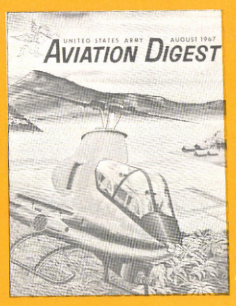
Warrant Officer Training—Fort Rucker Phase CPT E. R. Downing, Jr., and CPT C. R. Ledford 32

Crash Sense

- Emergency Landing Techniques in Helicopters Gerard M. Bruggink 36
- Aircraft Maintenance Is Everyone's Job, Ted Kontos 46
- NATOPS = Naval Air Training and Procedures Standardization, MAJ Kydean Whitlock 55
- Flight Safety Opinion Survey 58
- Pearl's 60

Keep Posted on AR 95-63, CW2 Harry O. Pierce 64

AH-1G



The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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Articles, photos, and items of interest on Army Aviation are invited. *Direct communication is authorized to: Editor-in-Chief, U.S. Army Aviation Digest, Fort Rucker, Alabama.*

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LETTERS

Sir:

In regards to the article "Wa Hoppen" in the January issue of the Aviation Digest. . . .

1. While inspecting an O-470 engine, that TM 1-2R-0470-508 (Modification of oil filler cap) had been complied with, the following discrepancies were noted:

a. The bracket that the safety pin goes through was not welded to the oil filler neck IAW TM 1-2R-0470-508, but was riveted and the rivet had worked loose.

b. The bracket tang with the hole in it was not ½-inch long IAW TM 1-2R-0470-508.

2. These two discrepancies would allow the pin to be installed through the oil filler cap and pass on the outside of the bracket tang, allowing the oil filler cap to turn, even though it appeared that the safety pin was installed properly.

This facility has submitted an urgent EIR on this problem area in keeping with the high standards of safety in Army aviation.

CW3 WILLIAM E. LEWIS
(CONNARNG)
162d Trans Bn TARS
Groton, Conn. 06341

● *The following comments were received from AVCOM:*

1. The possibility of an oil filler cap coming off after the cap has been secured into place and safetied is an extremely remote possibility rather than a probability.

2. If the oil filler cap came off, engine oil loss out through the oil filler tube would create an oil film over the outer surface of the aircraft fuselage including the windshield. This would be true even if a small quantity of oil were lost rather than the total engine supply. Thus the pilot would notice the problem.

3. The oil filler cap in proper working order secured to an oil filler neck in good condition will not come off in flight even if the safety pin is not installed.

4. The safety pin serves as an assurance that the oil filler cap is in the secure position by visual inspection. It also impedes the cap twisting to the insecure position.

5. No matter how simple and foolproof a servicing device may be designed, it will not eliminate the requirement for good maintenance and responsible servicing.

6. The O-1 aircraft has been in the system almost 20 years and many commercial aircraft use a similar engine with a similar oil filler system. In fact, new Continental engines utilize a similar oil filler cap without the safety pin (so does Lycoming).

Sir:

In reference to the April 1967 issue of Aviation Digest article "Debut of Super Lou," page 17, we wish to call your attention to the statement ". . . with a shot of 7808 hydraulic fluid and Mil 5606 oil."

Reference: TB AVN 2, dtd 27 Oct 1967, Sec III, oils, para 9 — Turbine Engines, subpara a, defines Mil-L-7808 as lubricating oil.

Reference: TM 55-1520-210-20, C 6, Chapter I, Section III, Table 1-1, defines Mil 5606 as a hydraulic fluid.

Since your magazine is so widely read by our troops worldwide, and a great amount of information is gained through the articles, we felt that we had to call your attention to this, before someone inadvertently used the wrong items.

Please retain the excellent quality of your magazine and we look forward to future issues.

SP 6 STANLEY C. CLARK
USAAVNS Museum
Ft Rucker, Ala. 36360

Sir:

I think your Digest is the greatest thing going! I very much enjoyed your April issue, especially your story on the "Debut of Super Lou." But I spotted a goof on page 17, second para! Whereas your Huey was fed a breakfast, by the crewchief, of Mil-7808 hydraulic fluid and Mil-5606 oil. Your crewchief got his menu a little fouled up. It should of been *Mil-7808 oil* and *Mil-5606 hydraulic fluid!* If we fed our choppers his menu, we *all* would be in a world of hurt. Outside of that, please keep up the good work. Thank you.

PFC WILLIAM E. BURTS
1st Aviation Detachment
APO New York 09128

● *Thanks to SP 6 Clark and PFC Burts for spotting an error that several editors and reviewers overlooked.—The Editors*

Sir:

Each class of warrant officer candidates attends a seminar before their graduation. A panel composed of three warrant officers and a moderator who is also a warrant officer conduct this two-hour period.

A most difficult question was presented to me at a recent seminar. "Sir, we have read a letter in the 'Army Times' from an instructor, referring to the lower quality of students being graduated from the Aviation School, and we are aware that the matter is discussed. What are your thoughts on this subject?"

That question generated these thoughts: I graduated from the Aviation School ten years ago with a class of 25 who had started training with 65 candidates. We were one of the largest classes to graduate at that time. I remember hearing the comment, "Flight school just ain't what it used to be; you just can't wash out anymore." If I had just been two classes earlier I could have graduated with eight . . . but then I probably wouldn't have made it.

At that time the rotary wing course was relatively new, and instructor experience ranged from a turn-around student to perhaps three years. At the school now are also instructors who graduated little more than a year ago —but that year was spent in Vietnam in the accumulation of nearly 1,000 hours and an equivalent of experience that would be impossible to measure.

Rotary wing instrument flying was still experimental and of course not included in our instruction. There are a few of our group who are not around today because we were incapable of executing a 180° turn without ground reference.

The newly assigned aviator will require and always has required unit training before becoming a fully operational aviator. I have found this to apply to both recently graduated aviators and to those with years of experience. I believe that the time required to accomplish this is less for today's graduate than for any before him.

There is no substitute for experience and I think that today's graduates are better prepared to face the real aviation school than any of us were—the one that begins when the wings are pinned on . . . and never ends.

CW3 ROBERT G. FRANK
Dept of Rotary Wing Training
Ft Rucker, Ala. 36360

Find the enemy

Airmobile Style

In an airmobile infantry unit in Vietnam today, intelligence and reconnaissance, always a difficult problem in the past, have been improved to a point where the enemy is located more rapidly than before in a counterinsurgency environment

Lieutenant Colonel Kenneth D. Mertel

VISUALIZE yourself the commander of a North Vietnamese Army (NVA) battalion. Your unit has been on the "trail" for the past 60 days. It has been a long hike; your troops are heavily laden with weapons and ammunition. Those 81 mm mortar shells and the 120s get awfully heavy. Movement has been relatively easy however. You have been in a neutral country and have been well cared for at the periodic rest stops. This is your last night in friendly territory. Tomorrow you cross the border into South Vietnam and have to be especially alert, for the rumors have been heavy concerning enemy activity in the area you are about to enter.

Reports from stragglers and casualties from other units that have preceded you speak of the ambushes, the devastating firepower, malaria, and the well armed enemy soldier everywhere. Your thoughts flash back to the detailed briefings and the careful planning that you went through before leaving North Vietnam. You know your routes across the border are secure, carefully hidden from the enemy, from his searching aerial eyes. The way stations are carefully placed and prestocked with food, medicine and ammunition, and are near water and shelter. The excellent system of native guides will take you over the carefully selected routes. Better get some sleep, for tomorrow will be a busy day. How busy you little know as you drift off for a few hours of peaceful rest, the last that you will ever know.

Across the border the next morning into the heavy jungle. The trails are good—you can move rapidly, two abreast under the thick canopy, and it is easy going for the bicycles and carts that are moving some of your heavy equipment. By mid-morning, in spite of your rapid movement you realize something has been bothering you—an awareness that you are being watched by unseen eyes—the faint noise of aircraft or truck engines from afar—the occasional sight of an enemy helicopter through the breaks in the heavy jungle canopy.

With darkness approaching, your lead reconnaissance elements send back word that the first way station has been reached. Nothing remains but burned out rice storage huts; the tobacco is destroyed, the ammunition gone. Evidence of recent enemy troops, empty food containers, as well as other indications that American soldiers have been there. Many GI boot marks in the soft soil.

This report is very disturbing but no great problem, for your men are carrying adequate food and you can replenish your supply tomorrow night. You spend a sleepless and nervous night as an occasional round of artillery or mortar fire explodes in the darkness—not far away, just enough noise to keep you partially awake. Airplanes overhead and bombs

COL Mertel is with the Directorate of Individual Tng, Office of the Deputy Chief of Staff for Personnel, Dept of the Army, Washington, D. C.

An armed Huey seeks out the enemy in Vietnam

falling in the distance—hard to realize that the enemy is so near.

Next morning, moving a little more cautiously—still good concealment. A few minutes later as one of your elements cross a relatively open area, it is brought under fire by two helicopters firing machineguns and rockets. Your men take cover, but not before several have been killed or wounded. Where did the helicopters come from? How did they spot you? Approaching a second way station, back comes a report —no food, nothing but debris and GI boot tracks. Another sleepless night, harassing artillery fire falls close at hand; two men are wounded.

Moving the next day, slower, even more carefully—you are beginning to see helicopters everywhere. One of your lead patrols encounters a small enemy force which melts away before your men can open fire. Several times you have had to take cover from low flying helicopters, little ones darting in and out of the trees—right in the treetops. They shoot at anything that moves or looks suspicious. Later on in the day as you cross a stream, part of your unit is bombed and strafed by fast flying aircraft. More casualties?

Another way station that night with little food remaining. Now your troops are nervous, hungry—morale is getting low. More harassing artillery and mortar fire during the night. Seems to be getting more accurate. The next day your lead company is ambushed. They walked right into a carefully laid trap, just like a group of recruits. Before you can assist them with the remainder of the battalion, you are under attack by an air strike—bombs, napalm, rockets and machineguns searching out your troops. The sky is full of helicopters. The enemy seems to be landing everywhere; they are all around you. The firepower is unbelievable, they seem to know exactly where you are—each one of your elements is pinpointed. Every time you move, they counter with a helicopter-borne troop force, much quicker than you can react and you are caught once more.

There is not much time left—there is little left of your battalion. You cannot comprehend, but you have encountered U. S. Army airmobility. This is a highly successful concept proved in Vietnam, with troops moved almost anywhere, rapidly with little concern for terrain or weather; tremendous firepower instantly available; outstanding communications, command and control; excellent logistics and superb intelligence and reconnaissance.

Let's now go back and analyze how the airmobile forces were able to locate you so easily and bring their vast combat power to bear so rapidly and effectively.

In an airmobile infantry unit in Vietnam today, intelligence and reconnaissance, always a difficult problem in the past, have been improved to the point where the enemy is located more rapidly than ever before in a counterinsurgency environment. This fact is evidenced by the increasing numbers of Viet Cong (VC) and NVA troops killed, wounded, captured or defecting.

Maps are an important source of information if properly interpreted

A U. S. operation is in the planning phase. Your airmobile brigade has been given a large sector to clear in a series of search and destroy operations. The airmobile infantry battalion which you command has been given a portion of that area of operations (AO). What information and intelligence gathering means are available to assist in planning and executing this operation?

First, at division level, are the normal means available to any U. S. unit. Maps, an important source of information, are plentiful and very accurate, especially with reference to permanent type terrain features such as rivers, canals and hill tops. Beware of trails, however, and the numerous intermittent streams. Many of the trails actually on the ground do not show on your maps and many of the old ones indicated on the map are overgrown with secondary growth and are difficult to locate.

Next, division will have some good terrain and weather studies of the area that can be most helpful. Photos are probably on hand; however, in the airmobile division, they can be obtained within 1-2 hours using the division's own Mohawks (OV-1). These Army aircraft can rapidly execute a photo mission and have the developed photos, or an interpretation read out to you, in a very short time period.

Infrared detectors on the Mohawk can see on the darkest nights, and are very useful in locating bivouacs with their ever present cooking fires. These pinpoint locations can be very accurate, except during certain times of the year when the mountain tribes or farmers are burning their fields. Readings from the side looking radar (SLAR) are effective for detecting moving vehicles and boat movement on waterways. Plain old "eyeball" visual reconnaissance from the Mohawks and the O-1 Bird Dog still provides the most information. This information can be supplemented by air reconnaissance reports from forward air controllers (FAC) operating in your sector, further enhanced by the many other pilots who fly over your sector, reporting what they see to your S-2.

If there is a U. S. Special Forces A or B detachment in your sector, do not forget to check with them for any information and intelligence that they may have. The Special Forces are very knowledgeable of the terrain and can furnish reliable U. S. and Vietnamese guides.

Check the after-action reports to see what units and operations have been conducted in your area in the past. The location of former landing zones (LZ) used, particularly those that have been improved, landing strips, trails, routes of movement, and enemy contact are available. Usually a trail overlay is part of every after-action report. In this regard your supporting Army aviation unit keeps track of all previously used LZs, location, size (so many birds), landing directions and obstacles. Your own artillery liaison officer (Arty LO) can obtain target information on previous actions in the area. The division engineer will furnish the word on previous use of mines, both friendly and enemy.

Actual aerial reconnaissance of the area may be limited by higher headquarters. Thus it is very important that you make use of all information and intelligence available before the actual flight. The first aerial pass over an area will reveal little to you but jungle growth or rice paddies. Repeated views are required, which will reveal well hidden trails, huts, stream beds, and other evidence of the enemy.

Your reconnaissance party, if you have a command helicopter, is probably your S-3, Arty LO, U. S. Air Force liaison officer (ALO), and perhaps the S-2. A reconnaissance with the rifle com-

pany commanders after the battalion order is issued is extremely valuable if time permits. Part of your reconnaissance if any air assault will be conducted must include the aviation company or battalion commander who will support you. His recommendations on landing zones, routes, etc., are essential.

An operation may begin with an air cavalry troop operational control under your brigade. If so, this unit is the best overt means of locating the enemy within the division. The White Team, two OH-13 helicopters, is most effective. This scout team works in the treetops, flitting about, searching out the trails, way stations, bunkers and caves by means of visual observation and reconnaissance by fire, using both 7.62 mm machineguns and 2.75″ rockets mounted on the helicopter. They cover each other as they work.

If something suspicious is developed beyond their capability, they call for the helicopter gun ships in the Red Team. These UH-1B helicopters, armed with rockets and machineguns, are excellent for developing a vague enemy situation. If troops are needed on the ground, the Blue Team, an infantry rifle platoon mounted on its own UH-1D transports, can land and physically search out the terrain. Many of the successful battles of the war have been developed in this manner.

White, Red and Blue Teams of the air cavalry troop, backed up by an infantry battalion—your battalion. Enemy discovered, in you go, with whatever forces are required to relieve the air cavalry and destroy the enemy.

Prisoners of war (PW) or Viet Cong captives (VCC) are a fruitful source of information and intelligence. Once an NVA or VC soldier is captured or surrenders, he feels that he is out of the war and will "spill his guts." A carefully conducted psychological warfare program using leaflets and loudspeakers will help provide prisoners. Many units offer a case of beer or an R&R for a prisoner. This will give good results in the early phase of an operation when the capture of prisoners is most critical.

Prisoners (above) can be an important source of information. Below, a Viet Cong prisoner eats lunch after receiving first aid treatment from a medical aidman

Interrogation of VCC in the early phase of the 1st Air Cav Div's Pleiku Campaign, Oct-Nov 1965, supplied detailed order of battle information to complete the picture of a newly infiltrated NVA regiment. A VCC captured on 4 Nov 65 in an ambush provided the first indication of the presence of another NVA regiment which was subsequently located and soundly defeated on 14-17 Nov at Chu Pong. As the operation progressed, order of battle developed additional forces. By 24 Nov it was determined that an enemy division had been engaged by the Sky Troopers of the 1st Air Cavalry.

Most NVA captives answer questions willingly, indicating that they have had little or no training in a code of conduct. They are also unaware of the usefulness of information given. For example, several told of their company locations. An air strike on 100 NVA in one of these locations resulted in 80 KIA. Eight other captives revealed the location of resupply points which were struck by air and artillery. Secondary explosions occurred five times out of eight air strikes.

In operation White Wing, conducted in Jan-Mar 1966 in Bong Song, documents and prisoners confirmed the presence of an NVA division in the province. Rapid exploitation of information given by a captured battalion

Find the Enemy — Airmobile Style

Troops may be inserted by helicopter (above) to establish company size bases from which observers can obtain information on enemy movements and positions

commander assisted in raising the enemy death count. Live broadcasts by a captive lieutenant resulted in at least one defection.

In Operation Lincoln Mosby, Mar-Apr 1966, conducted in the II ARNV Corps Tactical Zone, 17 VCC identified 15 separate units as being in the area. Out of these, three new infiltration groups, two newly infiltrated NVA regiments, and one engineer company were confirmed. Again prisoners and captured documents were invaluable in the discovery of lines of communications and storage depots, and further indications were evident of major routes of infiltration.

Documents are a valuable source of information and intelligence. The VC and NVA are great planners, everything worked out to the last detail in advance. Careful rehearsals are staged for almost every operation. Thus, most of their planning is reduced to writing on paper. Maps and sketches are plentiful. All enemy bodies must be carefully searched for useful documents, as well as searching for bivouac sites, caves, etc. All paper found must be turned in, since in the absence of linguists, the average U. S. soldier will not be aware of the value of the document. The abundance of helicopters in the area makes it easy to get documents for evaluation back to the rear to the S-2 types rapidly

before the enemy knows that a pending operation has been comprised. The finding of a sketch map early in the Pleiku Campaign of the 1st Air Cav Div, Oct-Nov 1965, provided the enemy routes of movement and locations of supply points and aid stations.

During Operation White Wing in Feb 66, the 1/9 Air Cavalry Squadron found a map on an NVA body. Four circles were drawn around locations in what is called the "Crow's Foot." A call to division revealed that these numbers corresponded to units of an NVA regiment. A search of one of these areas resulted in 63 NVA killed in a brief battle and the capture of a battalion commander. The battalion commander's interrogation led to the location of his regimental headquarters and the capture of many more valuable documents.

In Operation Crazy Horse, May-Jun 1966, in Binh Dinh Province, over 75 linear inches of documents were captured, giving the intelligence community an invaluable insight into the VC infrastructure in that area. Rapid interchange of information between multinational Free World Forces produced intelligence that resulted in locating and destroying enemy elements.

You may employ long range patrols, landed by helicopter or by parachute, to search a specific area, several days in advance of an assault. Every infantry battalion should have this capability well developed within the battalion reconnaissance platoon and within each rifle company. Some units give their long range patrols fancy names and scrounge special lightweight equipment that will permit them to operate off the land for several days without resupply.

Excellent communications are essential to receive reports and to retrieve the patrol in the event of emergency. The CH-47 Chinook helicopter is excellent for recovering patrols, day or night, using the ladder techniques. If you are operating in an area and expect to come back, it is a good idea to establish caches of food and ammunition, carefully hidden, but secretly marked so that they can be located, for the use of long range patrols at a later date.

Once the air assault is over and you are in the area, the use of patrols becomes the best method of obtaining information and intelligence—to locate the enemy. This may be accomplished by sending out rifle companies to establish a base, then dispatch small patrols on coordinated routes from that base. The patrols can be inserted by helicopter and retrieved later at a predetermined location and time. Many units have devised types of patrol techniques that they have given special names to, such as "checker board," "scatter," and "saturation"; however, they are really the same old tried and true methods that have been taught and practiced in two previous wars.

Most important, any time a patrol is out, either reconnaissance, stay behind or combat, careful plans must be prepared to provide fire support and reinforcements or retrieval. Small unit operations from squad to platoon, off by themselves, must be a very carefully planned operation for, generally speaking, no unit less than a company size combat team can really take care of itself in a sustained combat action against the enemy. Company and battalion commanders must know where their patrols are located at all times and be prepared to help them should the need arise.

When a company or battalion is moving overland, patrols must be used in advance, rear and on the flanks, even in the jungle. Otherwise, if you lack proper security, you will be surprised and ambushed. Liberal use of the helicopter scouts from the air cavalry squadron or your own brigade aviation section can provide a great amount of warning and protection. The enemy invariably reveals his location by shooting at the choppers.

Most divisions operate a Combat Intelligence Coordination Center (CICC), not unlike the Fire Support Coordination Center (FSCC). All information, documents and PW reports funnel into the CICC from all units. Here the information is easily translated into intelligence by the experts and then is made available to the combat units to help them in their mission to destroy the enemy. The vast amounts of information obtained through the many sources can be sifted and evaluated quickly to provide results of value to the combat units. If the division has not established such a system, the brigade may operate a CICC equally as well.

Good intelligence and reconnaissance is the difference between success and failure in Vietnam today. It is the primary factor in obtaining a favorable friendly-versus-enemy kill ratio. When one hears of a U. S. unit being ambushed or surprised at any location where they are based or secured for the night, there is little doubt that their intelligence and reconnaissance were faulty in spite of the many means and facilities available to them. Surprise or ambush gained by the enemy means that the enemy had good intelligence and knew exactly what the U. S. unit was doing.

Our Army today has excellent methods and facilities for gathering information and producing intelligence. Use them for greater success in battle and improved performance of the Infantry mission to close with and destroy the enemy.

a simple protective revetment for parked army aircraft

Major Vincent R. Ritts

INFORMATION from Vietnam indicates that increasing emphasis is being placed on construction of a protective revetment for parked Army aircraft. And why not? For a few dollars the Viet Cong can fabricate a bomb that can inflict heavy damage on an unprotected aircraft to the tune of thousands of dollars. The economics of this is quite simple, and balances heavily in favor of the VC. We may be a rich nation, but sooner or later, with continued damage of parked aircraft we'll begin to feel the pinch in our pocketbook. Worse yet, vitally needed aircraft will not be available when needed.

If a relatively simple protective revetment is constructed so parked aircraft can receive some protection from enemy attack, this unnecessary damage can be avoided, or at least lessened. The question is, How to build it? What's it made of? How much is needed? Who can build it? Obviously there are innumerable types of protection that can be built. TB 5-330-1 is a relatively comprehensive bulletin on the subject, and with some studying of it a type fortification for a specific need can be calculated.

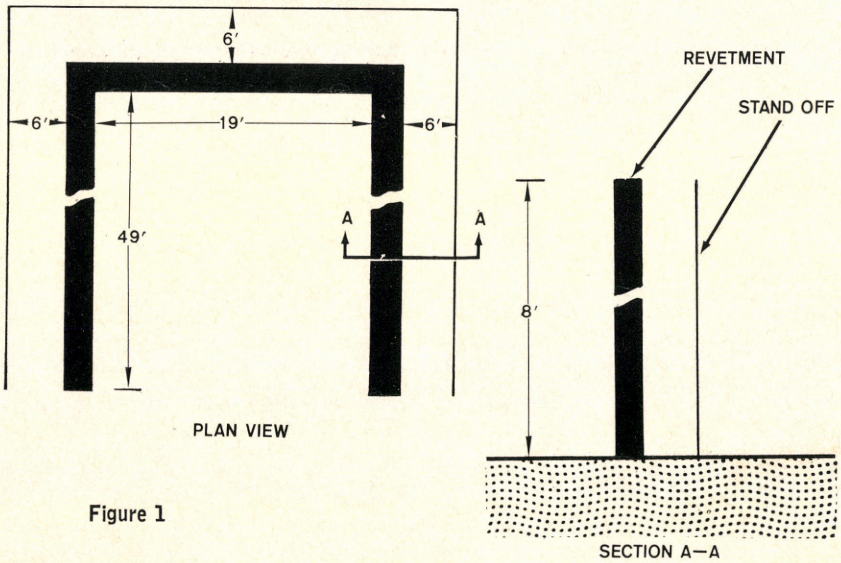

Figure 1

First thing to decide is what type ammunition to protect against: ball, recoilless rifle and/or mortar, and what size. After determining that, find out what type construction material is available (soil, sand, clay, concrete, timber, etc.). Then decide whether or not a standoff should be used. A standoff is a steel or timber wall erected about 6 feet in front of the protective structure to detonate shells to reduce the penetrating effect. Standoffs are desirable because they greatly reduce the required thickness of the protective structure, thus economizing on time and materials. Once all the above is investigated and considered, the best material with which to construct the fortification and the thickness of the structure should be determined.

Now it's time to decide on what

MAJ Ritts is Deputy Branch Chief, Fixed Wing Branch, Employment Division, Dept of Tactics, Ft Rucker, Ala.

type of protective revetment to build: sandbag revetment with standoff, free standing wall, etc. The materials available and especially the labor force and technical ability will govern this. Without going any further, and into too much detail, since specific situations can be gleaned from the TB, this article will present a type revetment for parked UH-1A and B aircraft in Vietnam. The design is relatively simple and is constructed with materials reasonably available in RVN. It could be constructed by non-engineer troops; however, technical supervision by engineer technicians is desirable. This design shows a partial protection revetment. Here, time and economy of materials were weighed against possible consequences of an attack with resulting damage to the aircraft. The design uses sandbag/soil-cement fill with a ½″ thick timber standoff. This will provide partial lateral protection against .50 caliber ball (AP), 82 mm recoilless rifle, and 120 mm mortar ammunition. The use of soil cement in the sandbags reduces the basic problem of rapid deterioration of sandbags. A soil-cement structure also eliminates the need for a retaining wall, thus simplifying the construction. It must be kept in mind, however, that a sandbag soil-cement revetment eliminates the need for a retaining wall through the interlocking arrangement of the sandbags; a fact which must be adhered to during construction.

Figure 1 shows the layout of the revetment. This small U-shaped design economizes on materials but requires ground handling of the aircraft into and out of it. Its height also affords little protection for the main rotor blades and rotor head. This is a calculated risk that must be taken. A higher revetment could be constructed, but with corresponding increase in costs and time required for construction.

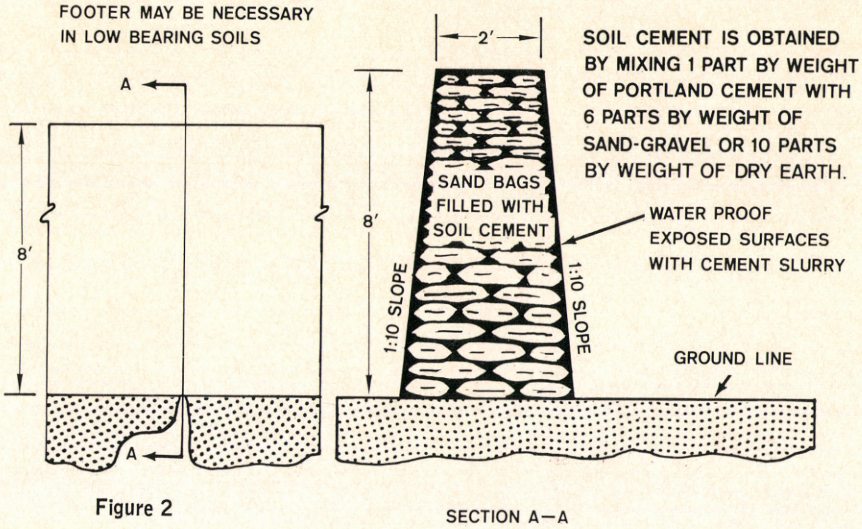

Figure 2

Figure 2 shows the design of the soil-cement revetment. If a greater height is desired, the 2-foot minimum thickness must be maintained to afford the same ammunition protection. The 1:10 slope must be maintained to prevent the wall from collapsing. Be sure the soil can support a higher wall; otherwise, a footer may be required.

Figure 3 shows the timber standoff design. Quarter-inch steel plate could be substituted for the timber, but this material probably would be more difficult to obtain.

Many other type structures could be used, such as filled 55 gallon drums, combinations with pierced steel planking, salvaged equipment, etc. TB 5-330-1 contains comprehensive information for a "do-it-yourself" revetment, and should be consulted before attempting to design a specific type for your needs. For a few dollars spent, considerable savings could result in sparing damage to parked aircraft. The old saying "An ounce of prevention is worth a pound of cure" applies very well in this case.

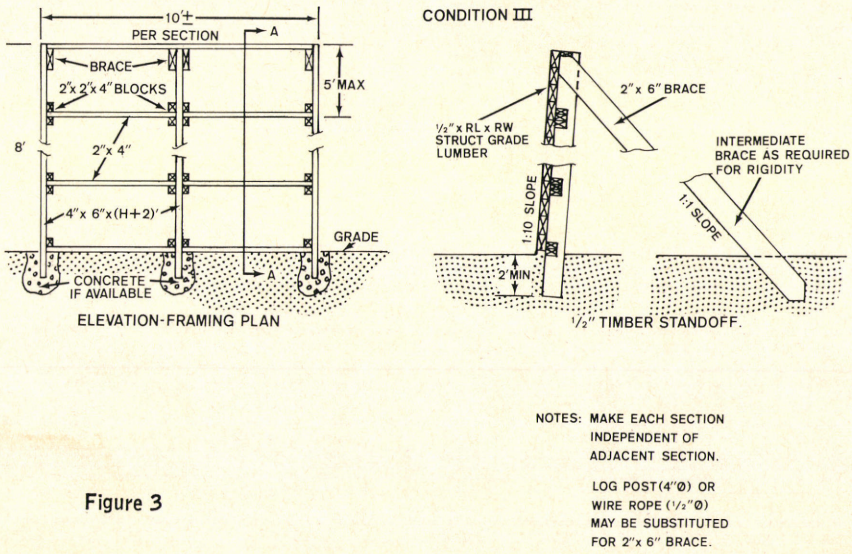

Figure 3

NOTES: MAKE EACH SECTION INDEPENDENT OF ADJACENT SECTION.

LOG POST(4″Ø) OR WIRE ROPE (½″Ø) MAY BE SUBSTITUTED FOR 2″x 6″ BRACE.

PASSING THE WEATHER BUCK

Blaming the weather for the loss of lives and destruction of perfectly good aircraft in thunderstorms is too often the easy way out

Captain Robert D. Kelley and Mr. Cletus N. Youmans

MANY AVIATORS blame the weather for the loss of lives and destruction of perfectly good aircraft in thunderstorms. This is just a way of "passing the weather buck." The real culprit is not the weather but the pilot who tries to fly through it.

Pilots who for some reason have flown through a thunderstorm often say they didn't know there was a thunderstorm in the area until they were in it. When this happens they generally blame the weather service. The fault, though, is probably their own because they failed to check or failed to realize the significance of what they heard the weatherman say.

No country in the world does as much weather-wise for its pilots as does the United States. There is hardly any place in the United States the aviator can be that he can't get the weather information he needs to make his flight plans.

The government has established Flight Service Stations, located within 75 to 80 miles of each other, to give weather information to aviators. There's an impressive amount of information to be had from them, and it's all free for the asking. An Army pilot only has to pick up a telephone and call them collect, or if he's airborne call on his radio.

Also, military pilots may contact any military airfield with a weather station to obtain information. If necessary, the pilot can also contact a nearby radio station, TV station, or newspaper and get a nonaviation type, but usable, weather report from the news teletype lines.

There are times, of course, that the aviator may not be able to get the weather information "all the way." Most Flight Service Stations and other weather sources can only give point to point forecasts. Many stations don't have the necessary weather radar and other equipment necessary to get the information themselves.

Sometimes the existence of a thunderstorm may not be known by the station. Thunderstorms can build up quickly and weather stations can't tell where they will be until they appear. It often happens that after a pilot has been told there are no thunderstorms in an area, one appears.

If an Army aviator can't get the en route forecast he wants and he has reason to suspect thunderstorms, he must rely on visual means of spotting them. Army aircraft usually don't have weather radar on board.

From a distance, locating a thunderstorm is not easy. The tall cumulus cloud may be buried in other clouds or look quite different from far away. A cumulus cloud looks much like a cauliflower with rolled puffy looking sides. As the storm grows the top will spread out in the direction the storm is moving.

In front of the thunderstorm cloud and near its base a turbulent cloud will sometimes appear. It usually extends downward from the main base. This is known as the "roll" or "squall" cloud. This cloud is caused by the agitation between a rapidly rising current in advance of the storm and a strong downdraft coming out of the storm. Its appearance indicates very rough weather within the storm.

Aircraft, especially light ones, should avoid this roll cloud if at all possible. It has the power to hurl an aircraft into the thick of the storm. Also it's unwise to try to fly under this cloud. Sudden changes in wind direction and speed set off by the roll cloud may change flying conditions and flight altitude so rapidly that the aviator may not be able to maintain control.

But suppose the aviator finds himself in a thunderstorm whether he wants to or not. What is the technique he should use that offers him the best chance of survival?

First thing to remember is that once started, continue on. Don't turn back. To turn around only means that it's necessary to go through most of the storm again.

Speed is very important. Going too fast will cause structural damage to the aircraft because of the gust loads that will be encountered. Too slow a speed will cause

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the pilot to lose control of the aircraft. The -10 gives the best speed for each aircraft. If it doesn't, figure the best to be about 20 percent less than normal cruising speed.

The aircraft should be cleaned up as much as possible to make it respond quicker when extra speed is needed. Retractable landing gear should be retracted. However, the landing gear can be lowered to slow the aircraft when reduced speed is needed. The gear should be raised again as soon as the correct speed has been reached.

Wings of the aircraft should be kept as level as possible to aid in maintaining a heading. Altitude should be considered of least importance so as to avoid excessive pitch.

The best altitude for entering the storm is about 4,000 to 5,000 feet above the terrain. This is high enough to take care of the downdrafts and yet keep the aircraft out of the high speed gusts found higher.

At 10,000 to 12,000 feet hail and ice are usually found, so these altitudes are very dangerous. There will be considerable lightning flashes. The outlines of the main cells can be seen and it's best to avoid them. The cockpit lights should be turned up bright to avoid blinding.

Thunderstorms are one of the greatest hazards to aviation. The best advice that can be given to an aviator is to avoid them. To avoid a thunderstorm a good flight plan is needed. It should take into account not only the weather as it is but also as it could develop. Once it becomes necessary to go through a thunderstorm, the pilot should pick an area with the fewest probable weather troubles, take the shortest route through, and hold the course until he comes out on the other side.

Weather frequently forms during the day (above) and erupts violently at night (below), with brilliant flashes such as these recently seen over San Francisco

The Army's new CH-47B Chinook lifts an M-56 self-propelled Scorpion gun which weighs 14,800 pounds

Here comes the CH-47B

THINK OF Vietnam and you think of the helicopter. Think of the helicopter and among those that immediately come to mind is the CH-47A Chinook.

Since its arrival in Southeast Asia in September 1965, the tandem-rotor aircraft has been one of the mainstays of the Army's aerial assault against the enemy. Now it has passed its 56,000th flight hour in Vietnam.

In accumulating these hours, the Chinook flew over 148,600 sorties and was called upon day after day to carry out a huge variety of missions. During the first 17 months of operation in Vietnam, Chinooks have transported over 1,094,000,000 pounds of cargo and moved 415,000 troops and civilians. A number of Chinooks have been deployed to that war-wracked country.

In the field of aircraft recovery, the big helicopters have retrieved downed aircraft, both rotary and fixed wing. Replacement costs of these aircraft total nearly $300,000,000.

The records show there's no doubt that the Chinook is good. Now it will be even better. The CH-47B is in production, the result of the Army's greater requirements. The first production CH-47B was delivered in May of this year. This is the first phase of a planned two-step program that would provide a significant payload and speed increase over the Chinook now in Vietnam.

The current Chinook gross weight was expanded from 33,000 to 38,550 pounds for the CH-47B. Cruise speed of the CH-47A is 130 knots and was increased to 155 knots for the CH-47B. Operating under sea-level standard conditions, with a full fuel load, the CH-47B payload capability is 14,500 pounds. This represents a 42 percent increase over the CH-47A Chinook payload capability. The CH-47B Chinook has a 60 percent increase in productivity when operating under combat conditions.

Changes in the CH-47B Chinooks will include the incorporation of the T55-L-7C Lycoming engine. This results in an increase of horsepower available from 2,650 to 2,850. In addition to increased power capability, the CH-47B incorporates a new rotor system

that provides rotor blades with a wider chord and a cambered airfoil.

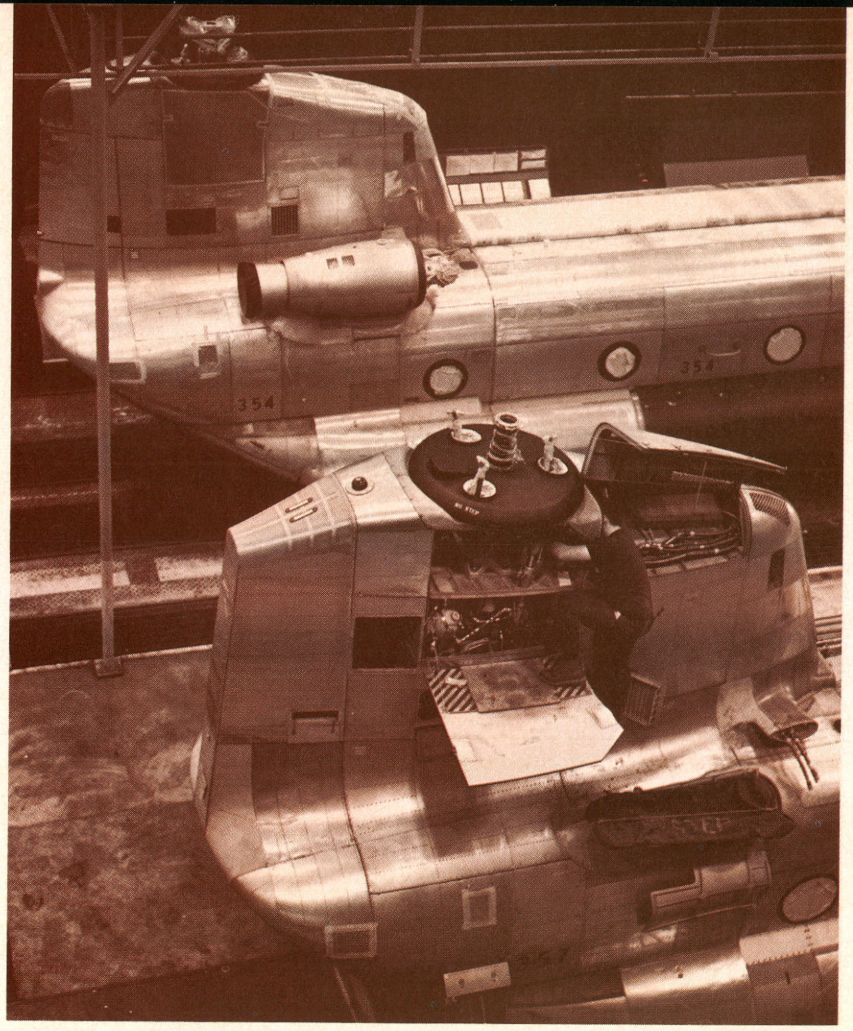
Popularly nicknamed the "Droop Snoot," the rotor system provides a significant improvement in aerodynamic capability. This, in turn, allows the speed and lift capability increases. The blade has also gone to a honeycomb core, adding to its strength.

Although the specification of CH-47B vibration levels have been met, Boeing-Vertol, manufacturer of the Chinooks, and the U. S. Army have conducted additional flight tests and shake tests to correct pilot complaints of vibration levels in the forward cockpit. These complaints were largely caused by a high-frequency buzz at the pilot heel slides and three per rev of the instrument panel.

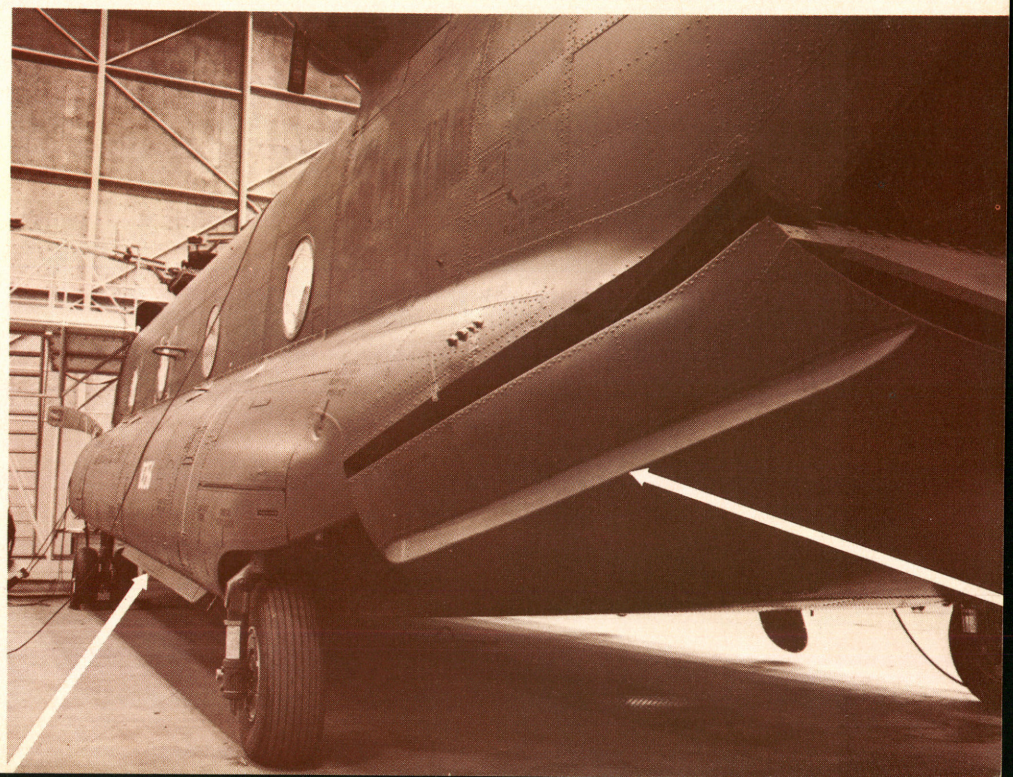
As an aid to cutting down this vibration and making the Chinook more stable, four absorbers were tested in a prototype. Two were placed aft, the others forward. A 90-pound weight, set on springs, was in each, making them approximately 120 pounds when installed.

Minor visual changes are also incorporated into the CH-47B. Among these are the blunting of the aft pylon and the inclusion of aft strakes. In addition, four spoilers have been added to the forward pylon. These additions make the aircraft almost statically stable in the directional mode.

The CH-47B is a forerunner of the CH-47C Chinook configuration now under consideration. The CH-47C would contain additional changes, including installation of new T55-L-11 Lycoming engines with a horsepower of 3,750 and strengthened transmission components to accommodate the increased power. It would have a multi-fuel capability, and its gross weight would be 44,000 pounds.



The CH-47B does not incorporate many visual changes over the CH-47A. However, a noticeable change was made on the tail, which was blunted. Above, a CH-47B aft pylon (foreground) can be compared with the A model beside it. Another change includes the addition of aft strakes (see arrows in photo below)



THE HUMAN FACTOR IN ARMY AVIATION

25th ANNIVERSARY CONTRIBUTION

Dr. Wallace W. Prophet
Director of Research, HumRRO
Division No. 6 (Aviation)
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SIGNS OF progress made in the 25-year history of Army aviation meet us on all sides. As one views the great changes that have occurred in the equipment and manner of employment of Army aviation, it would be easy to forget the most important factor in the system, the human factor. Our complex man-machine systems cannot function in optimum fashion unless sufficient attention is paid to the human components—the aviators, mechanics, observers, and other personnel.

Human factors as a specific area of research and development stem largely from the Aviation Psychology Program of the U. S. Army Air Corps in World War II. That program saw great strides made in many of the sub-areas which are part of the human factors field today—personnel selection, training methods, performance assessment, training devices, and human engineering. In the early and mid-1950s, the increases in equipment complexity and the general growth of Army aviation brought a growing recognition of the importance of the human factor in Army aviation. As a result, specific programs were instituted by the Army to meet these needs.

In this article some of the research activities of one of the Army's human factors research agencies, Division No. 6 (Aviation) of the Human Resources Research Office (HumRRO), will be discussed to illustrate the attention being paid the human factor in Army aviation. HumRRO is a contract agency of The George Washington University and has the mission of conducting research in the areas of training, motivation, leadership, and requirements for training devices. Two other Army agencies—the U.S. Army Behavioral Science Research Laboratory (formerly the U. S. Army Personnel Research Office) and the U. S. Army Human Engineering Laboratories—are doing research that is exclusively in the human factors area.

In addition to the three agencies mentioned, a number of other Army agencies perform research related to human factors. For example, at Fort Rucker the U. S. Army Aeromedical Research Unit (USAARU) and the U. S. Army Board for Aviation Accident Research (USABAAR) have programs in the human factors area. The collocation of these agencies and HumRRO Division No. 6 at Fort Rucker provides the opportunity for considerable interaction among the various human factors efforts. Guidance procedures for the conduct and coordination of the Army human factors research program are set forth in AR 70-8.

The Aviation Division of HumRRO began as a detachment of the Training Methods Division of HumRRO at Fort Rucker in 1956. In 1958 it became a full-fledged research division of HumRRO and is presently authorized a strength of 14 research personnel. Collocated with the HumRRO Division is the U. S. Army Aviation Human Research Unit (USAAVNHRU), a military unit which is authorized three rated officers and ten enlisted personnel.

The aim of the HumRRO aviation research program has been a simple one: to provide information basic to improvements in training and performance in Army aviation systems. Research on training is one of the most important aspects of human factors research, because training is the process in which human resources and hardware resources are brought together to produce operational man-machine systems.

One of the first problems faced by training researchers, one that was stated by DA as a "must" research requirement, was that of developing a more objective method of assessing flight performance. This general area of research, performance assessment, has been an important part of the HumRRO aviation research program through the first decade of its existence. Early experimental studies in 1957-58 indicated that flight grading was so unreliable that correlations between independently administered measures of flight performance for the same students were little or no better than zero. As a result, HumRRO developed the Pilot Performance Description Record (PPDR) which provides a more objective method of measuring helicopter flight proficiency. The PPDR system has been in operational use at the U. S. Army Primary Helicopter School (USAPHS) for about seven years now and is used for all checkrides there.

The PPDR is not a magic instrument, in spite of its being so described in a recent magazine. It is merely an objective listing of the performances the student exhibits while carrying out flight maneuvers. Use of the PPDR does result in standardizing what is observed, the sequence of events, and the information collected—all of which tend to increase grading reliability.

This standardized collection of detailed objective information made possible the development of a training quality control system in a subsequent phase of the research. This system, which makes heavy use of machine processing of checkride information, has proved to be a valuable tool for USAPHS management in terms of assessing the overall operation of the training program and indicating the need for specific changes in instructional or checkride practices.

Another area of continuing research interest has been that of aerial observation. In 1957 HumRRO Division No. 6 embarked on a series of research studies aimed at developing a training program for aerial observers. Research showed that existing training was doing an adequate job, except in four critical skill areas—visual search, target recognition, geographic orientation, and target location. Experimental training concepts developed for those four areas during the course of the research were adopted by the Army in FM 1-80 in 1962.

Subsequent to development of the observer training program described, the Army requested that research be undertaken to develop a programed text version of the observer training program to facilitate training in field units. The programed texts developed have just been published by the Army as TM 1-380-(1-6). Plans are currently being formulated for a joint effort by the Department of Tactics, USAAVNS, and HumRRO to integrate some of the "lessons learned" from Vietnam operations into the documentary materials available for use in observer training.

Training devices have been the focus for another important area of research. HumRRO Division No. 6 has participated with USAAVNS and with the U. S. Army Aviation Test Board in testing a number of flight training devices during the past eight years. From the human factors point of view, there is one overriding consideration in evaluating a flight training device: does the device produce learning of desired skills which can be shown to transfer to the actual flight situation? If this requirement cannot be met, all other aspects of the device—cost, maintenance, etc.—do not matter. The device must fulfill its primary function, that of producing useful skills that transfer.

The training device research program has been aimed at identifying those aspects or characteristics of devices which are critical

HumRRO personnel study the Whirlymite — a primary rotary wing trainer

to the transfer of training. Only when such relationships are understood and the training requirements are carefully analyzed can we be assured of receiving devices which will do their intended job at the least cost.

Several recent training device research projects are of current interest. In one, a study was conducted using a contact hovering trainer, the Whirlymite, for primary rotary wing training. This device—an actual, flyable, one-man helicopter mounted on a ground effects machine platform—produced a substantial reduction in primary flight attrition. USAPHS is purchasing 15 such devices for operational use in the primary flight program. In a second activity, HumRRO Division No. 6 developed, at the request of USAAVNS, an SDR (small development requirements) for a Synthetic Flight Training System (SFTS). This system of devices would be used, both at USAAVNS and in the field, for initial rotary wing instrument training, for transition training, and for maintenance of proficiency. The SFTS will incorporate such advances in simulation as modular concepts, digital computation, automation of many instructor functions, adaptive training, and automation of instruction programs. The possibilities of effecting substantial financial savings in connection with flight training and proficiency maintenance programs are of considerable importance.

The research activities described thus far have concentrated on observer and pilot training problems. The current year's program has seen the introduction of research on aviation maintenance training. Data collected by HumRRO Division No. 6 for the recent DA study of the Army logistics system pointed up a coming shortage of experienced mechanics, particularly in MOS 67N20. This shortage is occasioned by the rapid buildup in the inventory of UH-1 and OH-6 aircraft during coming years coupled with low reenlistment rates for aviation mechanics. In view of the critical role which the aviation mechanic plays in Army aviation, the research is aimed at developing techniques for maximizing the extent to which training is directly responsive to major field requirements. Without doubt, the aviation mechanic is one of the most important links in the chain of human factors which supports Army aviation operations, and research on maintenance training is of extreme importance.

The human factors research program does not treat only the problems related directly to training. A current study, concerned with the warrant officer aviator, lays heavy stress on the importance of various attitudinal and motivational factors in career planning. While this study also treats many aspects of warrant officer training, its concern with career factors introduces a new dimension in the HumRRO aviation research program.

The study of career factors illustrates the extension of human factors research to a broad personnel subsystem context. It also illustrates the fact that, while most HumRRO research is related to training and, hence, to school and USCONARC interests, the program is Army-wide in its orientation. Thus, the research effort is geared to requirements in addition to those of USAPHS, USAAVNS, and USCONARC. For example, HumRRO Division No. 6 provided the human factors input for the recent Combat Developments Command (CDC) study of aerial reconnaissance and surveillance systems for the 1975 time frame, TARS-75. Human factors inputs are routinely made to most CDC Aviation Agency documents and studies.

In the early days of Army aviation it was assumed that the factor which makes man unique, his great inherent flexibility and adaptibility, would allow him to overcome deficiencies in aviation training and systems design. However, as the overall systems and interactions with other systems have grown more and more complex, it has become increasingly necessary to plan for the human factor in the system. Otherwise, we will not take maximum advantage of human capabilities and will place requirements on the human component which cannot be met. The human resources of Army aviation are its most precious resources, and the human factor must be given preeminent consideration from the design of aircraft, through the selection and training of personnel, to the operational employment of Army aviation. These past 25 years have seen great strides in this regard; the next 25 cannot afford less.

DITCHING TECHNIQUES

Ditching Should Have As Many Or More Survivors Than A Forced Landing

IN 1960 a British study was published that included a summary of all reported free world helicopter ditchings up to that time. The study said: "Helicopters of the United States Army are rarely flown over water and there have been no cases of ditching by that service."

Since that report was published, we have become the world's largest user of helicopters and are now flying them more and more over large bodies of water.

We can no longer say we have had no ditchings. Between 1 January 1960 and 31 January 1966, we had 4 fixed wing and 5 rotary wing ditchings. Today every Army aviator can expect to be called upon to fly over large bodies of water and for this reason must know ditching procedures for his particular aircraft.

PREPARING TO DITCH

The time to prepare for the unexpected is not when it happens but before the event occurs. Likewise, the time to prepare to ditch is not in the air after it becomes necessary but on the ground before taking off. Most ditchings occur without warning. In these instances there simply is not enough time to think about everything that must be done to make the ditch a success.

Everyone on board the aircraft should know what he is to do and how it will be accomplished if it becomes necessary to ditch. The crew, of course, will have certain duties before and after the ditching, but passengers can be used as a backup in case one of the crewmembers is injured at impact. Helicopters are more likely to overturn in the water during the ditching sequence than fixed wing aircraft, so the occupants must prepare for this.

Passengers should be instructed in the use of all emergency equipment before the flight gets underway. This is especially important if the airport being used is like the New Orleans Lakefront where the aircraft takes off and lands over water. This is also the time to instruct passengers in the proper sitting position during the ditch. The Navy teaches that placing your back against the bulkhead, facing away from the direction of flight, is the best position. The Coast Guard advises that the best position for an individual obviously is strapped in a secure seat. A person in a forward facing seat equipped with a lap belt but no shoulder harness should bend forward and cover his head with his arms. If it is necessary to sit on the deck, padding between the person and bulkhead are recommended.

All passengers and crewmembers must be told that as soon as ditching becomes imminent they should remove from their person ties, eyeglasses, sharp objects, and any other items that might cause injury during impact. Crewmembers should also make sure that all toolboxes, cargo, and loose equipment are secured against impact forces encountered in a forced landing.

Before taking off the aviator should review the ditching characteristics of the aircraft he is to fly. Does it have good ditching qualities, or is it likely to nose over upon contact or sink into the briny deep within seconds? Will adequate emergency equipment be on board?

What about passengers on board? Will old people, wounded soldiers, women and children be on board who may not be capable of surviving in the water? Are life rafts available?

Obviously all of these things can't be considered in the few seconds you have in an emergency ditching situation. For this reason it's best to take a few minutes longer in making your preflight plan to review all these factors before takeoff.

Faced with an emergency over water, the hardest decision to make is whether to ditch or not. Often

Ditching Techniques

this decision is made for you by the aircraft engine just quitting, leaving nowhere to go but into the water. But at other times you will have to decide if you should carry on and risk the possibility of ditching without power or ditching while you still have control of the aircraft. The Coast Guard recommends that the following general rules be considered when ditching:

- Ditch while power is still available.
- Ditch in daylight if possible.
- Ditch beside a vessel if possible.
- If flying in the vicinity of a coastline or island, and a crash landing is inadvisable, ditch in the lee of land.

At that critical time you are the only person who knows the variables. About the best advice that can be given is that if you know you are going to have to ditch, you should do so when ditching presents the best chance of survival for you, your crew, and your passengers.

In making the decision to ditch or to fly as long as possible in hopes of getting nearer or reaching land, consider the difficulty of rescue. Are ships nearby that can make a rescue within minutes or is the ditching site far from help?

Then there are the weather conditions. Are the waves high and bad weather brewing? What is the temperature of the water and the air?

If land is near what about the terrain? Is it flat and relatively free of obstacles? Or is it mountainous or rocky, offering little hope of a safe landing?

During preflight planning a good suggestion is to break up the trip into half-hour parts and consider each part as a separate trip. In each part consider all the above factors as much as you can in advance. After deciding what your ditching policy will be in each part, stick to that decision unless something happens to drastically change the situation. For instance, the weather might worsen, causing seas that are harder to survive in, or the aircraft might catch fire making it necessary to ditch regardless of other decisions.

LIFE JACKETS AND RAFTS

Before starting off on a flight you should decide if it is necessary to carry overwater lifesaving equipment. Like the British report said, we operate in a land environment. Since we use our aircraft on short fields, they are comparatively small and have limited cargo space. We simply don't have room to carry lifesaving equipment all the time.

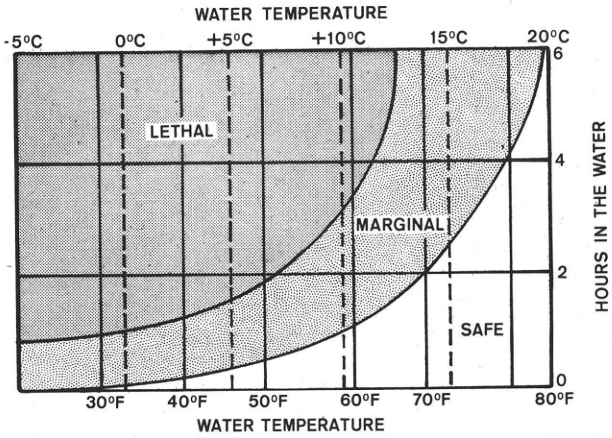
One trip report from Vietnam said that the pilot in Vietnam is subject to fly over water whether it was planned or not. The same might be true in any situation where the flight route is near water and weather is present along the flight route.

A good guide in deciding when to put overwater lifesaving equipment on board can be found in AR 95-1 and in the rules laid down for civilian aircraft. The council of the International Civil Aviation Organization (ICAO), of which the United States is a member, says that single-engined land plans should carry life jackets when flying more than gliding distance from shore. Dual-engined aircraft should carry life jackets when they are beyond 30 minutes from a suitable airfield that can be reached with only one engine. If a land plane is to be flown more than 90 minutes (single engined) or 120 minutes (dual engined) from shore, ICAO says that it must be equipped with life jackets.

The FAA requires that U. S. Civil Air Carriers provide individual flotation equipment for each person on board when operating over virtually any body of water. This includes takeoffs, landings, holding or en route operations. ICAO is formulating a similar rule. The FAA also requires carriers to carry life rafts on any flight beyond 50 miles from shore. The Coast Guard recommends that life rafts be carried whenever possible when flying any distance from shore. Numerous ditchings have occurred well within the 50 mile belt and studies have shown that without life rafts the survival rate drops off rapidly as distance from shore increases. One study of a 10-year record of ditching incidents indicates almost a 100 percent survival rate with rafts at a distance of 15 miles offshore, while without life rafts it was only 30 percent.

When an aircraft is ditched and the occupants do not have life jackets, their chances of survival are less than if they have life jackets. Of course, a lot depends upon the condition of the water. In

Figure 1. Survival in water



40° F unstable water, a normal man in the prime of life will become rigid in approximately 5 minutes and will probably sink if he has no life jacket (see fig. 1). Under identical conditions, but with a life jacket, a normal man can expect to live from 30 minutes to 2 hours in the water. Men past their prime and women and children are lucky if they can stay alive in the water for 30 minutes.

Of course there are exceptions to all rules. On record is report of a woman who stayed alive in 40° water for 13 hours without a life preserver.

In life rafts survival time may be stretched out into days. When survivors are provided with life rafts, there is a good chance of their coming through the ordeal. Without life rafts, the chance of surviving is much less even though life jackets are used.

SPOTTING OBJECTS IN WATER

It is very hard to spot someone floating in a life jacket even when the weather is perfect. If it is anything less than perfect, it may take hours for an aircraft to spot survivors after it has arrived on the scene. Survivors in a life raft are much easier to locate. Of course survivors in the water or in life rafts have a much better chance of being spotted if they have dye marking kits or other locating devices.

Weather conditions will, to some extent, determine the time it takes an aircraft to spot survivors after it has reached the general area. The type of aircraft used will also make a difference.

Chances of rescue within 20 to 30 miles of land are greater than those farther out in the ocean. But even here are some difficulties—such as muddy estuaries, fog, and poor visibility.

The Coast Guard feels that a radio is the most important single aid to a survivor in the water. This thought is based on the theory often advanced by survival experts that if a survivor is equipped with an operating homing and communicating device, he probably will be rescued before he must rely upon much of his survival equipment.

There is currently a DA approved small development requirement for an emergency beacon and voice transceiver. This radio will provide downed Army aircrew personnel with a means of transmitting homing information to Army aircraft on the VHF/FM frequency band and to Air Force and Navy search and rescue aircraft on the UHF/AM band and to Air Force and Navy search and rescue aircraft on the UHF/AM band. In addition this set will provide voice communications channels on both the VHF/FM guard channel (40.5 MHz, Mega Hertz) and the UHF/AM international distress frequency (243.0 MHz). The transceiver will replace the present standard AN/URC-10 radio set which is not compatible with the homing system in Army aircraft. The dual channel capability (VHF/FM and UHF/AM) will make the device compatible with communication/homing equipment on Army aircraft as well as that of other services. This equipment will be small and light enough to be carried comfortably in standard flight and fatigue uniforms so that when ejection, bailout, or evacuation becomes necessary it will remain with the crewmember. A limited buy has already been made. It will be designated the AN/URC 68.

GETTING HELP

One pilot who had to ditch said that he often felt lonesome while flying over large bodies of water, but not as lonesome as he felt when he had to ditch. And to tell the truth, he had good reason for feeling lonesome. The oceans are mighty big; there is much more sea area than land area.

In spite of the ocean's large size, help may be closer than it would seem. There are many thousands of airplanes flying and thousands and thousands of ships plying the waters. Those capable of assisting are required to change their course and assist those in trouble.

Before any of these can come to your rescue, they must know about your misfortune. If you are in contact with a ground station, tell them about it. If not, use the emergency frequency available in your particular aircraft. Most Army aircraft have UHF emergency 243.0 MHz and some have VHF emergency 121.5 MHz and HF emergency 8364 KHz.

At the earliest possible moment the pilot should request from ATC (or any radio facility) positions of ships in his area. The Coast Guard maintains a system (AMVER) for tracking thousands of ships in the Atlantic and Pacific. Specific information on ships in a given area can be provided in a matter of minutes. Merchant vessels can usually be contacted on the voice frequency 2182 KHz. U. S. Naval ships can be contacted on 243.0 MHz. Transoceanic aircraft should guard 243.0 or 121.5. In many areas —even well at sea—a Mayday issued on one of these frequencies will often be received by another unit.

If the emergency is near land, the aviator should head that way. If an airfield is close by he should head for it, but he should go to land first and then to the airfield. He should not take a longer route to land just because it is a route to an airfield. This is true even if the land is rocky and hilly. Ditching close to shore is much better than ditching out at sea.

If there is no land within reach and the emer-

gency occurs close to an ocean station vessel (OSV), head toward it. If you can't reach an OSV, attempt to reach any vessel in the area. If there is a choice, make it a naval or larger commercial vessel as these are better equipped to effect a rescue.

If no ships are in the area, head towards any airplane in the immediate vicinity. Of course, another land plane can't set down on the water and rescue survivors, but it may be able to drop life rafts and keep track of survivors until a rescuer shows up.

READING THE SEA

When flights are to be made over large bodies of water, part of the preflight should be devoted to sea evaluation, selection of ditching headings, and general ditching procedures. Once over the water reevaluate the sea and your ditching headings based on what you are now able to see first hand. After that reevaluate the sea continuously every half-hour leg of the journey as long as there is enough daylight to see.

To select a ditching heading you must be able to read the sea. Since the wind is largely responsible for waves, whitecaps, and foam, these can be used to determine the speed of the wind.

A rule of thumb says that when the sea is calm or with only small waves, the wind is from 0 to 20 knots. With many whitecaps the wind is 20 to 30 knots. When streaks of foam appear, the wind is from 30 to 40 knots. When the wave crests give off spray, the wind is from 40 to 50 knots.

In reading the sea also consider the swells. Swells are large waves that move steadily without breaking. There are two kinds—major and secondary. In between major swells are troughs or low areas. Secondary swells are found in these troughs. Since you are mostly concerned with the major swells, learn to distinguish them from secondary swells.

Major swells are, of course, larger than secondary ones; you can tell the difference by comparing their size. If you have trouble, go up to 2,000 feet or more and the major swells will be clearly visible. At times, the secondary swells are so small it is necessary to be at 500 feet to see them at all.

Even when there is no local wind, there may be swells generated by distant storms. Swells are the principal danger when ditching. Smaller secondary swells will usually be found running at angles to the larger or primary swell systems.

SEA EVALUATION AT NIGHT

As soon as the sun sets and the air begins to cool, a layer of fog may form on the water. In addition, there are no dark and light areas as you have on land to show up in the little available light.

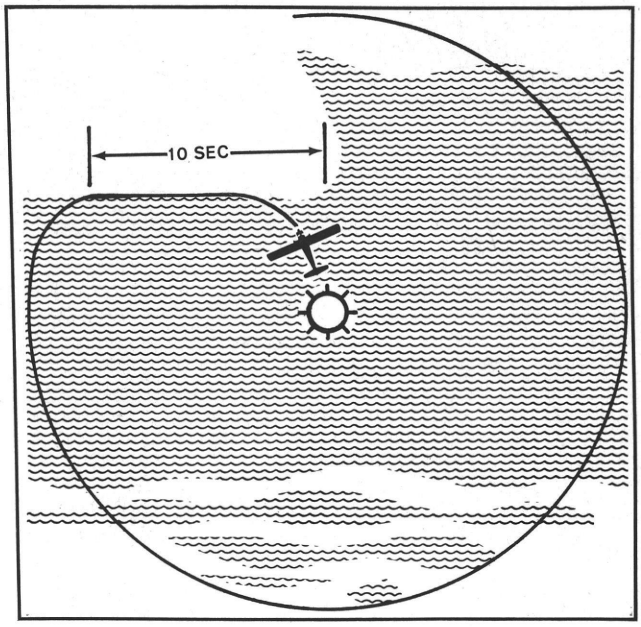


Figure 2. Circling Sea Evaluation

The best bet is to get the needed information from appropriate rescue units. But if this isn't possible, you will have to get the information some other way.

You can ask some nearby surface ship for the sea condition, but often no one on board knows how to figure a ditching heading. But they will know the speed of the wind and the direction of the swells. The rest you can figure for yourself.

Reading the sea by moonlight can be dangerous. The moon plays tricks on your vision while you are flying over water just as it does on land. All aircraft flying over water at night should carry flares which should be used even when there is a moon shining.

There are two acceptable ways to use a flare in evaluation of the sea. One method is called the "Circling Sea Evaluation" (see fig. 2). The parachute flare is set to ignite 300 feet below the airplane and dropped from 2,500 feet. After the drop turn 90° left and hold for 10 seconds. Then turn left again until the illuminated water is visible. Decrease the rate of turn and circle the flare. By circling the flare you keep it in sight until it drops into the water or burns out. It gives a long look at the water but since you are constantly turning, it makes the evaluation very difficult.

In another method—the "Teardrop Sea Evaluation," which is favored by the Coast Guard—this difficulty is eliminated but you have only a short time to look at the water. Again the flare is set to

ignite 300 feet below the aircraft and dropped from 2,000 feet. Continue straight and level for 45 seconds and then execute a standard rate turn to the left until you see the flare about 15° off the nose of the aircraft. You will be able to see it for the last minute of the turn and for about 40 seconds of the straightaway (see fig. 3).

When the flare first goes off, it will look as if it is burning just aft of the cockpit. Actually it will be several hundred yards away. Burning flares always look closer than they are, but play it safe and pass it to the side, well away from the aircraft. Don't look at the flare, but directly at the water. As soon as you pass the flare shift back to instruments.

These methods can be used either in fixed wing or rotary wing aircraft.

FIXED WING DITCHING

The key to successful ditching in a fixed wing aircraft is slow speed, optimum noseup position, and correct heading. If the airplane hits the water nose down it will tend to dive. In addition, the force of the water will cause disastrous impact loads.

The proper attitude for ditching varies with the type of aircraft. The Coast Guard advises that speed should be as slow as possible with good control and a low sink rate. The Army's -10s usually say "moderate nose high" or "nose high attitude." Some unofficial publications recommend 7° to 12°. But the noseup attitude can be overdone. If the airplane comes in with the nose too high, the tail digs into the water causing the nose to slam down hard.

Army airplanes with high wings are easier to land on water than those with low wings like the U-8 Seminole. This is because the wings often interfere with ditching at first contact. As far as the wings are concerned, the U-6 Beaver and U-1 Otter are good initial ditchers from the standpoint of their slow landing speed but they have fixed landing gear which cause them to nose over.

On the other hand, low winged airplanes like the Seminole tend to float longer. This is because the wings rest on the water, adding buoyancy and helping to stabilize the aircraft.

It is generally considered that airplanes like the OV-1 Mohawk, with wings slightly above the bottom of the fuselage are best for ditching. Their position is a good compromise between a high wing and low wing aircraft. Ditching capability of the Mohawk is so good that its -10 says: "The ditching capabilities of the aircraft (Mohawk) are such that in any emergency condition over water, when airspeed can be maintained, bailout may not be advantageous."

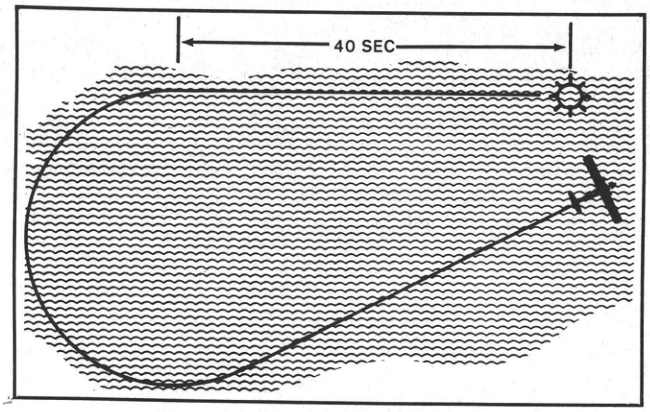


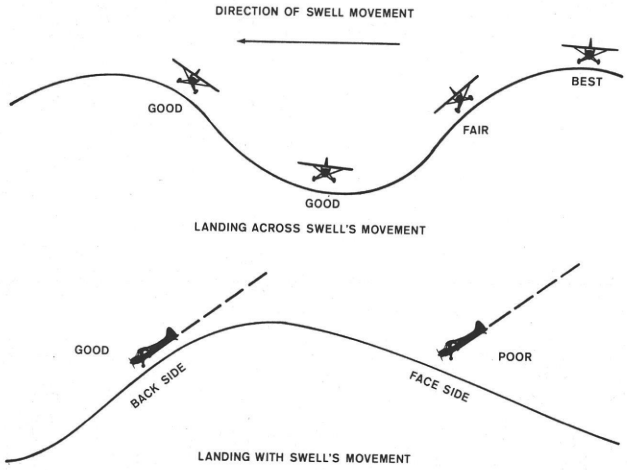
Figure 3. Teardrop Sea Evaluation

Army aircraft have an advantage over some of those flown by the other military services. For years we have purchased airplanes that land at slower speeds and have a short runout. Take advantage of this factor and ditch as slow as possible while maintaining adequate control.

Wingtip tanks in low wing aircraft can be a great help in planing during the water runout. They also add buoyancy, allowing greater escape time. The trouble is they must be empty or near empty. So burn out the fuel or transfer it to internal tanks if possible. Remember, however, the tip tanks might get knocked off or even cause the wing to shear if the water is hit hard. If one should come off, the airplane might roll over.

When ditching in the Seminole, Mohawk and other twin-engined airplanes, it is important that the thrust and aerodynamic drag be kept symmetrical. If there is partial power, it should be used to maneuver the airplane and reduce the rate of descent. If there is no power, the props should be feathered.

Figure 4. Landing on swells



Ditching Techniques

The first rule in ditch heading selection should be to land parallel to the primary swell in winds (see fig. 4) less than 25 knots. If there is only one swell system (rarely the case) this reduces the problem to landing in one of two directions. Generally the direction offering a headwind component, if any, is best. Where two swell systems are running, it is often best to land parallel to the primary and down the secondary, again disregarding the wind if less than 25 knots. One low-wing land plane ditched parallel to the swell with a 42 knot crosswind and encountered a very smooth deceleration. However, it is generally advisable to land into a wind of over 35 knots. In this case it's best to hit the water on the back side of the swell. Do not go in on the face side, which would be like trying to land uphill.

Of course, all of this is assuming that you have enough power to control or enough altitude to align your aircraft into the proper ditching heading. If you have no control, the above ditching headings are what you shoot for but may not reach.

NIGHT DITCHING

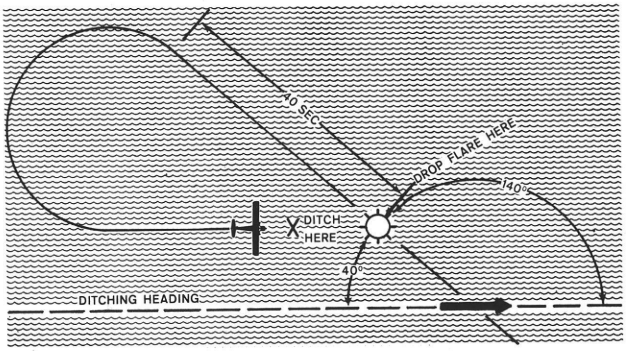
When ditching in the day or at night with illumination, descent can be broken by flaring with power, if you have it, just before hitting the water. But when it's dark and the water can't be seen, a power approach should be used to touch down if power is available.

Make a normal approach until you are within a few hundred feet of the water. Then establish a power approach with a sink rate of about 200 fpm, a nose-high attitude and with a speed sufficiently above stall to establish positive control. Do not depend upon the altimeter but be ready to make contact at any time; altimeters may be a few hundred feet off in mid-ocean.

Chop power as soon as you make contact with the water. If the airplane bounces, hold the control in the touchdown position. If it is a very hard bounce, use the elevator to keep the attitude constant.

If you have a flare to illuminate your ditching, the Tear Drop Self-Illumination Pattern is a good technique to use (see fig. 5).

Figure 5. Self-Illumination Pattern



ROTARY WING DITCHING

In one way the helicopter is an excellent ditching aircraft. It can enter the water with no forward speed at all. On the other hand, some helicopters will even roll over on their back and most will sink within seconds after touching the water. When they don't roll over on their backs, ditching in a helicopter can almost be a pleasant affair. One helicopter pilot who had to ditch at night said he entered the water so softly that he didn't know he had completed his ditching until the helicopter was almost completely submerged. "I just kept right on trying to fly the fool thing until I started breathing water."

When you are ditching under a controlled situation take advantage of one of the helicopter's good points. Just before touching water bring it to a hover. Open hatches and panels needed for escape. Launch the rafts and allow the passengers and crew to board them. Then move the helicopter downwind enough to clear the life rafts and ditch it. The survivors should then move their rafts to where you are and help you get on board.

The -10s give the proper pilot techniques for each type Army helicopter. Included is the proper side to roll the helicopter upon water contact if necessary. Every aviator should study these ditching techniques before flying a helicopter over water.

Although each type helicopter reacts differently when being ditched, there are certain general rules that can be followed for all of them.

All Army helicopters ditch better at zero speed. Also all of them should enter the water in a nose-high position. The -10s usually tell how much this should be. The best idea is to follow the -10.

There is still some controversy about rolling the helicopter on its side. One of the reasons this is done is to stop the rotors and prevent injury to those persons getting out of the helicopter. Most Army helicopters do not have rotor brakes and there is no other way to stop the blades.

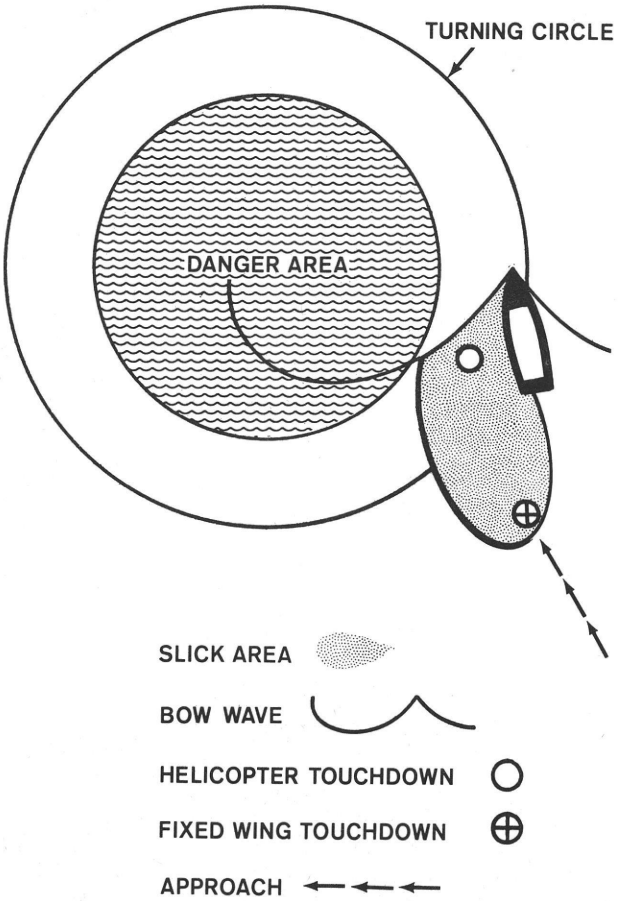
The old wooden blades sometimes would break off or shatter. This helped as it reduced the top heaviness of the helicopter. However, metal blades seldom break in the water. If the rotors are rotating very fast, they might cause the fuselage to roll over when the blades dip into the water.

If ships are present in the ditching area and there is time, ask for help in making a "cast recovery." This is a technique developed by the Navy back in the days when ships carried operating seaplanes. It is now considered an obsolete procedure but can be of some advantage to the Army aviator in helicopters and small land type airplanes.

When a ship makes a sharp turn in water, the centrifugal force causes water to surge upward from under the ship, which in turn makes a slick form off the inboard quarters (see fig. 6). This slick extends from 100 to 300 yards depending upon the size and speed of the ship. Army aviators will find an advantage in ditching in this slick area when the seas are choppy and when the ship is large and fast enough (in excess of 12 knots) to clear a wide area.

Evaluate the sea in the normal manner and select a heading. The turning ship will have little or no effect on the swells, but will smooth the seas superimposed on them. Consequently, less attention need be given to the chop as the ship largely flattens it.

Figure 6. Landing in the slick



When ditching an aircraft follow -10 instructions

The approach should be made to touch water close aboard the inside quarter of the ship at or just beyond the wake if the aircraft is fixed wing. Runout should be completed within the slick area before encountering the bow wave. Helicopters ditching with no forward speed should touch down just behind the bow wave to have the maximum time for clearing the aircraft before the wake appears.

Do not touch down on the central area of the turning circle. At this point the ship's bow wave converges and focuses in an "Archimedes' spiral" effect that culminates in an extremely confused and unpredictable situation which may result in unusually high and steep peaking seas.

Single screw ships circle best to the left while twin screw ships do equally well to the left or right.

AFTER DITCHING

After ditching, all personnel should immediately evacuate the aircraft. There have been some cases when an aircraft remained afloat for awhile but most sink rapidly. In cases where the aircraft has remained afloat, it has sunk very rapidly and without warning when hit by a large wave or swell.

It is quite normal for a person who cannot swim to want to remain aboard or cling to the aircraft as it's a sort of mother earth to him. This must be prevented at all cost as he will not have time to get out when the aircraft starts to sink.

If life rafts have been placed on board in preparation for flying over water, they should be launched as soon as the aircraft hits and before the passengers disembark. Do not inflate them in the aircraft. After launching they should be tied to the aircraft so they won't float away before they are loaded. However, use slip knots so that they can be quickly untied when the aircraft starts to sink. If possible, personnel should move from the aircraft directly into the rafts.

CONCLUSION

If you have studied the techniques of ditching and have provided yourself with the proper equipment, you can make a successful ditching. In a study of ditchings the Civil Aeronautics Board concluded that: "All factors being equal, premeditated ditching should have an *equal or greater* number of survivors than a forced landing on land, if adequate survival and rescue facilities are provided."

25th ANNIVERSARY CONTRIBUTION

AVLABS

Colonel Harry L. Bush
Commanding Officer
U. S. Army Aviation Materiel Laboratories
Fort Eustis, Virginia

WHAT WILL Army aircraft look like in the year 1980? Will it have wings or rotor blades, or neither? Will it have one engine, six, or more? What about speed? Will its speed be 400 knots? 800 knots? Faster? How many passengers will it carry? What kind of armor? Will it use a new type fuel? And will the aircraft itself be manufactured from new materials (such as boron, glass, or metal fiber reinforced resins) stronger, lighter, more dependable than those now used?

These questions are but a few of the fascinating problems that challenge the imagination and skill of a relatively small group of highly trained engineers and scientists who make up the first team of Army aviation research.

This group, with an authorized strength of 402, is known as the U. S. Army Aviation Materiel Laboratories — or AVLABS for short. It carries out its work quietly and without fanfare at Fort Eustis, Va. Also located here is the U. S. Army Transportation Center and Fort Eustis (USATCFE). AVLABS operates as a tenant class II activity, which means that its activities are separate and distinct from TCFE.

AVLABS is the R&D field organization of the U. S. Army Aviation Materiel Command (AVCOM) and reports directly to the commanding general of AVCOM in St. Louis, Mo. AVCOM, in turn, is a major subordinate command of the U. S. Army Materiel Command (AMC) in Washington, D. C. AVLABS, the Army's principal aeronautical research activity has been in business since 1942—and was created at the same time Army aviation came into being. In former years, when it also supported the Transportation Corps (TC) in all modes of transportation, it operated under such names as USATRECOM, TRECOM, TRADCOM, TRADS, TDES and the TC Board. In April 1964 it was placed under AVCOM. It has been called AVLABS since March 1965, and now devotes all its energies to Army aviation research.

But ever since 1942, the goal of this organization has been to find, develop and help put into operation new and better equipment to improve Army mobility.

The word "research" — which means to search again — is the key word in AVLABS' goals. To put it in official terms, "AVLABS' mission is to plan, organize, and conduct research, exploratory development, advanced development, and technology support to systems development in the field of subsonic, low-flying Army aircraft used in support of ground forces in combat." And there you have it—to increase the airmobility of the Army.

But what does AVLABS really do? What has it accomplished? What is it working on today that will increase the airmobility of ground forces in combat?

The first paragraph of this story offers a clue, because research in any field takes time. Research into areas well beyond today's capability may not materialize into actual hardware until 1980. On the other hand, research breakthroughs often occur — sudden new developments are made— and the lead time may be reduced from years to months.

AVLABS' nine technical divisions are hard at work on dozens of vital projects, but space permits mention of only a few. Some of these top projects include the Composite Aircraft Program (CAP), the regenerative engine, and emulsified fuel (safe fuel). In addition there are many small-

er programs, which are also considered vitally important to meet the constantly changing Army requirements to meet new conditions.

Major innovations and changes and improvements in any field simply do not just happen. Obviously, the Southeast Asia situation has dictated hundreds of new requirements, new needs. This new need or request may take the form of a change or an improvement on existing aircraft. Or, as often occurs, combat experience may see the need for an entirely new concept of an aircraft. After general requirements are set forth from the appropriate agencies, various ideas and new approaches are discussed in detail. From this beginning, new designs are created; often dozens are analyzed and evaluated before the field of contestants is reduced to what is considered the best (and feasible to develop) from a cost and time viewpoint.

COMPOSITE AIRCRAFT PROGRAM (CAP)

In the case of the CAP, Composite Aircraft Program, a whole new aircraft design was needed. Purpose: To develop the technology for a vehicle combining the efficient hover characteristics of a helicopter with the efficient high-speed cruise characteristics of a fixed-wing turboprop aircraft. Eight aircraft companies submitted initial designs.

From these eight submittals, three contracts were let for preliminary design studies of the most promising concepts.

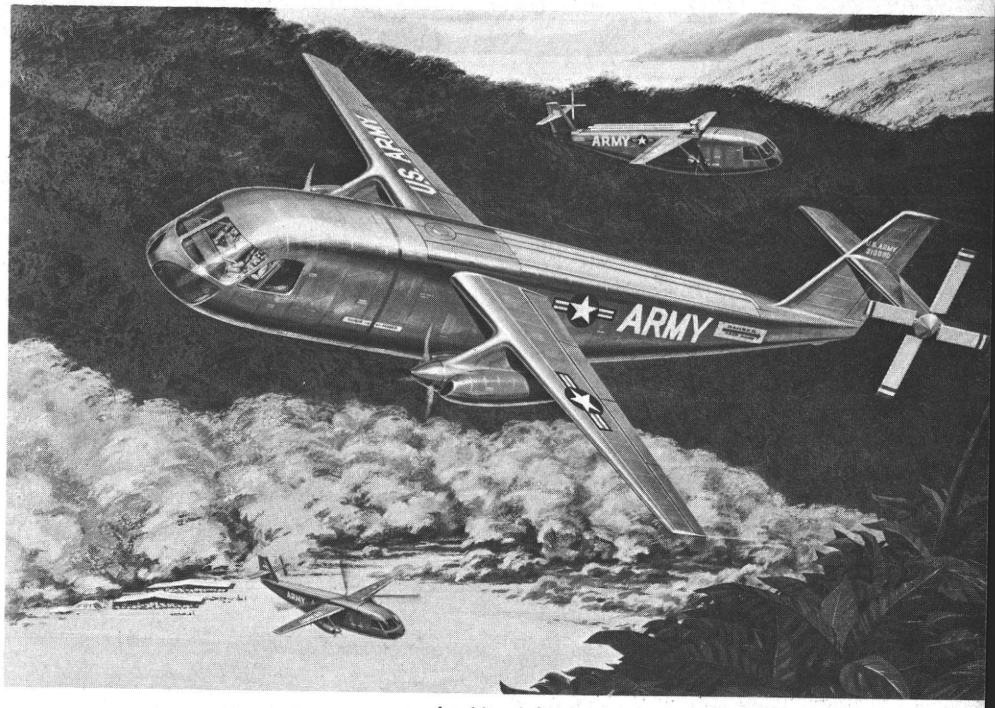
Bell Helicopter Company was to study the tilting rotor-prop concept; Hughes Tool Company to study the jet-powered stopped rotor-wing concept; and Lockheed-California Company to study the stopped/stowed rotor concept.

The *Bell* composite has a high fixed wing with a tilting rotor-prop at each wing tip. These rotor-props are used as helicopter rotors when pointed upward and as propellers when pointed forward. The engines are mounted inboard at the wing root. The aircraft has a tricycle gear.

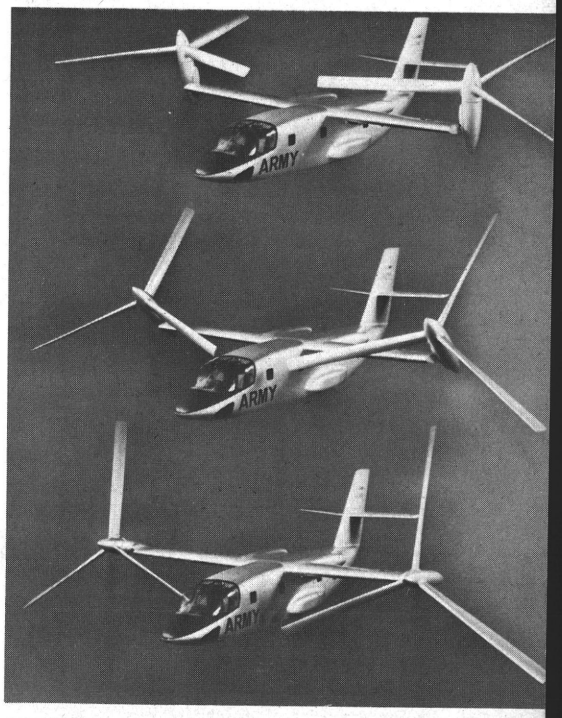
The *Hughes* composite has a jet-propelled rotor system which acts as a helicopter rotor for slow speed. At high speed, the rotor is stopped and acts as a fixed wing. The aircraft then flies as a conventional turbojet-powered airplane.

The *Lockheed* composite has a high fixed wing and a rotor which stops, folds, and stows for high-speed forward flight. It has a turboprop powerplant mounted on wing pylons for forward propulsion. The aircraft has a tricycle landing gear.

The Army has completed evaluation of these conceptual studies for a composite aircraft, and has awarded two contracts of $1,900,000 each to Bell Helicopter Company and Lockheed-California Company to continue the program.



Lockheed-California and Textron Bell have been awarded contracts under the Composite Aircraft Program. Above: Lockheed's "retracted rotor" design with the rotors stowed (center), retracted (above), and in operation. Below: Bell's tilt rotor concept in helicopter flight mode (above), midway through conversion (center), and after complete conversion to high speed flight mode



AVLABS test pilots are participating in CL-84 evaluations

AVLABS PILOTS TEST THE CL-84 V/STOL AIRCRAFT

AVLABS has its own group of assigned research test pilots who are called upon from time to time to give their evaluation on specific projects. One such project is the Canadair CL-84, a twin-engine, tilt-wing vertical and short takeoff and landing (V/STOL) aircraft undergoing a triservice (Army, Navy, and Air Force) evaluation to determine the aircraft flight characteristics, operational capability, and its suitability to perform a military mission.

T63 REGENERATIVE ENGINE

Aircraft propulsion systems are under constant research to make them more powerful, lighter, and to get the maximum performance out of the fuel used. It is this last goal, low fuel consumption, that now has the attention of AVLABS Propulsion Division engineers. For one of the current drawbacks of the small gas turbine engine is its high specific fuel consumption at aircraft cruise power settings.

Engineers know that lower fuel consumption results through the use of high turbine inlet temperatures and/or use of high compressor pressure ratios. But they also know that further reductions in fuel consumption can be obtained through the use of what they call "the regenerative cycle." The regenerative gas turbine engine uses a heat exchanger (regenerator) in the exhaust gas path to remove waste heat and return it to the compressor discharge air; thus less fuel is required to reach the scheduled turbine inlet temperature.

Regeneration can cut fuel consumption by 10 to 40 percent. The range depends on the level of heat exchanger (regenerator) effectiveness. Lower fuel consumption can result in these obvious but extremely important advantages:

- Reduced aircraft gross and empty weights.
- Reduced fuel logistical requirements to overseas theaters.
- Increased aircraft range capability.
- Increased aircraft payload capability.

To evaluate the installation problems and to seek actual aircraft experience, the T63 regenerative engine experimental flight test effort was started to determine first-hand just what a regenerative engine could do in an aircraft. Since 1960 the Army has researched various heat exchanger concepts, such as liquid metal, plate tubular U tube, miniature tubular, and the toroidal rotary types.

In July 1966, the Allison Division of General Motors ran tests with the first set of regenerators on a small helicopter engine. The first set of regenerators did not hold up as expected. So researchers tried again. Modifications were made based on the facts learned in the test, and tests were run again. This time the experiment was successful.

The regenerative T63 engine completed the 50-hour flight worthiness tests (FWT) in February 1967 with very satisfactory results. Aircraft modifications are now underway to install the engine in an LOH aircraft to compare its performance directly with the conventional engine installation. The flight tests are scheduled for September. Upon completion of these tests, AVLABS should have an assessment of the major installation and operation problems and advantages of a regenerative engine.

POSTCRASH FIRE

Of all possible threats to the survivability of an aircraft and its occupants, the one which creates more panic, causes the greatest number of fatalities, and is the most difficult to reduce or control is fire. Fires occur in only 10 percent of major Army helicopter accidents but are responsible for about 45 percent of all injuries and 70 percent of all fatalities.

The most frequent cause of aircraft fire is flammable fluid spillage which is caused by one of several factors: ruptured or torn fuel cells, severed fuel, oil, or hydraulic lines, or failure of fuel cell fittings. Two areas in which research is being conducted to control the flammable fluid spillage are fuel containment and fuel modification.

Goodyear Aerospace Corporation, under contract with AVLABS, has developed a new material that offers excellent resistance to tear and penetration

and indicates that sufficient knowledge now exists for achieving significant gains in fuel containment in the immediate future.

This material, coded ARM-021, consists of layers of high-strength nylon cloth that is laminated by use of standard polyester-polyurethane elastomer. The elastomer is primarily a surface bond between plies, and the cloth plies remain virtually dry. The material requires an appropriate fuel barrier on the inside and out. This material has shown its superior performance in enough tests to indicate that it will outperform all known crash-resistant materials by a considerable margin. Figures 1 and 2 illustrate the relative superiority of this material in both puncture resistance and impact tear over the typical crash-resistant fuel tank material.

Research is also being carried on in the area of improving the aircraft fuel transfer system to incorporate such concepts as self-closing lines, self-sealing breakaway fittings and frangible couplings. This is an attempt to minimize the threat posed from fuel lines during crash impact.

The concept of fuel modification involves modifying the normal liquid or free-flowing state of aircraft fuel to a consistency of an emulsion (similar to mayonnaise). Such a process will retard the release of large quantities of fuel in a pure liquid state, will provide controlled volatility and resistance to spraying and misting, and thus will prevent the rapid vaporization that usually occurs when fuel tanks rupture.

Research studies and tests of various JP-4 emulsion as means of reducing the flammable fluid fire hazard in aircraft have produced very promising results, some of which are as follows:

- Burning rate and propagation rate of JP-4 emulsions are much lower than those of JP-4 alone.
- Emulsions have successfully passed through gas turbine engine fuel injector nozzles and slinger rings, with little or no increase in pumping pressure required.
- Emulsified fuel has been burned in five gas turbine engines without modification to components of existing engine fuel and control systems.

The limited research conducted with emulsified fuel has been extremely encouraging; however, the major portion of required effort still remains to be accomplished. Both theoretical and practical work are needed before emulsified fuel systems can be considered for operational use.

In carrying out the Army aviation research mission, the commanding officer is supported by 13 key administrative and technical directors and nine technical division chiefs. In addition, AVLABS uses the research services of universities and industrial organizations, a majority of the major aircraft and engine manufacturers and other government agencies.

It appears there are quite a few cooks in the AVLABS kitchen and that is true. But each is an expert in his own field and through a well coordinated effort his talents are helping to mold Army aviation today and for 1980.

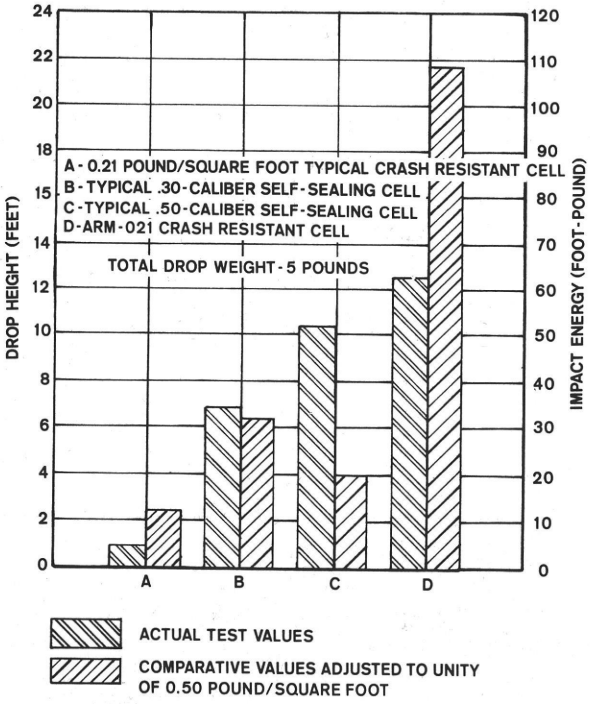
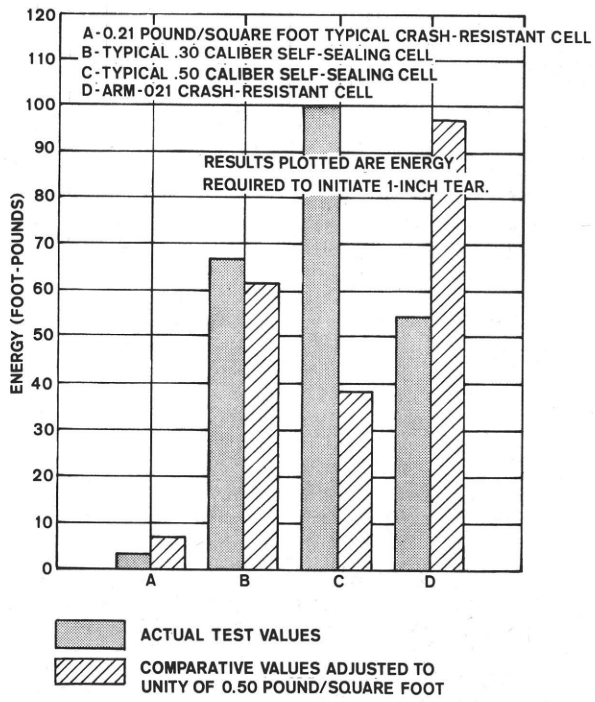


Fig. 1

Fig. 2



AIR MISSION COMMANDER (and a little luck)

Major Gordon T. Carey

THE WARNING order was similar to the 20-odd others we had received during the month of September. It was back once again to War Zone C in Tay Ninh Province. We were to lift a company of Civil Irregular Defense Group (CIDG) forces in a raid about 35 kilometers north of the city Tay Ninh. The force was to make a ground reconnaissance of the landing zone, take soil samples and provide information on the suitability of the area as a future base camp.

Two U. S. Army Special Forces advisors and two engineer soil specialists would go in with the assault, requiring a total lift of 94 troops. The airlift company to support this operation was mine, the 71st Assault Helicopter Company, 145th Combat Aviation Battalion. Time of attack was scheduled to be at first light with an estimated 20 minutes required on the ground to complete the mission. Reserve forces was one platoon of CIDG located at a Special Forces camp on the edge of War Zone C, 10 minutes flying time by helicopter from the landing zone.

Preplanning and coordination of the pickup zone, route of flight, tactical air support, reconnaissance of the area and location of the reserves was accomplished on the afternoon of the day preceding the assault. Briefing of air crews participating in the operation was accomplished at 2000 hours on D-1 to include issue of maps, overlays and the operations order.

In the predawn darkness on D-day, the 71st Assault Helicopter Company arrived at Tay Ninh city airport, the pickup zone. The company consisted of twelve UH-1D and four UH-1C helicopters organized into an assault element of ten troop carriers, one command and control (C&C) helicopter, one maintenance heli-

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copter and two light fire teams.

The C&C helicopter departed with one light fire team and arrived over the objective area as three F-100 tactical fighters were rolling in on their first flying passes.

On board the C&C were myself (air mission commander), my operations officer, the Vietnamese CIDG commander (airmobile force commander), his operations officer, the U. S. Special Forces team commander and one U. S. Special Forces captain as an observer. Neither an artillery liaison officer nor an air liaison officer was aboard. The objective area was beyond the range of friendly artillery so no artillery liaison officer was required.

The forward air controller was in a separate aircraft in constant radio communication with the C&C helicopter and could perform the duties of the ALO if required. He reported that the fighters were receiving light automatic and semiautomatic fire on their initial passes, but as the prestrike continued the ground fire ceased.

The flight leader of the assault element checked 5 minutes from the landing zone and the fighter strikes were terminated. The light fire team orbiting with the C&C helicopter was ordered to prestrike, recon, and mark the landing zone for the assault element. The fire team leader reported receiving light ground fire during prestrike and reconnaissance. Assault elements were now one minute out on final approach for the landing zone and receiving light ground fire as they started their descent.

I gave the order for full suppressive fires in and out of the landing zone. Maximum fire was placed below the approach path by the door gunners and escorting light fire team while the prestrike fire team continued to suppress the landing zone.

He was hit, on fire, going down!

The assault was accomplished and after 7 seconds on the ground trail, the aircraft commander advised lead that the troops were out and the flight departed the landing zone. As the aircraft were leaving the ground, two aircraft commanders reported receiving enemy fire. Ten seconds later, as the rear of the formation was clearing the trees on the departure end of the landing zone, the aircraft commander of the trail aircraft stated his aircraft was hit, on fire, and going down. An emergency landing was made in a clearing in the dense jungle about 500 meters from the landing zone. The fire was extinguished immediately and the four-man crew established a perimeter of defense.

I ordered one fire team to cover the downed aircraft and one fire team to cover the landing zone. The maintenance aircraft was to land and assist the downed aircraft and the first four troop carrier aircraft to proceed directly to the Special Forces camp, pick up the reserves, and return them as a security force for the downed aircraft.

Within 5 minutes the maintenance officer reported that the downed helicopter had been hit by automatic weapons fire, there were holes in the fuel cells, and the tail rotor to include the tail rotor gear box was missing. Two maintenance personnel were assigned the mission to rig the aircraft for a sling recovery, while the remaining five personnel aboard the maintenance aircraft reinforced the security perimeter.

At this time, I requested the forward air controller to obtain additional fighters for air cover and I called "Loadmaster" for a recovery CH-47.

In rapid succession, the fire team leader reported he was receiving and returning automatic weapons fire on three sides of the downed helicopter approximately 200 meters from the perimeter. The U. S. advisor in the landing zone reported that except for a few sniper shots there was no enemy contact and that they would be ready for pickup in about 5 minutes. The flight leader at the reserve pickup point advised that the reserves were not ready to go and he anticipated that it would be an additional 20 minutes before they could be assembled and depart.

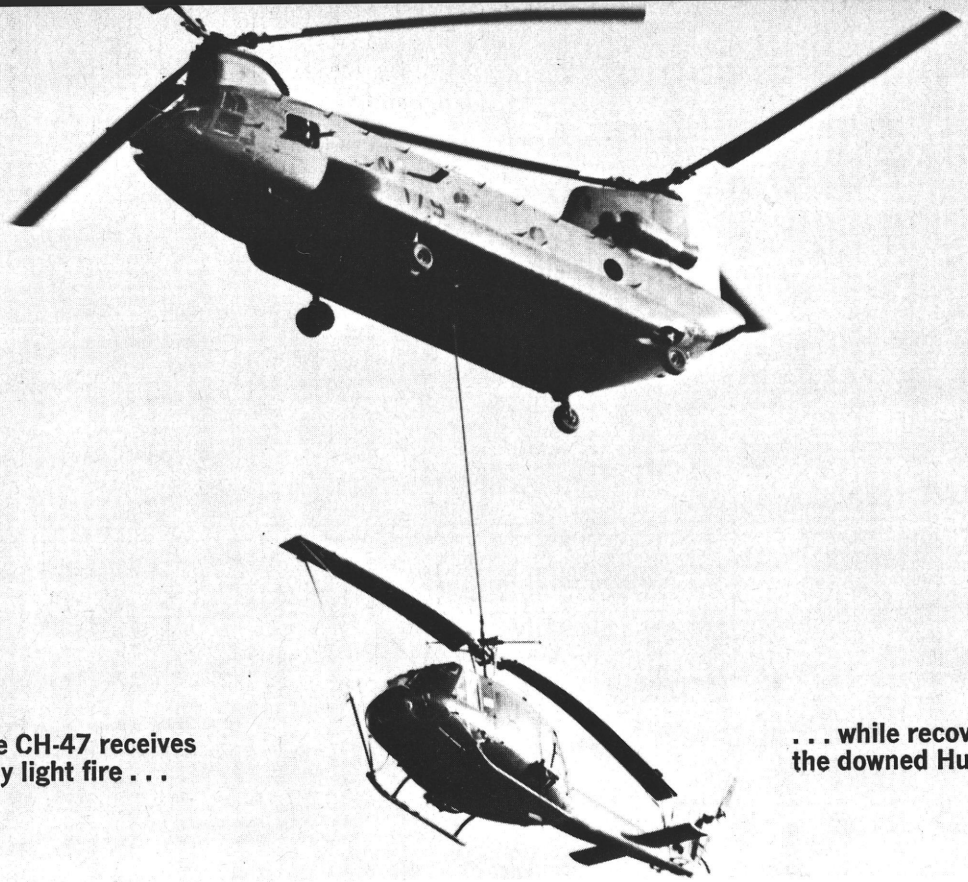
The fire team leader observed enemy fire was now about 100 meters from the downed aircraft. The U. S. advisor in the landing zone reported his forces ready for pickup, and the senior advisor aboard the C&C suggested we destroy the downed aircraft and everybody get out of there. No comments were made by the Vietnamese commander.

I rejected the suggestion to destroy the downed aircraft and ordered the five orbiting empty troop carriers to return to the landing zone, pick up one-half of the landed force and deposit them in the clearing with the downed chopper as a security force. The U. S. advisor in the landing zone was so informed and instructed not to load the soil specialists on the landing aircraft.

At this time, "Loadmaster" came on the air and advised that a CH-47 was being dispatched from Phu Loi and should arrive in 30 to 40 minutes.

The flight leader at the reserve camp was instructed not to wait for the reserves but return immediately to the objective area.

By this time one-half of the ground force had been landed at the downed ship and a good perimeter of defense established.



The CH-47 receives only light fire . . .

. . . while recovering the downed Huey

The five helicopters that had ferried this force were instructed to return to the landing zone, pick up the remaining forces and deliver them to Tay Ninh.

Since the fire team covering the downed aircraft was almost completely expended, it was ordered to return to Tay Ninh with the five troop carriers, refuel, rearm and return as quickly as possible. The fire team that had been covering the landing zone now assumed the mission to cover the security forces.

The four empty troop carriers arrived from the reserve camp and were placed in a high orbit as an emergency extraction capability if the situation so dictated.

"Boxcar," the CH-47 from Phu Loi, reported estimating our position in 20 minutes.

The forward air controller advised he had three A-1E fighters inbound and would be on station in 5 minutes.

The fire team on station reported all rockets and 40 mm expended and could now support with machineguns only. Two areas of moderate enemy fire about 100 meters from the perimeter were pinpointed for the forward air controller. As the A-1Es came in, the fire team was pulled out and the fighter strikes placed on these areas.

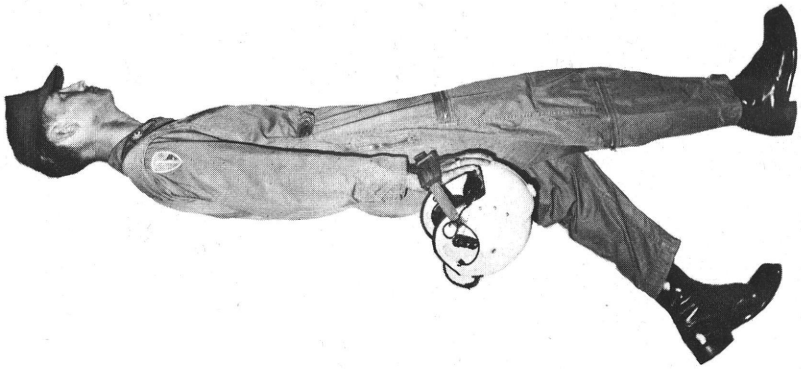
"Boxcar" was now 5 minutes out and the fire team from Tay Ninh was en route back. having solicited the aid of the "slick" crew in refueling and rearming.

The fully armed fire team escorted the recovery CH-47 into the clearing and the empty fire team was sent to Tay Ninh to rearm. Still no contact with the enemy by the security forces.

A normal sling recovery of the downed aircraft was made by the CH-47 while receiving only light enemy fire.

The five troop carriers from Tay Ninh now arrived. I determined that seven aircraft would be needed to extract the total security forces on the ground, since the high trees around the clearing would not permit maximum loading. The maintenance aircraft was ordered out of the clearing and the security force alerted for pickup by seven helicopters.

Two of the four helicopters that had been orbiting as an emergency extraction force were told to join the five that had recently returned from Tay Ninh and, with escort, were sent in for the pickup. Extraction was completed under light to moderate enemy fire. The light fire team and the A-1Es then saturated the area with rockets, machinegun and 40 mm fire. All elements returned safely to Tay Ninh with almost half of the force flying on the low fuel warning light.



FOR AVIATORS ON THE WAY UP

↑ ↑ ↑

ARMY AVIATION COMMAND & STAFF OFFICER COURSE

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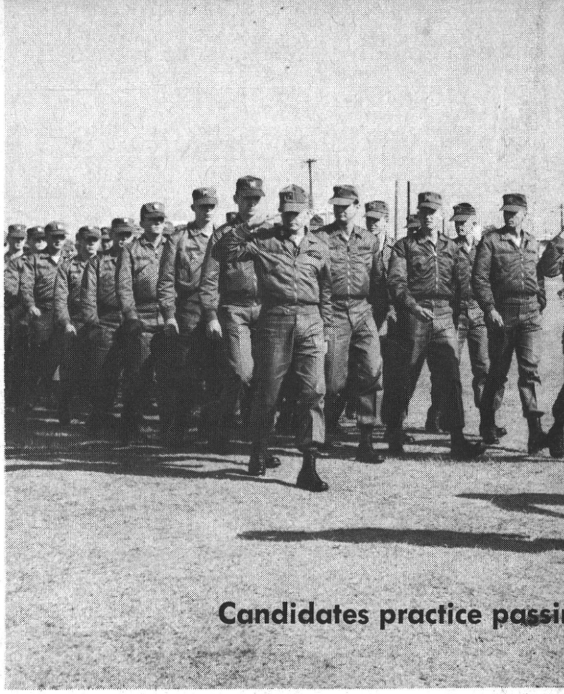
Fort Rucker, Ala. 36360

Warrant officer candidates learn in classrooms like the one above where an NCO conducts a technical maintenance course and in the aircraft such as below where a candidate uses a sight to aim Huey weapons systems



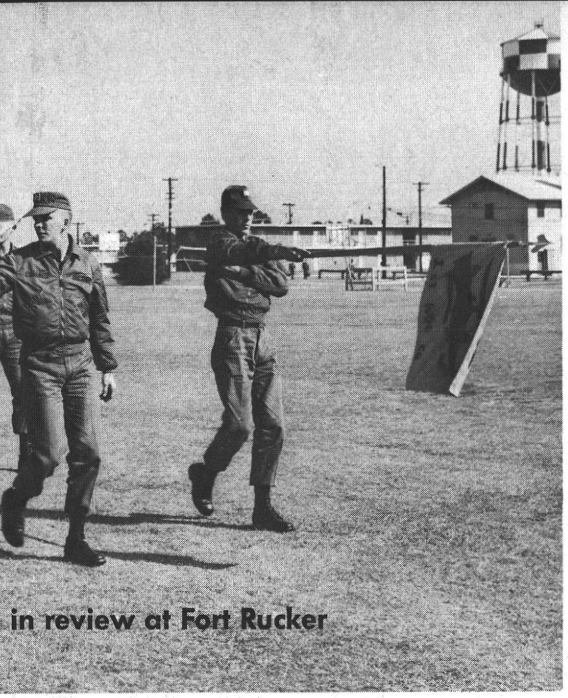
Candidates practice passi

Warrant Off
—Fort R

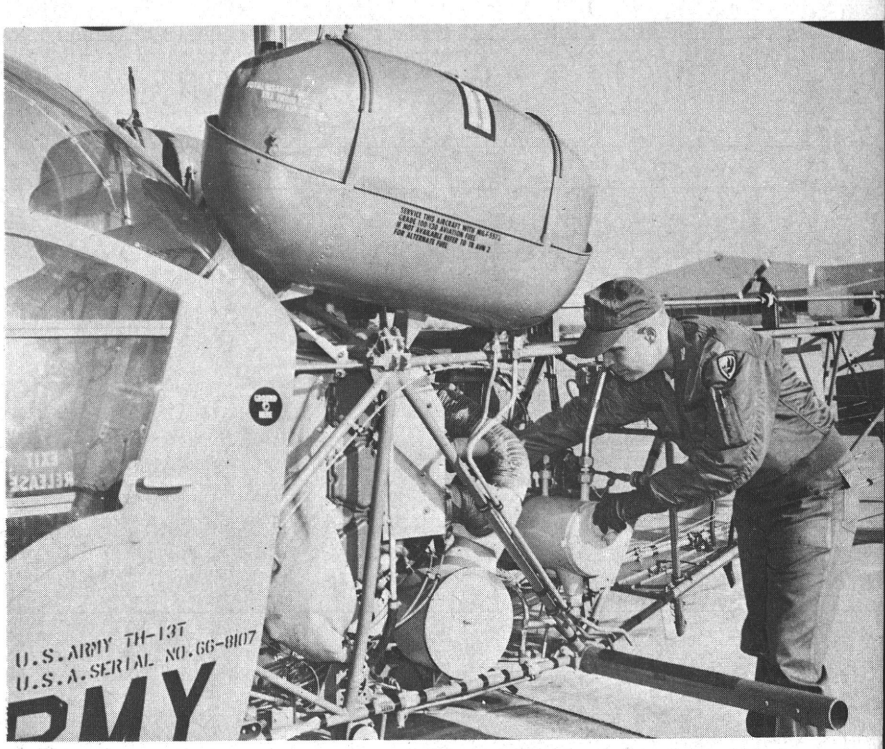
"There's nothing to it now. They have with quantity." Some graduates of the have been heard making such stater Warrant officer candidates are not onl respect to grasping the academic and ize the importance of self-discipline a

Captain E. R. Downing, Jr

WHAT IS A WOC? Not something you frow at a wabbit! Warrant officer candidate is the spelled out version of the abbreviation. Some alumni of the program will extend the definition into greater detail and say that a "WOC is a nervous, ill-tempered, harassed, underprivileged individual who is undergoing transformation from an enlisted man to a warrant officer,



in review at Fort Rucker



A candidate soon learns that a thorough preflight is absolutely essential (above). He also meets the other side — which includes full instruction in such areas as protocol, Army social life and military bearing (below)

cer Training
ucker Phase

one away with quality and replaced it arlier days of the warrant officer program nts, which in reality are entirely untrue. now exposed to a greater burden with ght instruction, but also are made to real- self-responsibility

nd Captain C. R. Ledford

and simultaneously learning to operate a flying machine."

The Warrant Officer Candidate Battalion at Fort Rucker has learned that the above statement is true, but it has arrived at its own definition, based upon daily contact with the candidates. A WOC is a soldier between the ages of 18-30 years who has an above average mentality, is a superior specimen of human

Candidates are issued complete sets of reference publications

physical fitness, and desires to become a warrant officer and an Army aviator, not necessarily in that order.

He has demonstrated the necessary motivation and leadership potential to merit recommendation first by his commander and second by a board of officers convened to evaluate his potential to the Army. He lives in a constant state of criticism and praise, both from the tactical staff who are responsible for molding him into a warrant officer and the flight instructors who are imparting to him aviation instruction that is second to none in the world today. He will always be found somewhere en route between takeoff as an enlisted man and touchdown as a warrant officer and an Army aviator.

By the time the candidate arrives at Fort Rucker, he has already undergone four rugged weeks of preflight, including study of all basic military subjects, and four months of primary flight training at Fort Wolters, Texas. At Wolters he is introduced to the candidate program, the tactical officers, who are themselves products of the WOC program, the student chain of command, and the established routine of a military organization. Constant pressure is applied at Wolters to develop leadership traits while learning the operation of the TH-55 or OH-23 primary helicopter trainer.

Upon graduation from Wolters, the candidate is sent on to Fort Rucker to receive additional instruction in basic and advanced instruments, UH-1 transition, and a tactics phase of training which exposes the candidate to every conceivable type mission within the capabilities of Army aviation. The flight departments deal with this tremendous task of teaching the candidate the necessary skills for him to take his place among the world's finest aviators.

What happens to the leadership training upon arrival at Rucker? This is where the Warrant Officer Candidate Battalion comes in.

MISSION: To qualify selected personnel to be warrant officers in the reserve component of the United States Army and for them to be capable of performing duties appropriate to their grade. To determine the applicant's stamina, will, motivation, physical qualifications, potential as a warrant officer, and to give an indoctrination in basic military subjects; perform command, administrative, and supply duties for all personnel assigned; recommend those candidates who are fully qualified to be appointed to warrant officer upon completion of fixed or rotary wing training.

Simple, huh? A widely scattered misconception is that the WOC Battalion is here for housekeeping chores alone. Yes, part of the mission is to billet, feed, and provide the most dedicated officers and NCOs, who realize that the warrant officer is the backbone of Army aviation; the battalion could let it go at that. However, the 18-year-old soldier who enlists for the WOC program is not going to be capable of filling the highly skilled and technically qualified ranks of the warrant officer aviators without additional assistance, guidance, and development from the staff at Fort Rucker.

Some graduates of the earlier days of the warrant officer program have been heard to say, "There's nothing to it now. They have done away with quality and replaced it with quantity." This is entirely untrue. Warrant officer candidates are not only now exposed to a greater burden with respect to grasping the academic and flight instruction, but are also made to realize the importance of self-discipline and self-responsibility.

No longer are a tactical officer and tactical NCO assigned to a section to supervise and control the daily functions of the candidate. He has been thoroughly exposed to this at Wolters. He now either has to face up to the realization that he soon will be a warrant officer and must assume the obligations and responsibilities commensurate with that rank, or withdraw from the program. Classes have increased to a monthly output of approximately 275

CPT Downing is CO, 1st WOC Company, Ft Rucker, Ala.
CPT Ledford is CO, Enlisted Student Casual Company, Ft Rucker, Ala.

while the permanent staff has remained the same. There is no one at Rucker to lead the candidate by the hand, to point out his mistakes and show him the way. All that should be behind him, and is in most instances.

Each warrant officer candidate company within the battalion has assigned to it four tac NCOs. These NCOs are assigned to two sections of candidates (approximately 80 men) and are available to the candidates for assistance 24 hours a day. The "on the spot correction" is the primary tool of the tac NCOs here to fulfill their mission of channeling the WOCs toward becoming WOs. Additionally, they are the unit commander's liaison with the candidates to ensure that proper standards of military courtesy, military bearing, and performance in the chain of command are maintained.

The tactical staff is augmented by the assignment of advisors or counselors. These are warrant officer aviators who have full-time primary jobs as flight instructors, academic instructors, or staff assignments and are assigned on the basis of one per section (approximately 40 candidates) as an *additional duty* to provide guidance, assistance and counseling to the candidates in the daily routine functions of the chain of command, academic and flight instruction. Their burden is greater than that of the OCS or Wolters tac officers in that it is an additional duty.

These advisor counselors are a unique group, and this system is not used anywhere else in the Army. They are the mainstay of the program. They have been through it. They are familiar with the candidates' problems and usually have an answer for them in any given situation. All are dedicated, devoted individuals who have a personal interest in seeing to it that only those candidates who are fully qualified make the grade. Their personal interest stems from the fact that they are proud to be members of the warrant officer corps and desire that the standards of its membership be maintained in accord with the highest traditions of the service.

The 18-20 age group are the primary target for the tactical staff. They all meet the prerequisites for the course, which are high by any standards. But these younger candidates require much more attention than do the older soldiers in the program who are familiar with military life. The younger ones must be trained, encouraged and developed into warrant officers who can assume the responsibility associated with varied technical positions to include maintenance, supply, mess and other additional duties which are common throughout aviation units, with a minimum hesitation, doubt, and loss of efficiency.

Every effort is made to expose the class to typical situations they may expect to encounter in routine assignments after graduation. Every man, regardless of previous military experience, serves a two-week period in the chain of command in some capacity, from a squad leader through company commander. Upon completion of his tour of duty, he is rated by his peers in accordance with established procedures. He is made aware of either his satisfactory or unsatisfactory performance, is counseled regarding what he might do in future tours to improve performance, and is given an opportunity to express himself in self-analysis and evaluation.

In addition to all this, while he is at Fort Rucker the candidate company must ensure that the candidate is fully qualified, in accordance with existing regulations, to be shipped overseas. The candidate is qualified with the .45 pistol, is sent through a gas chamber exercise, receives instruction on protocol and Army social life, and has an overseas orientation to include emphasis on personal affairs.

The flight from an enlisted status that terminates with the award of a pair of brown and gold bars and a set of shining wings is a treacherous one, filled with the many pitfalls of a candidate's own weaknesses. It is pockmarked with hurdles that will stifle the initiative and enthusiasm of all but the most motivated individuals. The lust for flying, a determined will, and a never-ending dream of joining the ranks of the Army's finest is the steed that carries the successful WOC to the graduation ceremonies.

The end product is a direct result of the professionalism and pride in performance that each of us demonstrates during the embryo stage of a candidate's development.

Responsibility of rank is exemplified through a change of command ceremony

crash sense

the following 28 pages prepared by the United States Army Board for Aviation Accident Research

EMERGENCY LANDING TECHNIQUES IN HELICOPTERS

Gerard H. Bruggink

FOREWORD

Colonel Warren R. Williams, Jr.

THIS ARTICLE IS designed to assist helicopter pilots in making successful emergency landings under the most adverse conditions. The guidelines presented are based on accident experience. They should not be interpreted in any way as interfering with established procedures in aircraft handbooks. What Mr. Bruggink has written is designed to supplement rather than replace handbook procedures.

The first section of this article contains information on the crash dynamics of fixed wing airplanes. This was included to give helicopter pilots a more complete understanding of crash safety concepts. In every other respect, the contents of this article are oriented toward helicopters—especially the single engine, single rotor helicopters.

Since this article is the first known attempt to acquaint helicopter pilots with all pertinent aspects of crash survival, it is obviously subject to improvement. Comments dealing with proposed changes, deletions, and additions are solicited, particularly from pilots who have hard-earned experience to share with their colleagues. All correspondence should be directed to: Director, USABAAR, ATTN: Chief, Prevention Branch, Fort Rucker, Alabama 36360. Direct communication is authorized by AR 15-76.

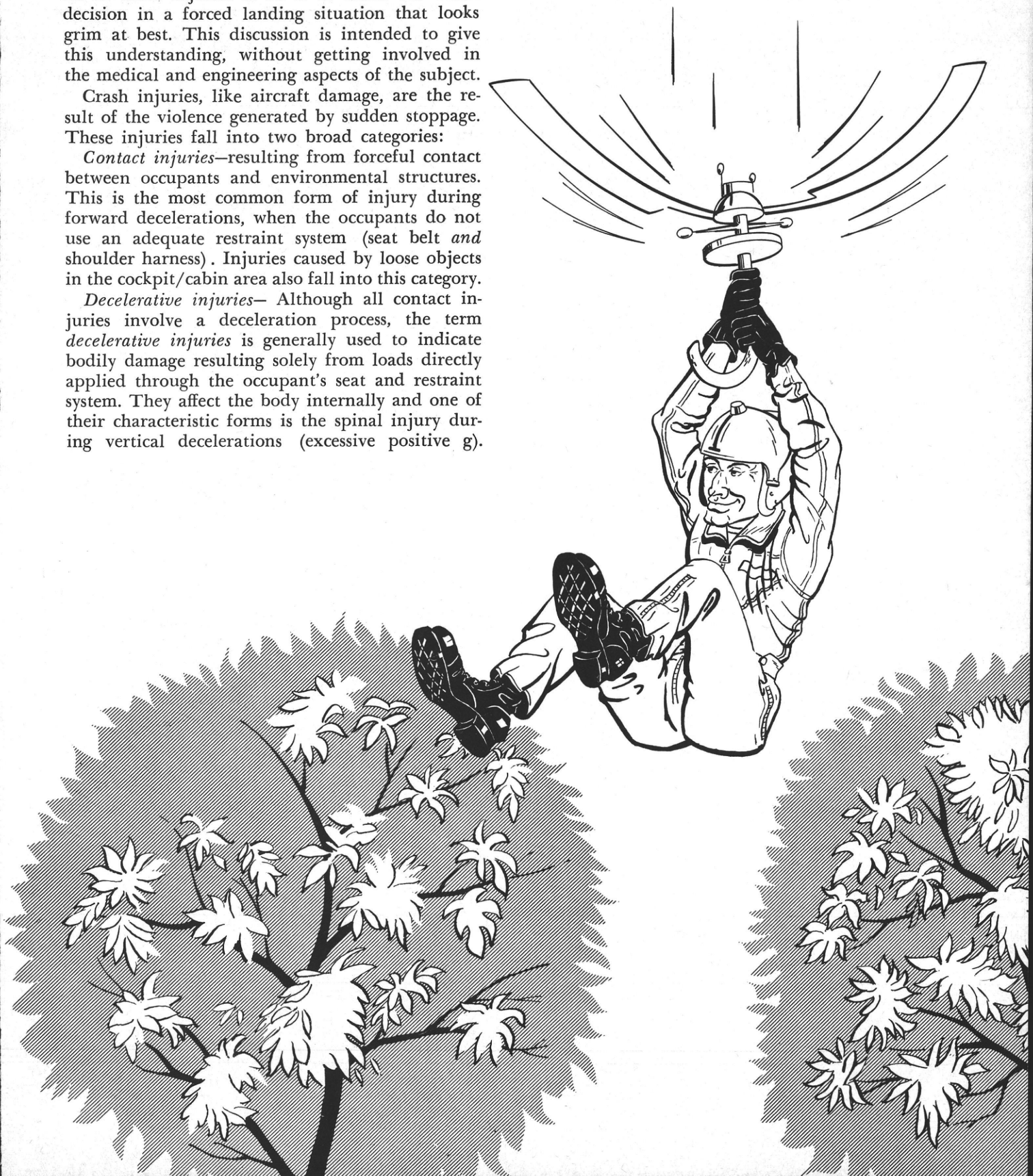
CRASH SAFETY CONCEPTS FOR PILOTS

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. This 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. These injuries 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.

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 their characteristic forms is the spinal injury during vertical decelerations (excessive positive g).



EMERGENCY LANDING TECHNIQUES IN HELICOPTERS

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 . . .

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° 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 form postcrash complications form a separate category. Fuselage distortion and final aircraft attitude may interfere with the timely evacuation of the wreckage in case of fire or during ditching. Although this hazard can be controlled to some extent by the design of fuel systems and emergency exits, it is mainly the pilot's landing technique and his knowledge of the aircraft that govern the postcrash survival aspects.

The violence of the stopping force, expressed in g's, depends on speed and stopping distance. The total energy of motion—crash energy—is a function of groundspeed and varies as the square of the velocity. Example: Assuming a 20 knot wind, an airplane with a 60 knot stalling speed could be landed with a groundspeed of 40 or 80 knots, depending on landing direction. Under normal conditions, the downwind landing would require four times as much rollout distance as a landing into the wind, assuming similar braking action. In a crash situation, the same 4 to 1 relationship holds true for the total crash energy.

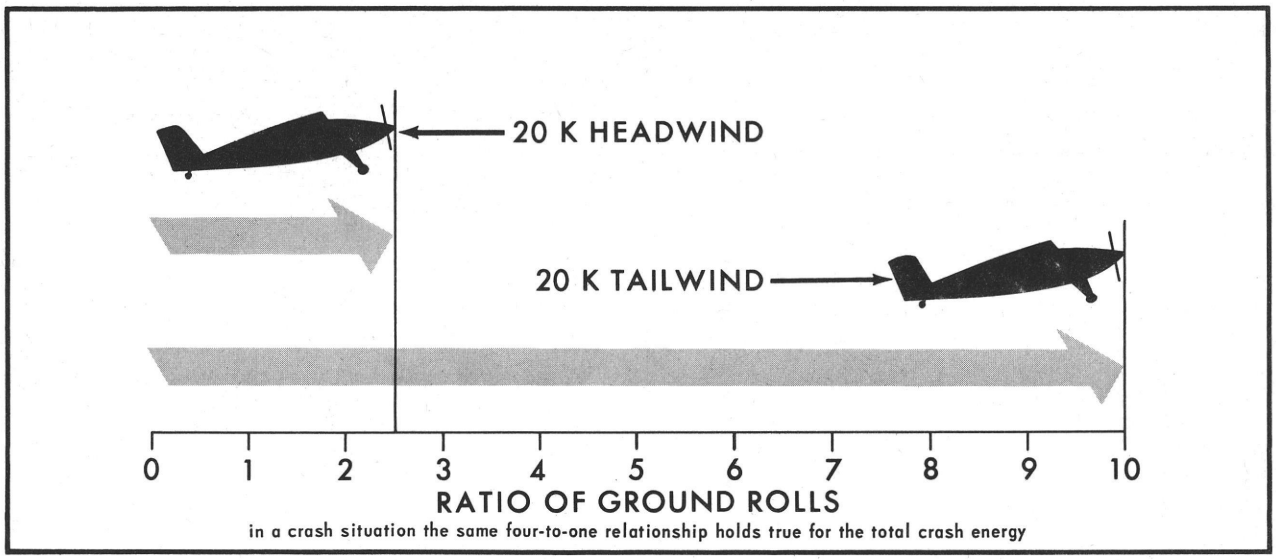
Speed in itself is not a killer. The danger lies in how it is dissipated. A common misconception in this respect is that it takes hundreds of feet of obstacle-free terrain to make a survivable crash landing. Theoretically, it would take only 20 feet to decelerate from 100 to 0 knots at a tolerable level of about 20 g's, *if the stopping force could be applied uniformly over this distance.* The same uniform deceleration (20 g) would bring an airplane to a stop from 60 knots in a distance of about 8 feet. 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 inclosure as a protective container and try to keep this container reasonably intact by instinctively avoiding direct impact against it. Accident experience and full-scale experimentation have shown 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 has met the first requirement for impact survival.

The second requirement is that occupants should participate as closely as possible in the deceleration of their immediate environment by means of their support system (seat, seat belt, shoulder harness). Any time an occupant's body — or any part of the body — is allowed to gain velocity with respect to the environmental structure, serious body blows may be expected.

Disregard for this basic law of physics kills thousands of car drivers every year in front-end collisions. Even when he is using a seat belt, the driver's upper torso and head may gain 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 1 foot. Assuming the deceleration is uniform, a 1 foot stopping distance for the cockpit behind the nose results in a mean deceleration of 13.6 g (formula used: $g = .034 \frac{MPH^2}{S}$ – stopping distance, S, in feet). The pilot, who is not using this shoulder harness, jackknifes over his seat belt, striking his head on the instrument panel. Assuming that the panel has 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 one inch, the effective stopping distance of the pilot's head will be 1/12 of a foot. This will result in a head impact of about 164 g's, or 12 times that of the overall cockpit deceleration. Depending on the shape and hardness of the head impact area, and whether or not a crash helmet is worn, this could easily be a fatal blow.

In addition to understanding the reaction of aircraft structures to crash loads, pilots must have a general knowledge of the reaction and tolerance of the human body under these conditions. The notion that there is a similarity between the human tolerance to g loads resulting from flight maneuvers and the tolerance of g loads imposed in crash-type decelerations should be discarded. Flight loads are of long enough duration to affect the blood circulation, for which the body has a very limited tolerance. Unconsciousness may occur at about 4 to 6 g's. 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 g's positive (parallel to the spine) and over 40 g's 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 g's. 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 airplane always involves forward velocity (groundspeed). Naturally, the pilot should aim at the lowest practicable groundspeed, *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 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 airplanes – 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,

EMERGENCY LANDING TECHNIQUES IN HELICOPTERS

. . . as far as impact survival is concerned, only the forces transmitted to the occupants' area are critical . . .

such as fuel spillage and fire.

For single-engine airplanes 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 terrtain.

The horizontal deceleration of freely sliding wreckage is very low. On a smooth hard surface, such as a runway, the stopping force is proportionate to the coefficient of friction and, therefore, always less than one g. However, at initial impact, this horizontal stopping force has to be multiplied by the vertical g load resulting from the 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.

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 these 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.

Rotary Wing Crash Dynamics—Where the fixed wing airplane'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 alleviate 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 respect is—*The worse the terrain, the more important it is to reduce the forward velocity of touchdown.* Since a zero groundspeed touchdown requires more finesse, it would be unwise to use this technique when terrain permits a running touchdown.

What are the peak g levels in a typical accident situation? A zero groundspeed 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 24-40 g's (based on an effective stopping distance of about 4 inches). 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 on hard terrain were made with forward groundspeed, a peak horizontal deceleration in the order of 15 to 25 g's 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. To avoid undue concern, it might be well to note that a 1,500 fpm touchdown at zero groundspeed on soft terrain that allows 1 foot of additional vertical stopping distance would not have injurious effects.

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 groundspeed tree landing. This causes the main rotor to act as an umbrella, while the fuselage settles into the trees and loses its excess vertical velocity.

★ ★ ★

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

Forced landing— when further flight is impossible, but not as a result of catastrophic aircraft control problems.

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:

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 this dreaded moment, he tends to maintain altitude at the expense of control (loss of speed and/or rotor rpm).

The 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. 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.

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.

TERRAIN SELECTION

Except for the few critical seconds following takeoff, a pilot never has an excuse for denying himself some form of choice in the selection of an emergency landing site. This does not mean that he has to fly around preoccupied with engine failure and suitable landing spots. Rather, it means that he has to develop some protective instincts and sound habits in the following areas:

Routing— Using imagination in the planning of a route goes a long way towards improving the survival aspects of a forced landing. The difference between a direct route which leaves no choice in case of an emergency and one that detours over better terrain is often a matter of only a few minutes or a few gallons of gas. The same type of defensive thinking should go into the selection of terrain over which local training flights are conducted and the direction of takeoff from confined areas.

Altitude and Airspeed— More altitude above terrain means more choice in time and distance. Excess airspeed can be converted into altitude and terrain choice. Flying needlessly low and slow over neck-breaking terrain is one of aviation's capital offenses. However, excessive altitude is not a blessing when it leads to indecision. The helicopter pilot should probably learn to think in terms of optimum altitude — high enough to make an autorotation and low enough to get the aircraft safely and quickly on the ground in case of a critical malfunction.

It is unfortunate that in most training situations so much stress is placed on the selection of a field that will allow a (simulated) forced landing without damage. This training practice and the bias it creates put heavy demands on the composure of a

EMERGENCY LANDING TECHNIQUES IN HELICOPTERS

pilot who finds himself beyond gliding distance of a suitable field. What is he expected to do — call his instructor for further guidance or a refund? Obviously, no flight training is complete unless the student has been conditioned to accept the inevitability of aircraft damage when circumstances force him to sacrifice dispensable structure to protect the cockpit/cabin area.

Assuming that the pilot is beyond reach of a suitable landing area, he should judge the terrain within gliding distance for its energy-absorbing capability. If sufficient altitude is available, he should head towards the area that seems to offer the best choice without being immediately concerned about a specific spot. When the available time is very short, the choice may be limited to a variety of obstacles, but it is still a choice as long as the pilot maintains control of his helicopter.

The following discussion of the pros and cons of the different types of terrain is intended as general orientation only.

Trees (Forest)— Accident experience proves conclusively that trees can be a helicopter pilot's best friend in an emergency situation. In conjunction with the modern, all-metal main rotor blade, trees have an energy-absorbing capability that may even compensate for partial loss of aircraft control or an excessive sink rate. In practical terms, this means that under certain circumtances (low rotor rpm or control difficulties) a tree landing may be less hazardous than one on flat, open terrain.

Water— It is difficult to explain the apparent reluctance of some pilots to ditch. It may be the subconscious knowledge that the helicopter will most likely be a total loss, or fear of getting trapped. Based on actual experience, the ditching of a helicopter definitely presents much less of a problem from impact than a landing on very rough terrain, or in high trees. If there are any problems they are mainly self-imposed ones in the form of premature evacuation of the occupants (before the main rotor has stopped) and failure to have all doors open at the time of water entry. (See "Ditching Techniques" page 17, this issue, and "Ditching the Huey," May 1967 issue of the DIGEST.)

Desert— Selecting a suitable landing area in the desert should not present a problem. The survival and comfort aspects after landing, such as the proximity of settlements and the availability of water, food, and shelter, are sometimes more critical. For this reason, the original choice — when considerable altitude is available — should be one of direction, rather than a specific spot. Since orientation is easily lost in the desert, it is advisable to make a mental note of a walk-out direction in relation to certain terrain features, or the planned landing direction. This suggestion is made without inferring that a conspicuously located aircraft

Flying needlessly low and slow over neck-breaking terrain is one of aviation's capital offenses. The pilot should learn to instinctively avoid situations where an emergency would leave him without choice.

should be left in favor of an uncertain search for comfort.

Mountains— It is impossible to give general rules for terrain selection in mountainous terrain. What was said earlier about giving yourself a chance in case of an emergency definitely applies to the pilot's initiative and habits in mountain flying. The pilot should learn to instinctively avoid situations where an emergency would leave him without choice. Once he develops this instinct, the helicopter pilot will discover that the unique flying characteristics of his aircraft give him considerably more freedom from worry in rugged terrain than his fixed wing colleague.

APPROACH

Terrain selection from altitude is initially based on appearances, and is not always final. As the actual terrain features become more apparent, the pilot should not hesitate to discard his original choice for one that is obviously better. However, as a general rule, he should not change his mind more than once. A well planned and executed crash landing can be less hazardous than a wild approach into a large established field. Once the pilot has made his final decision he should suppress the tendency to keep looking for other — and hopefully better — fields and concentrate on the approach. The best advice here is to fly a normal landing pattern, without aggravating an already difficult situation by using nonstandard or unproved procedures.

When the pilot has time to maneuver, the direction of the approach is governed by two factors — the wind and the location of obstacles in the approach path. A third factor, the dimensions of the chosen field, enters the picture only when ample landing space is available. A simple rule of thumb in the latter case is: When the wind velocity is 10 percent of the touchdown speed, a downwind landling requires 50 percent more groundroll, or sliding distance, than a landing into the wind.

A critical situation is one in which the only available field is a confined area that will accommodate the aircraft only when the pilot executes a flawless approach. From the pilot's point of view, this setup is a perfect trap which he can avoid only by asking himself: From what direction should I approach to avoid disastrous results from possible errors in judgment and technique? Considering the two most obvious approach errors (coming in too high or too low), it is apparent that obstacles (wires, buildings, trees, etc.) permit only one type of error — coming in too high. To encourage the hard-to-convince pilot to treat obstacles with respect, the probable results of coming in too low are listed.

Striking an obstacle during the final part of the approach almost always implies loss of aircraft control before the planned touchdown point is reached.

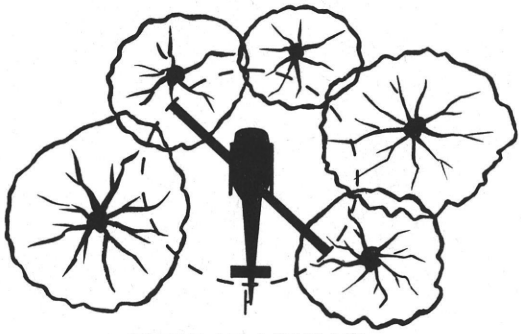
Stretching the glide across obstacles to reach an open area means sacrificing rotor rpm and yielding control over the rate of sink at touchdown.

The foregoing should make it clear that the approach direction into a confined area within gliding range is determined by obstacles as well as wind. The pilot should aim at a wind/obstacle combination that permits a controlled touchdown with the greatest margin of error. When there are no obstacles to contend with, wind should be an overriding factor only:

When its effect is readily apparent in the aircraft's ground track.

When there is sufficient time to do the necessary maneuvering without jeopardizing aircraft control.

Too many approaches go sour and end as serious mishaps because the crew pays too much attention to the fixing of whatever they thought went wrong (engine restarting attempts, etc.) and not enough to the planning and execution of the approach. Emergency landing procedures and aircraft control always take precedence over restart procedures, even if the pilot knows — the exception rather than the rule — that the situation is correctable within



TREE LANDING
VERTICAL VIEW

A tree landing should be made with a zero or near-zero groundspeed and a tail low attitude. Tree trunks should provide a clearance of at least one and one-half times the rotor diameter.

the available time. There is no need to explain that preplanned crew coordination for occasions like this can save the day.

In case of an erratically operating engine, it is often better to kill the engine and shut off the fuel before the final approach. This action not only preserves the pilot's initiative, but it reduces or eliminates the most common fire hazard, a hot engine. A turbine engine cools off extremely fast after flameout. Another ignition source, the electrical system, should be handled in a similar manner when the pilot is no longer in need of the system's services and when time permits.

Advice concerning protective equipment should not be necessary, since every helicopter pilot always has his seat belt, shoulder harness, and helmet chin strap fastened. Contrary to what most handbooks recommend, the locking of the shoulder harness (reel) is optional. It should be done only if time permits and if the pilot can do it without endangering aircraft control. The purpose of the automatic reel is to give the pilot the required freedom of movement in the cockpit, while automatically protecting him in case of an abrupt deceleration (in excess of two to three g's). To obtain real benefit from the manual locking of the shoulder harness, all slack should be taken out of the straps, after moving the control handle from automatic to manual.

TOUCHDOWN

Toward the end of the approach, the pilot is in the best position to judge his aircraft's remaining maneuvering capability with respect to the rapidly narrowing terrain choice. He must now make the final decision about the exact touchdown spot and the manner of touchdown. This is not the time to get alarmed because the terrain doesn't look as good as it did from altitude, or because the best area is overshot or undershot. Of all the errors that can be made up to this time, there is only one that's critical — loss of rotor rpm and the resulting loss of control over the manner of touchdown.

Open Terrain— Before instinctively heading towards open terrain (including established fields) the pilot should ask himself these questions:

Can I reach the open area with a normal glide, without being tempted to stretch it? (Note: The speed for maximum glide distance, power-off, is not necessarily the same as the speed for minimum rate of descent.)

Does the surface permit a running landing in case of an excessively hard touchdown?

If I decide on a running landing, do I have sufficient aircraft control to ensure a touchdown without drifting or crabbing?

If the surface conditions are poor, do density altitude and gross load permit a zero groundspeed touchdown at a reasonable sink rate, or do I have to compromise in the form of a minimum groundroll touchdown?

As explained earlier, a running landing is less demanding with respect to pilot judgment and technique than a zero groundspeed touchdown. It may even be said that a straightforward emergency, such as an engine failure, over terrain that permits a running landing, hardly presents a problem. However, the pilot has to be prepared for the most adverse conditions. For this reason, his training cannot be considered complete unless he has been taught to perform a zero groundspeed autorotative touchdown.

Tree Landings— When a tree landing is unavoidable or preferable, the pilot should select a touchdown spot based on the following considerations:

The height of a tree is less critical than the height above the ground where it begins to branch. Tall trees with thin tops allow too much free-fall height after the aircraft passes through the branches.

When dealing with young or short trees (twice helicopter height or less), the most densely and evenly wooded area should be chosen. This is an ideal situation in which the bottom of the aircraft as well as the main rotor provide a cushioning effect.

When dealing with large trees, resistance against the bottom aircraft structure should be avoided in such a manner that the fuselage and tail boom will settle between the treetops before the main rotor engages the branches of the surrounding trees. In other words, the pilot should look for an area where the rotor disk meets equal resistance at treetop level with the softest spot for fuselage and tail boom to ensure a tail-low attitude at ground contact. The general implication is that, although their branches may overlap, tree trunks should provide a clearance of at least 1-1/2 times the rotor diameter.

If at all possible, main rotor contact with heavy trunks high above the ground should be avoided as it may result in loss of the main rotor or transmission failure. If a retreating (metal) blade strikes very heavy lumber, the tendency of the transmission is to fail in the forward direction (with counterclockwise rotor rotation). The opposite is true when an advancing blade strikes a heavy obstacle, including the ground.

A landing in a sparsely wooded area may require more finesse than landing in a dense forest canopy, since the few individual trees act as obstacles rather than energy absorbers. Under these circumstances, the terrain itself will probably be the main touchdown area and hitting an obstacle prior to touchdown often leads to loss of aircraft control and an uncontrolled crash. For example, if the left side of the rotor disk were to settle into trees, while the right side met no resistance, the helicopter would tend to strike the ground on its right side.

Brush-type vegetation of less than helicopter height should be dealt with as if it were not there.

Clearings in woods should be treated with caution as they may contain tree stumps and other obstacles that may penetrate the aircraft's bottom.

Dead trees are dangerous. They offer little energy absorption and tend to puncture the fuselage.

A tree landing should be made with a zero or near-zero ground speed and a tail low attitude. If the pilot is unable to reduce forward velocity to safe limits and tree contact is unavoidable, he should flare in an extremely nose-high attitude against the densest growth, and as close to the ground as possible. In this case, the pilot is using the trees to absorb energy of motion in the horizontal plane and the bottom of the aircraft becomes the main contact point as well as a protective shield. Even individual trees — preferably the smallest ones — can be used for this purpose if the center of the helicopter is aimed at the center of the tree crown. Uprooting a tree under these conditions adds to the impact attenuation process, as shown by accident experience.

As far as less yielding obstacles and man-made obstructions are concerned, the same concepts apply: Avoid nose-first contact under all conditions and avoid destruction of the main rotor until the helicopter is close to the ground and/or the forward velocity is negligible.

The reader is reminded that the purpose of this article is to increase the helicopter pilot's understanding of how to avoid or lessen the hazards associated with emergency landing situations. The intent is not to instruct the pilot how to fly or to give the impression that the reading of these contents relieves him of the responsibility to maintain his routine skills and knowledge. The concepts and guidelines presented should be seen as a tool to sharpen the pilot's judgment in the use of available skills and knowledge under demanding circumstances. Their proper application can help to reduce our already low occupant fatality rate in emergency landings to zero.

Ted Kontos

Although maintenance-caused mishaps represent a small portion of all mishaps, their number is steadily increasing . . .

THE CREW OF A CH-47 heard a loud noise and saw the forward transmission start to descend into the cockpit as the aircraft was landing. With the aft gear on the ground and the forward gear still in the air, the blades dephased and were destroyed. The aft transmission and rotor head tore loose from the aircraft, and the no. 1 engine caught fire.

This accident resulted from oil starvation of the bearings supporting the input pinion shaft of the forward transmission. Oil starvation was caused by contaminants in the oil system blocking three of the four jets which lubricate the pinion shaft. Contamination came from corrosion and deep pitting of the transmission sump. *A check showed that a maintenance inspection required by the organizational maintenance manual (-20) had not been performed. Improper preservation and storage resulted in the corrosion and pitting.*

A UH-19 aircraft fell through during an attempted power recovery from a practice night autorotation and landed hard, causing major damage to all components. The hard landing resulted from clutch failure due to improper maintenance. Discrepancies included:

Failure to safety top nut
Other nuts grossly undertorqued
Flyweights and area void of oil and operated dry
Splines worn in cam
Fluid coupling loose due to insufficient torque
The free wheeling unit was dry and inoperative

A UH-1 fishtailed during climb after takeoff. The pilot entered autorotation, bringing in power for the landing. The helicopter touched down in a right turn and bounced twice while still turning to the right, causing major damage to the skid gear and fuselage. *Failure to safety the lock nut on the tail rotor tube assembly allowed the slide assembly to move off the tube, causing antitorque failure.*

Another UH-1 aircraft crashed and burned. The red damper mounting bracket broke, allowing the red damper to strike the white control tube. This caused excessive bowing and breaking of the white control tube, allowing excessive pitch in the white main rotor blade, and separation of the rotor head. *Laboratory analysis concluded that installation and torque requirements for the damper mount bracket bolts were most probably not complied with during installation.*

Although maintenance-caused mishaps represent a small portion of all mishaps, their number is steadily increasing. During FY 1964, the monthly average of established or suspected maintenance-caused mishaps was approximately 7.5. This figure rose to 10.2 during FY 1965 and 18.4 during FY 1966. During the first eight months of FY 1967, it was 33.4.

Analysis of maintenance-caused accidents, incidents, forced landings, and precautionary landings during the past year shows the majority were due to improperly performed maintenance. Mistakes included:

Failure to lock quick disconnect couplings
Mismatched bearings
Failure to correctly adjust doors, windows, carburetors, oil pressure relief valves, voltage regulators, etc.
Failure to correctly torque components and hardware
Incorrect routing of flight controls, hydraulic lines, and electric wiring
Excessive grease
Reverse (Murphy) installation of parts

Failure to perform required maintenance and inspections, and failure to detect defects during maintenance and inspections were the next greatest causes. Mistakes included:

Failure to install cotter keys and safety wiring where required
Failure to detect chafed fuel, oil, and hydraulic lines, as well as electric wiring
Failure to comply with MWOs

Other maintenance-caused mishaps resulted from:

Fuel contamination
Improperly secured internal and external loads
Dropping tools, parts, and hardware into engines and transmissions during maintenance
Guiding taxiing aircraft into obstructions
Loose objects, such as rags, panels, canvas, etc., blown about by rotors and propellers on maintenance ramps

Recently, a door came off a UH-1 and damaged a main rotor blade. A check showed that although one MWO for preventing door separation had been complied with, a second one had not. Maintenance personnel were not aware of the additional requirement.

everyone's job

After completing the basic aviation maintenance course, an Army mechanic is ready to go to work . . . but only under close supervision . . .

Occasionally, records of transferred aircraft show that MWOs have been complied with when they have not. Information concerning time change items cannibalized from other aircraft is sometimes not recorded. TMs used by maintenance personnel are not always complete or current, and units finding errors often take no action to have them corrected.

One such example can be found in the U-8 organizational maintenance manual (-20) which lists maintenance requirements to be followed when an engine overboost occurs. These range from no required action to engine removal, depending on the severity and duration of the overboost. However, this publication defines overboost as ". . . any time a manifold pressure of 48″ Hg is exceeded." This is not necessarily true. Engine overboost can occur at less than 48″ Hg during flight or at high field elevations during ground runup.

A mechanic operating the engines of a U-8 at a manifold pressure of 48″ Hg at a field elevation of 1,000 feet will have overboosted them by approximately one inch. Should he operate them at this setting for over 15 seconds, the engines should be replaced. But, according to the -20 definition of overboost, no corrective action would be taken. At present, this definition has not been corrected.

Another problem area arises when reliance is placed on TMs beyond their intended scope or purpose. Although TMs are a must for correct maintenance, and perform a vital function an any maintenance training program, they cannot serve as a substitute for formal training, on-the-job training, or experience. The idea that you can hand an inexperienced mechanic a TM and tell him to follow a specific procedure does not guarantee correct maintenance — even if he follows instructions to the letter.

Assume that a newly trained mechanic is to replace some aircraft component retained by steel self-locking nuts. Using the TM, he follows step-by-step removal and installation procedures. From school, he recalls that self-locking nuts should not be reused, so he gets new ones. However, instead of steel nuts, he installs brass nuts. They look alike and an honest mistake sets the stage for a mishap. Unlikely? A few months ago, a technical inspector spotted a cracked nut on the transmission plate assembly of a UH-1. On removal, the nut was found to be made of brass. A check of the remaining ones showed that all were brass. Inspection of other aircraft revealed that brass nuts were installed on several. This maintenance had been performed by *experienced* personnel.

In contrast, a combination of training and experience has prevented errors. In one such instance, two mechanics were filling a portable tank with isopropyl alcohol for the anti-icing systems of their aircraft. The work was accomplished at night and flashlights provided the only light. After emptying two drums, one mechanic noticed that the color band around the third drum was green instead of the correct yellow. Checking the contents, he found that the drum bore the wrong color marking and *did* contain isopropyl alcohol. This might have been the end of the check. But the mechanic wasn't satisfield and decided to inspect the emptied drums. Although both were *properly* marked, one contained methanol alcohol. Thanks to the mechanic's skepticism, none of the unauthorized mixture reached the aircraft. This type of constructive thinking does not come from books. It is acquired from a combination of training and experience.

After completing the basic aviation maintenance course, an Army mechanic is considered qualified to perform maintenance on aircraft, engines, and related components. He has been taught fundamentals, theory, use of tools, forms and records, and schooled in the use of publications. He is ready to go to work — but only under close supervision.

Hand this man two bearings removed from an engine that has been operated for some time and ask him to inspect them. One is shiny and new looking. The other is brownish and dull. Are both good? If not, which one is? What engine malfunction is indicated? Would he know how to associate the new looking bearing with inadequate lubrication?

Let the inexperienced mechanic use the boroscope to examine the internal condition of a cylinder. He can follow correct procedures, but can he spot defects? How should a normal piston and cylinder head which have seen use appear? How much carbon build-up is considered normal? Are the fine scratches he sees on cylinder walls normal?

What does a feathered valve look like? Can he detect signs of hot spots? Similar questions can be asked about inspection of most major aircraft components. Usually, the new man is not qualified to answer them correctly — even with a TM in his hands.

A few months ago, a freshly trained UH-1 mechanic was assigned as crewchief after completing 10 days on-the-job training. Shortly afterwards, his helicopter crashed, killing four occupants. Investigation showed that the maintenance defect which caused the accident was present during an inspection performed by the new crewchief. He failed to recognize it as a defect.

Unbelievable as it may seem, we sometimes encourage a new mechanic to commit violations. He may lack experience, but he has been trained to use correct procedures and observe safety practices. Despite this preparation, his job performance is going to be influenced by his environment.

When he reports for his first assignment, will he be greeted by a prominently displayed NO SMOKING sign on the hangar exterior, only to open the door and step into the welding shop which occupies one corner of the structure, perhaps in conjunction with the sheet metal shop? Will he walk past these and find that the maintenance supervisor's office consists of a desk located to one side of the open hangar? Does he find that the only separation between the shops, office, smoking area, and the areas where aircraft are in various stages of repair, consists of lines painted on the concrete floor? If so, without a word having been spoken, he has been told to forget what he has learned — that there is one set of rules which is taught and another which is used. Do these hangar arrangements sound exaggerated? They exist.

Another factor that results in maintenance-caused mishaps is excessive pressure to get a job done. Although the new mechanic is more likely to make mistakes under conditions of pressure, the old-timer is not immune. At one military installation, a MWO required replacement of piston pins in a particular type engine. Because more than 100 aircraft were equipped with this engine, pressure was applied on maintenance personnel to get the work done in a hurry. In his haste, one mechanic failed to note that the piston rod had dropped out of the piston when he inserted the new pin. Damage to the engine during runup necessitated engine replacement.

This mechanic was no novice. He had more than 15 years of maintenance experience and had performed maintenance on this particular type engine for two years. His mistake was the result of pressure

a bearing removed from an engine is shiny and new looking . . . will the inexperienced mechanic know what engine malfunction is indicated . . . ?

to hurry. The average experience level of the mechanics performing this compliance was approximately eight years and each had a minimum of one year of experience on that type engine. We can only speculate at the results if inexperienced personnel had performed this work under the same conditions of pressure.

Unfortunately, it is the inexperienced man who generally finds himself under pressure to complete a job. Often work lags because of his inexperience and he finds himself trapped in a vicious cycle as he frantically tries to catch up. Limited knowledge makes it difficult for him to accurately diagnose symptoms. He wastes time replacing suspected components which do not cure the problem. Meanwhile, other aircraft are downed for scheduled inspections or needed maintenance, creating an additional backlog of work.

Further confusion results when mechanics must be pulled off one job to complete another more minor one. During shift changes, additional complications set in. Lack of work continuity causes delays and serves as a breeding ground for accidents, particularly when it occurs in conjunction with inexperience and inadequate supervision. Recently, failure of a newly installed OH-13 tail rotor gear box caused a major accident. Investigation showed that the failure resulted from mixing parts of two tail rotor gear boxes. *It was caused by lack of supervision due to a shortage of supervisory personnel; lack of continuity during exchange of tail rotor gear boxes between two aircraft (removal and installation of the assemblies were accomplished by different personnel); failure of an inexperienced mechanic to use the TM; and hurriedly performed maintenance.*

Another common result of hurrying is the treatment of symptoms instead of causes. In one instance, the fouled spark plugs of a rough-running engine were replaced. Shortly afterwards, the engine failed and the pilot had to make a forced landing. The cause was a blown supercharger seal which allowed oil to enter the induction system and foul the spark plugs. What might have been the results had the engine failed over woods, mountainous terrain, at night, or under IFR conditions?

Inexperience resulted in the maintenance crew of one aircraft spending several hours trying to determine the cause of low hydraulic pressure. When an experienced mechanic was assigned to help, he found an internal leak in a hydraulic cylinder in only five minutes. In another instance, two mechanics spent several hours trying to find the cause of low engine power output. An experienced crewchief performed a routine engine operational check, noted higher than normal manifold pressure indications at low rpm settings, and lower than normal manifold pressure indications at high rpm settings. He tentatively diagnosed the trouble as an induction leak. A visual check of the engine showed that an inter-cylinder baffle had broken and vibrated against an intake pipe, wearing a hole in it. The total time for this accurate diagnosis was 25 minutes.

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Effective on-the-job training of maintenance personnel can increase production and decrease or eliminate mistakes. In the long run, it is probably the cheapest and most effective way of obtaining these benefits, particularly when the number of assigned personnel is limited. A continuous training program is needed not only for newcomers, but for seasoned mechanics who lack experience on a particular type and model aircraft. Despite their advantages of knowledge and experience, they can still make mistakes. A mechanic accustomed to adjusting valves on an R-1340 engine need not worry about the position of the valve adjusting screw before locking it. However, for an R-1300 engine, he must establish correct clearance, and ensure that the adjusting screw is not left in a position which might block internal oil passages and cause loss of lubrication.

The importance of maintenance methods and policies can be seen by comparing the methods of performing PE inspections at two comparable in-

stallations. At each, aircraft are washed and moved into the hangar nightly. The following morning, maintenance crews perform required inspections and record discrepancies. At one installation, the aircraft are kept in the hangar until *all* discrepancies are cleared. At the other, aircraft are transferred to the flight line at the close of the day, where *line* personnel correct any remaining discrepancies. On paper, the second installation, using approximately the same number of mechanics as the first, completes PE inspections in approximately one-half the time, but the end result is an increase in maintenance errors, pilot writeups and flight delays.

Pilots also contribute to maintenance-caused mishaps. The failure of pilots to write up overtemp, overspeed, and overboost conditions and the approximate duration of each have led to inflight emergencies. Recently, a UH-1 major accident resulted from numerous hot starts by different pilots. None were recorded. Causes for cracked cylinders and burnt valves in 0-480 engines of U-8 aircraft have been traced to engine overboosts. Again, none were recorded. Since the thoroughness of inspections and necessity for engine removal is based on the degree and duration of these conditions, maintenance personnel must be furnished this information before they can take corrective action.

Some pilots continue to provide insufficient information when recording discrepancies. One such writeup read: "Engine vibrated during flight." Maintenance crews spent hours checking the engine systems, mounts, and propeller without finding any cause. A test flight showed that vibration occurred

Couple the effects of fatigue and inexperience with family, financial, or other psychological problems and the chances for maintenance errors skyrocket . . .

everyone's job

only after liftoff. A check of the nose wheel showed it to be badly out of balance. Inadequate pilot writeups cause unnecessary delays and wasted effort.

Pilots sometimes accept aircraft for flight or continue flying when known discrepancies exist. In one instance, the pilot of the U-8 aircraft elected to take off, even though the landing gear warning horn sounded while the aircraft was on the ground. Because the throttle limit switches had been adjusted, the pilot felt certain that they were the cause. They weren't, and the landing gear retracted prematurely during takeoff, causing major damage to the aircraft.

In another instance, two pilots took off in a U-8 aircraft on a proficiency IFR training flight under actual instrument conditions. Although the gear failed to retract after takeoff, the pilots decided to continue their mission. All went well until an engine failed. Because of increased drag due to the extended gear, the flying speed was barely above the minimum required for level flight. When the aircraft was banked sharply to avoid a hill, it stalled and crashed.

Some pilots place excessive confidence in the abilities of their crewchiefs, and tend to be lax when performing preflight inspections and engine operational checks. It is because of the falibility of every individual that the present system of maintenance checks evolved. These are designed so that an error made or a discrepancy overlooked by one individual may be spotted by another. Overdependence on any one person or group defeats the purpose.

Adequate supply is vital to good maintenance. Cannibalization results when needed parts are not available. Aircraft hydraulic systems are not pressure checked before starting engines when units do not have portable hydraulic test stands. Several accidents have resulted from this cause. Lack of special tools can cause similar mishaps. Recently, several UH-1 aircraft were involved in accidents because rod end trunnions failed. These failures resulted from cracks caused by overtorqued attachment bolts. A check showed that many units did not have low range torque wrenches (0-150 inch pounds). More recent surveys showed that some units still have not obtained these wrenches.

Other factors that induce maintenance errors are physiological and psychological. Aviation safety officers are well aware of the role these play in

success in any maintenance safety program requires discipline . . . it includes adherence to established procedures and covers all aspects of maintenance, including completeness and currency of publication files . . .

pilot-caused accidents. They are no less important when they are applied to maintenance personnel. A fatigued mechanic is dangerous to himself, his coworkers, and his aircraft. Fatigue may result from personal habits or from frequent additional duty assignments, such as KP, CQ, guard duty, etc. These may allow little or no rest before returning to maintenance duties.

Unlike a pilot who can get to bed early when he knows he is scheduled for a morning flight, every day may be a work day for the mechanic who is expected to be on the job and proficient at any hour. Couple the cumulative effects to sleep loss with inexperience and pressure to get a job done, and a dangerous trio is formed. If family, financial, or other psychological problems are also present, the chances for maintenance errors skyrocket. Under these conditions, the mechanic may be on the job — but he won't be proficient.

Maintenance-caused mishaps can be prevented through quality control. Inspectors are in a position to make objective observations. Yet, they are often hampered in their efforts because mechanics (1) fail to use their services, (2) place them in compromising positions, and (3) rely excessively on their abilities.

Three major accidents, resulting in six fatalities and three injuries, and numerous forced and precautionary landings have been caused by failure to properly lock fuel quick-disconnect couplings. Since improperly connected couplings constitute a safety of flight hazard, the aircraft should be placed on a red X status when any are disconnected. Clearing this symbol requires the services of an inspector who must check the couplings for security and leakage under pressure. If this procedure were followed, we would not have mishaps from this cause.

Often, when the inspector checks maintenance work that requires retorquing of components or hardware, he finds that retorquing has already been accomplished. He has no way of knowing whether or not correct procedures were followed. He must either insist on the work being redone, or approve it after a visual check.

Despite his qualifications and dedication, the inspector is human and subject to mistakes. Recently, one failed to note that pressure and return servo lines of a CH-34 were crossed and a major accident resulted when the engine was started. If the required TM procedures had been followed for performing a ground operational check of the system before starting the engine, or if a thorough preflight inspection had been made, this accident would not have happened.

Mishaps which happen during flight are only one type attributed to maintenance. These are widely publicized. But there are other types of maintenance-caused mishaps which receive little or no publicity. These are the mishaps which occur during maintenance. Typical are:

Wings damaged by wing jacks

Inadvertent gear retractions, causing damage and injuries

Engine magneto switches being left on, causing engines to fire and propellers to strike personnel when propellers are rotated

Fire resulting from the use of gasoline as a cleaning solvent

Falls caused by spilled oil

Eye injuries resulting from failure to wear safety goggles during grinding or sheet metal operations

There are no maintenance-caused mishaps which cannot be prevented. Take a good look at your maintenance program . . . then take action.

Servicing oxygen system with acetylene, causing destruction of aircraft and injuries to personnel
Injuries caused by performing maintenance on rotor head that was not secured
Damages to engines from parts dropped into engines during cylinder replacement
Personnel walking into turning rotor blades
Asphyxiation by working in area of concentrated fuel fumes without adequate protection
Infections caused by frequent contact of hands with gasoline
Ear nerve damage from working in high noise level areas without using protective earplugs or muffs
Taxiing aircraft into parked vehicles or other objects
Injuries sustained from "horseplay"
Damages to aircraft or engine components by the use of unauthorized tools or equipment.

Success in any maintenance safety program requires *discipline*. Unfortunately, many of us tend to look at this word with distrust, associating it with some form of punishment. This should not be the case. Displine also means ". . . That which is taught; training or course of training which corrects, molds, strengthens, or perfects a faculty or faculties, such as one's talents; rules affecting conduct or action . . ."

The "rules" that produce accurate and safe maintenance are available and known. They need to be followed and following them is a sign of effective discipline. Its existence can be noted in many ways:

The condition of mechanics' personal tools
Maintenance of special equipment
Frequency of spot checks
Cleanliness of work areas
Completeness and currency of publication files
Absence of many delayed discrepancies, etc.

But discipline goes much deeper. It includes adherence to established procedures and covers all aspects of maintenance, including the new man assigned to a unit. The initial impression made on this man on his arrival will largely determine his future performance. If he finds himself in a unit that is proud and well disciplined, he will most likely conform to the group's values. Failure to do so will make him unpopular. When he is provided with good leadership, a knowledge of what is expected of him, and the sight of others living up to established standards, he is not likely to permit himself to lower these standards.

The cure for maintenance ills requires corrective action and involves all areas. Numerous aids are available. A good starting point can be found in the maintenance section of the Aircraft Accident Prevention Survey.

The Monthly Maintenance Summary, distributed each month, lists confirmed and suspected maintenance-caused mishaps which occurred during the preceding month as well as pertinent safety information.

Additional information can be gleaned from accident summaries prepared for specific type aircraft.

Like a commercial product trying to find customers, good maintenance practices must be constantly and effectively advertised. The use of bulletin boards and safety posters can play an important role in accomplishing this goal.

There are no maintenance-caused mishaps which cannot be prevented. Take a good look at your maintenance program — then take action.

NOTE: A series of maintenance oriented articles are planned for publication in future issues of the U. S. ARMY AVIATION DIGEST. If your unit is experiencing problems, or if you have found cures for problems, let us know. Similarly, if you would like to see articles on specific areas of maintenance, or specific systems or aircraft, tell us your needs.

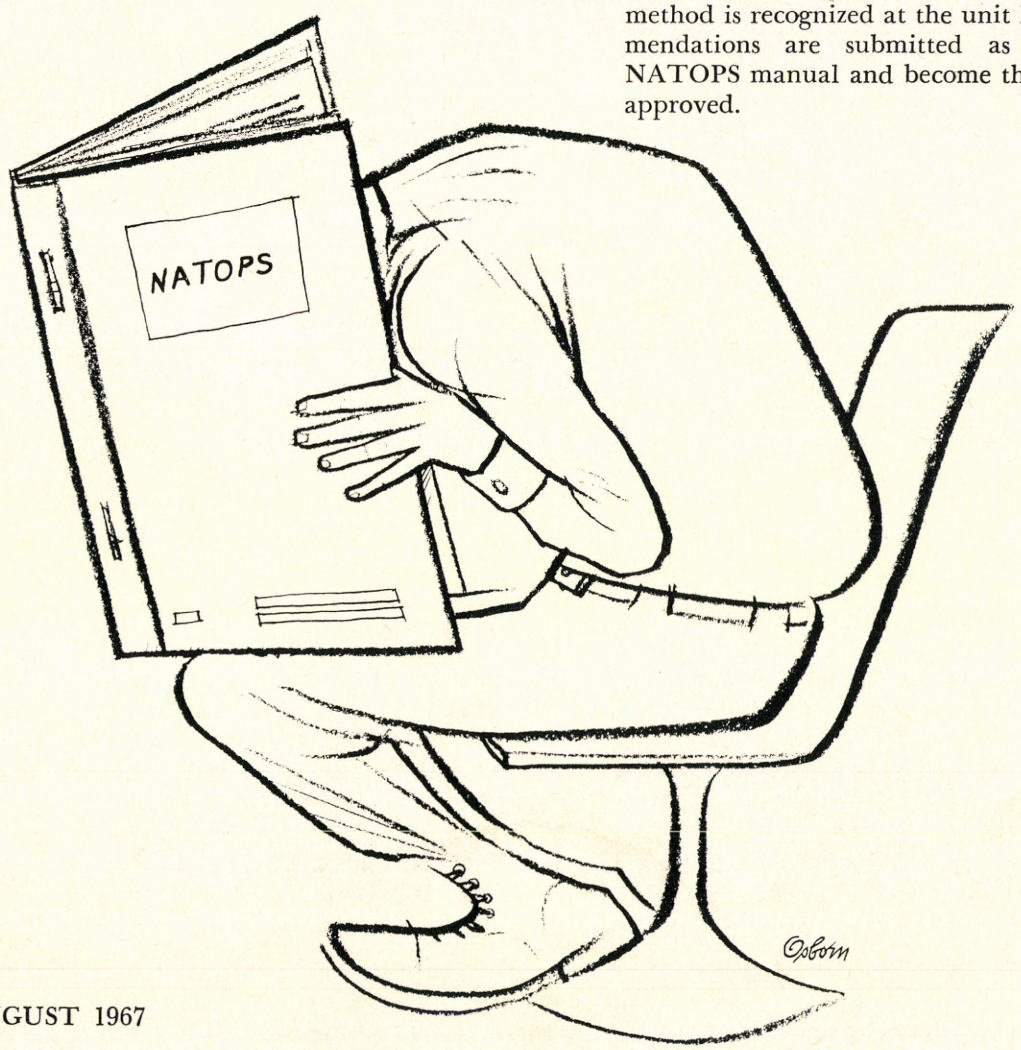
Address all correspondence to:
Director
USABAAR
ATTN: ELD
Fort Rucker, Alabama 36360

Adapted from an article in APPROACH magazine by MAJ Kydean Whitlock, USABAAR representative with the Naval Aviation Safety Center

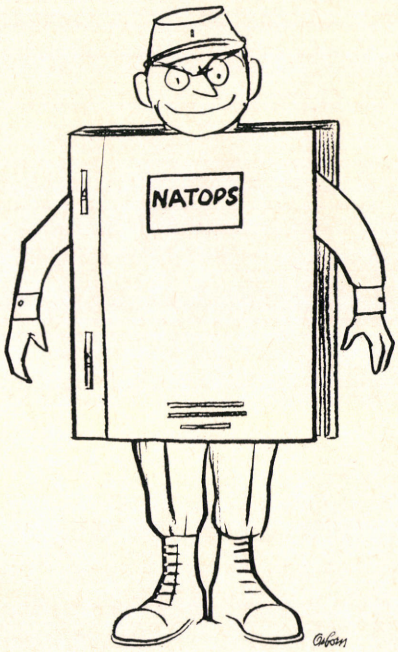
NATOPS = Naval Air Training and Procedures Standardization

TO THE AVERAGE Army aviator, the term NATOPS means very little. To the naval aviator, it is the key to correctly flying the Navy way. There are many ways to fly any aircraft. NATOPS selects the one correct and safe approach that will assure maximum mission accomplishment.

Naval Air Training and Operating Procedures Standardization is a real mouthful. However, the key to the whole program is right there in the title. It isn't called a system of "check procedures" or "a spy in the sky." It is just STANDARDIZATION! Standardization, the backbone of the NATOPS program, is a tool, not a club. NATOPS is designed as a means of providing the best and safest aircraft training and operating procedures in an easy to use manual for each aircraft. The NATOPS manual is attentive to the needs of the operating forces, and provides a training tool for the squadron commanders' use in determining areas of weakness in his training program, or an individual. NATOPS is a user document. Corrections and modifications originate at the user level. If a better method is recognized at the unit level, these recommendations are submitted as changes to the NATOPS manual and become the new rules when approved.



. . . the standardization program would be designed to work to improve combat readiness training goals through safety and efficiency . . .



If you stop to think about it, in some ways, combat readiness training is making such a system mandatory for Army use. New pilots are now arriving every month in units, both in CONUS and overseas. If all pilots flying a given aircraft are flying the same way, preflighting the same way, and handling emergencies the same way, this new pilot's training is automatically tailored to the procedures he will find in any unit to which he is assigned. New procedures to be learned after reporting will be less, and old habits can be retained, rather than changed.

Once we really start thinking about this program, questions and objections immediately arise. Where does the -10 fit into the picture? What standards are to be met? What grades used? What happens if a pilot flunks? One of the foremost objections could be "just who in h— are they to tell me how to fly the Huey?" Pity poor old Orville! When Wilbur completed the first hop for a total flight time of 59 seconds, he was the expert! There was nobody, but nobody, who could tell him a thing about flying. Orville just plain wasn't with the program. Fortunately for us, we have a large number of experts for this purpose. A new program of this magnitude must grow gradually. Naturally, it would be improved as users become more familiar with it. Making such a program work to our benefit would be up to us as Army aviators.

In outlining the program, one point should be cleared up at this time. The standardization manual (call it what you will) is complementary to the -10 and little or no overlap is desired or intended. The -10, for example, is presently written by the contractor for the Army Materiel Command and primarily contains technical descriptions. In other words, the contractor is stating that a system works as follows, or, if a given set of items are checked and/or actuated, a given emergency will not get out of hand, etc.

The standardization manual should tell you how to operate a system that functions as described in the -10, or how to make a set of systems function to achieve your mission. Here are the guidelines on how it is to be done: flight tactics and techniques, rather than technical descriptions. The mechanics of the aircraft are in the -10. Techniques and tactics are in the standardization manual. Once a standardization manual has been proved by use, the next step involves combining the -10 and standardization manual into one operators' manual in which the technical data and flight techniques are mated for ease of reading and understanding.

As envisioned, the standardization program would be under the Director of Army Aviation. An advisory group would be formed with representatives from all major commands, under whose direction the standardization program would be administered. Under each of these representatives, there would be a standardization organization. A *standardization evaluator* would be assigned for each type aircraft in the major command. In each special category aviation unit, CH-54, etc., there would be a standardization evaluator. In company-sized aviation units, UH-1, CH-47, etc., there would be a *standardization instructor* who would function directly under the commanding officer when in his standardization capacity, much as safety officers now function.

The United States Army Board for Aviation Ac-

cident Research could monitor the program. Their advice is always available, and, at times, their statistics could very well dictate a modification in existing procedures.

Before you could be expected to properly support and use these manuals, some insight into how the manuals would be prepared is essential. In our case, the Director of Army Aviation could send out a general outline of sections to be covered in each model manual, along with general guidelines for content, to a number of aviation units or organizations operating each model aircraft. These activities would include the major commands and aviation schools. These are the people who would write the manuals. Rough drafts could then be forwarded to other units for comments, and conferences could be held to resolve differences in opinion.

Completed draft manuals would be sent to the Director of Army Aviation for publication. In the director's office, there would be someone responsible for publishing the manuals and changes to them. The director could select a "Model Manager" (specified aviation unit) to oversee each manual. These units would collect, coordinate, and authenticate user inputs before publication.

The provisions of the manuals would be mandatory and implemented at the earliest practical time. Ground schools could be held, open and closed book examinations conducted, and emergency procedures checked.

Admittedly, a few errors could creep into the manuals, but most would be corrected in a short time. It would be up to you to try and direct attention to the good features of the manuals, let the higher-ups know your objections, and trust those in charge of the program to gradually smooth it all out.

Once manuals are received, the *evaluators* designated, and *standardization instructors* assigned, the program could be gotten underway. The Aviation School could establish a short course of instruction for *standardization instructors,* initially. Navy and Air Force programs could be evaluated. Although their program may not be the system we need, it never hurts to see how a well-organized, well-run, and thoroughly experienced organization carried out similar tasks.

Eventually, the *evaluators* would conduct checks on the *standardization instructors,* plus several other unit pilots selected at random. The *evaluator* could call on a *standardization instructor* from another unit to assist. This evaluation would not be intended as a system of spying on each other, but would be planned solely to assist and ensure actual standardization and to provide liaison on new ideas as a by-product. There would be no place in the standardization scheme of things for the "I'll scratch your back if you'll scratch mine" type of approach to the program. The machines we fly are too expensive, the numbers too limited, and the missions too important for this approach.

Another facet of this program would be that the results of the majority of these checks would be intended for the prime use of the commanding officer of the unit concerned. They, in turn, could adjust training emphasis for the whole unit, or for individuals, based on results. Failure of just one or two items would not necessarily mean the pilot is not qualified. On the other hand, certain failures could automatically result in an overall unsatisfactory grade — such as "what to do with engine failure, just after takeoff," or in other critical areas. All this would be spelled out when grading sheets and criteria become available.

In the event of a failing grade, the pilot would have 60 days to achieve a passing grade, and two consecutive failures would normally result in a unit evaluation board. This would still be at unit level. The unit board result could very well be a recommendation for further training, in which case it would still be within the purview of the unit commander, and stay at unit level. In flagrant cases, the unit commander could request evaluation board action under applicable directives.

Since "to err is human," a system to correct these manuals and to ensure they are kept up-to-date would be an integral part of the program. As mentioned, the manuals must be attentive to the requirements of the people who are operating the aircraft.

Basically, changes would fall into two categories: *routine* and *urgent. Urgent* changes would be sent out by TWX by the Director of Army Aviation to major commands. *Routine* changes would be sent out similar to the present system for changes to ARs. To ensure that your manuals have the latest changes incorporated, the 310 series would have a listing showing the latest changes.

The keynote of the program would be speed and ease of getting new and/or better ideas into the manuals. To try out new ideas, permission to waive the provisions of any manual could be granted by the major command with a definite period of time assigned for the deviation.

The standardization program would be designed to work to improve combat readiness training goals through safety and efficiency. These goals could be achieved if we face the problems with the right attitude.

From the May 1967 issue of THE MAC FLYER

Flight Safety Opinion Survey

Billed as the best new safety idea in years, you'll find this survey helpful and informative in your accident prevention program

WHERE, HOW, AND WHEN will your unit have its next accident? What will cause it? Like to know? So would a lot of other people, including your flying safety officer.

These same questions have bothered commanders, flying safety officers and many others — especially aircrews — for years. But one FSO has finally broken the old trend of talk, talk, talk, but no action on this vital subject. He is Maj John Wells, FSO, for the Air National Guard's 146th Military Airlift Group at Van Nuys, Calif. When Major Wells was learning how to be an FSO at the University of Southern California, he dreamed up an Aircrew Opinion Survey as part of his class project. He got an "A" for his efforts, but fortunately, he didn't let the idea drop. Instead he took it home with him and tried it out on his C-97 crews.

The results were astonishing. In a very short time Major Wells was able to give his commander a really accurate picture of the flying safety status of his unit. How did he do it? Simple, like all great ideas. He just asked each member of the group three short questions: (1) What "hairy" experiences have you had while flying the past year? (2) What do you think will cause your unit's next accident? (3) How could it be prevented?

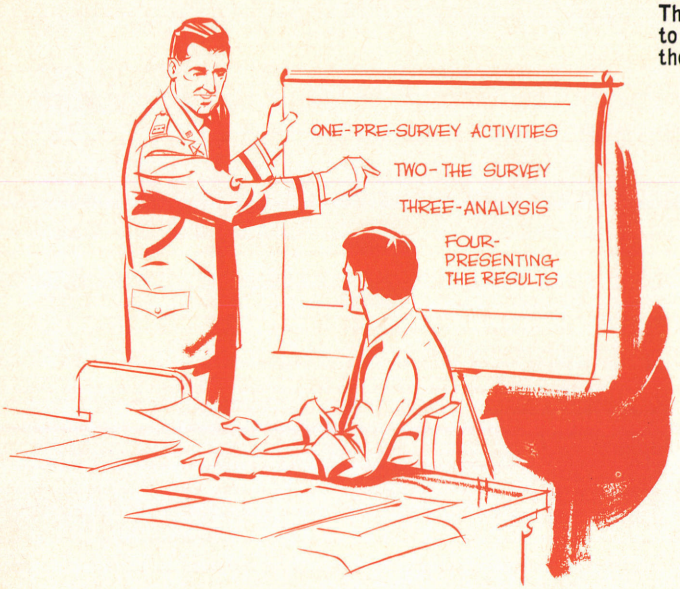
At first blush this may seem too simple. And isn't it based on personal opinion? What possible value could opinions be? In the military everyone wants facts. But let's think this all the way through. If a hazard DOES exist, can it exist long without SOMEONE knowing about it? No, it can't. Just like crime, flying safety hazards don't exist in a vacuum. But crime fighters have long had the same problem as FSOs — how do you get the people who know these things to speak up? Thanks to John Wells, we may have the answer.

The Flight Safety Opinion Survey detailed on these pages has been used with great success by a number of ANG, Air Force and MAC units already. Recently, it formed the basis for a command-wide survey of all MAC flying unit commanders. Each was asked to name and document his most pressing flying safety problems. The answers were routed upward through all intermediate commanders where they were carefully reviewed and commented upon. These comments included an evaluation of the reported hazards and the actions taken to correct them. Three large boxes full of these reports now rest in the MAC Flying Safety Branch. Those three boxes probably represent the most complete and accurate picture of a major command's safety status ever assembled. This material, when fully analyzed and translated into specific corrective actions, will form the basis for the MAC flying safety effort for years to come. Perhaps, it will even lead to our long sought goal of completely accident-free operations.

THE MAC FLYER is happy to furnish the survey elements to anyone who wants them. The more people who use it, the better.

STEP ONE
PRESURVEY ACTIVITIES

1. Arrange to survey as many crewmembers as possible. Assemblies such as group safety meetings



The survey elements are available to anyone who wants them . . . the more people who use it, the better

are ideal for gathering 100-200 crewmembers.

2. Notify commanders of the nature of the survey before the meeting. Do not notify the crewmembers in advance of the survey.
3. Have sufficient quantity of questionnaires prepared and have pencils on hand for the meeting.

STEP TWO
THE SURVEY

Before passing out the questionnaires, the Flight Safety Officer should conduct a briefing emphasizing these points:

a. No discussions between crewmembers.
b. Answers should be confined to the unit being surveyed.
c. Answer all questions.
d. Do not sign the questionnaire.
e. Turn in questionnaire as soon as completed.
f. Explain how the results will be used.

STEP THREE
ANALYSIS

Using tabulation forms (some samples are shown), list the answers and group the opinions into usable percentages.

By analyzing the cause factor opinions most often mentioned and weighing them with experience levels, age group and crew position make conclusion to be used in step four.

Analyze the remedies suggested in question no. 6. Present these recommendations with most often mentioned accident potentials listed under question no. 5.

STEP FOUR
PRESENTING THE RESULTS

Present the results either verbally or in a written formal report. Use the same general format for formal report as well as briefings.

1. Introduction (explain survey method)
2. Findings
3. Conclusion
4. Recommendation
   (Here, the Flight Safety Officer has the opportunity to exercise *his* judgment and experience by outlining recommendations and suggestions to counteract the safety hazards revealed by the survey.)
5. Appendix (attach the tabulation forms)

THE QUESTIONNAIRE
FLIGHT SAFETY OPINION SURVEY

INSTRUCTIONS: Please answer the following questions as honestly and frankly as possible without consultation or discussion with your neighbor.

DO NOT SIGN THIS QUESTIONNAIRE.

1. Indicate your age group:
   Under 25 years _____
   25 to 35 years _____
   Over 35 years _____
2. Indicate your experience level:
   500 hours or less _____
   500 to 1,500 hours _____
   1,500 hours and over _____
3. Indicate your crew position:
   Pilot _____
   Navigator _____
   Flight Engineer _____
   Other _____
4. What hazardous situations or occurrences have you observed or been involved in during the past year? (Please confine your answers to the unit to which you are now assigned.)
5. What, in your opinion, will cause the next accident in your unit?
6. What action would you recommend to prevent this accident?

The information gathered in this survey will be used expressly for the prevention of accidents in this unit.

OPINION SURVEY
DEVELOPED BY
JOHN WELLS, FLYING OPERATIONS
LOCKHEED-CALIFORNIA CO.

pearls personal equipment and rescue/survival lowdown

This month, we're going to talk about one of the most important items of your survival gear, the URC-10 (RT-10) survival radio (URC-10, FSN 5820-858-5721; RT-10, FSN 5821-912-4480). To do this talking, I'm calling in two experts who have recently written articles on the subject: From the April 1967 issue of the 12th Combat Aviation Group's ACCIDENT PREVENTION BULLETIN:

SURVIVAL RADIO

Major Leroy G. Twilley, Signal Corps

WE TALK a lot about having the proper survival kits, knives, pills, and a dozen other items just in case. . . . Now let's talk about the most important one — your survival radio!

With the large number of aircraft operating in Vietnam, chances are very good that any downed aviator will be able to immediately talk to a fellow pilot. Of all the things an aviator might be able to accomplish during a survival situation, none is better than being able to talk to that rescue chopper just above the rubber trees. If you've ever had an opportunity to give another aircraft a talkdown GCA to your location or instruct your wingman to suppress ole Charlie a little over on the west side, then you can appreciate the finer points of having an operational survival radio.

Last week the last bunch of RT-10 radios were issued by S-4. Looking over my records, I see that every unit has enough to put about two in each aircraft that's flying. So there is really no reason to be without one. I can assure you they'll be of more personal value to you than an extra life insurance policy!

Next time you fly, check to see if that little jewel is on board. It actually should be in a crewmember's pocket! You might also check to see if it works. After all, it is breakable you know! The way they're sometimes thrown around you sometimes suspect they are made of steel. While I'm on the subject, I might add that unless you habitually

monitor the TR&G or guard position on your UHF, you may miss your buddy when he calls for help. If you have to turn off the guard channel due to interfering chatter, then turn it back on shortly. Old Joe, down there, will appreciate it, 'cause his URC-10 or RT-10 will only talk on 243.0.

In closing, I'll just point out that the "beeper" capability on the survival radio is of little value to an Army aircraft. He cannot home in on the signal, as can a better equipped USAF rescue aircraft. So when you check the radio be sure the voice feature works. This is what you will be using.

That's all there is — have a survival radio and be sure it works! Next time you are knee-deep in a rice paddy and you discover that your radio is back in the supply room or it doesn't operate, call your friendly signal officer. *Mine works number one.* You'd better believe it!

Pearl climbs Alabama pines to demonstrate how antenna can be raised for greater range

From the June 1967 issue of AEROSPACE SAFETY:

SAVED BY "SAVVY"

Lieutenant Colonel Robert J. Destiche
Aeronautical Systems Division
Wright-Patterson AFB

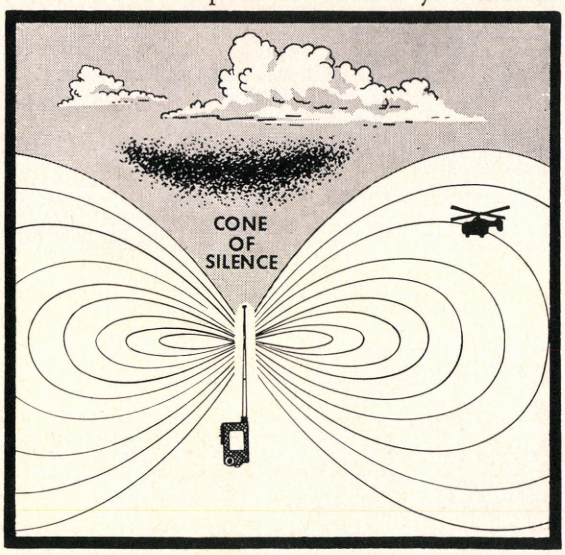
Could you ever find a similarity between a mod-dressed teenager on an American main street and the Air Force flier in a survival situation in Vietnam? It may be "way out," baby, but each is clutching a transistor radio and both are seeking recognition.

The teenager's transistor may be tuned in to the local "jump" station but it's his clue to success with the girls. In the aircrewman's case, it could mean his life.

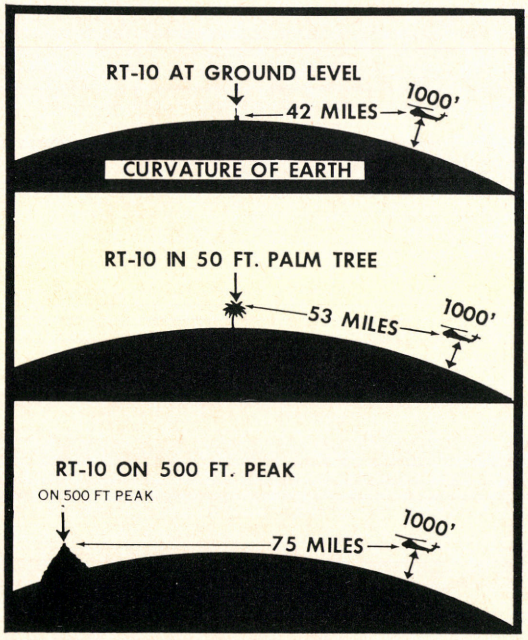
Survival radios have come a long way since the "Gibson Girl" cranked out her plaintive message. Today in combat ready units the URC-10, or its modified counterpart the RT-10, is an airman's most prized survival possession. Countless lives in Vietnam have already been saved by its proper

use. Unfortunately, there have been some users who didn't operate it properly or were unaware of its capabilities and limitations.

My purpose is not to tell you how the URC-10 or RT-10 functions or how to work it. If you want to know how it works, I suggest you read the TO or talk to a communications specialist. If you want to know how to operate it — and you should — please consult your personal equipment specialist. In addition, you should receive training in its operation, preferably by actually handling the unit and practicing with it. Check your operations officer for the training, but be sure you obtain clearance before using the radio in a practice situation. Remember! It operates on guard frequency.



Antenna pattern for URC-10 (RT-10) survival radio (not to scale)



Showing "line of sight" transmission

My objective is to give you helpful hints on operational use of this radio — hints that could save your life — and facts on its operation that cannot be found in any TO and, perhaps, not from some of your most experienced survival or personal equipment specialists.

To understand the capabilities and limitations of this miniaturized radio transceiver, let's look first at how it sends out its signal. At left is the transmitting pattern for its antenna. Note that its ultra-high frequency emission is in a kind of doughnut pattern. This means that the radio gives its best performance with its aerial at a right angle to the ground. Also note this can cause decreased transmission efficiency directly over the tip of the antenna, perhaps even a *cone of silence* like navigational radio ranges.

Recently in several rescue incidents in Vietnam poor radio contact was reported. The rescued air crewman later told debriefing officers he could not understand it, because he could see the rescue bird and kept pointing his antenna directly at it. Poor procedure? No. Poor training!

To prevent such occurrences, Air Force is rushing through a decal to put on the radio saying: "Keep Antenna Straight Up," but a decal isn't much help in the Stygian gloom of a Vietnam jungle! Training, familiarity, and practice are the answers.

Since the URC-10 (RT-10) is a UHF transceiver, its signal pattern is *line of sight* (left). Other factors being equal, the downed airman betters the chance of someone's picking up his signal by increasing the height of his antenna. For example, with the rescue bird at 1,000 feet, transmission from the ground has maximum contact range of 42 miles; with an antenna height of 50 feet, the contact distance stretches to 53 miles; at 200 feet, the range increases to 62.5 miles. These distances are based on maximum battery power but they emphasize the value of increasing the height of your transmitting location in contacting rescue aircraft.

In survival there is an old axiom about "according to the situation" which certainly is true here — but, if you don't want to compromise your concealment, your secure location, etc., it is best to find high ground, perhaps even to climb a tree. Remember, you can buy roughly another 5 miles of transmitter pattern with every 50-foot increase in antenna altitude!

Two other major factors influence your transmitting range: battery power and the physical conditions under which you are transmitting. Radiating power of the URC-10 is 200 milliwatts minimum. At this power, you can expect at least 50 operating hours at 80° F. (when alternately transmitting half an hour and receiving half an hour). Your preflight check should include assurance that the battery is fresh. *Within two years of manufacture* is the current criterion, but the Air Force is now rushing procurement of Battery Tester, TS-2530/UR, which will give an accurate reading of remaining useful battery life. Temperature affects battery power; cold decreases battery life. That is why the URC-10 has a separate battery and a 3-foot cord, so the battery can be kept warm inside the flier's clothing in a cold weather survival-rescue situation. If you have an RT-10 (battery; built into back of radio) and are downed in cold weather, you can get better radio performance (and longer useful battery life) by keeping the entire set warm or slipping the battery out and keeping it warm before you use it.

If the signal's having to pass through solid or partially solid objects, transmitter power (and range) will be decreased. This is called attenuation by the electronic experts, which means dilution. Perhaps the most common factors affecting a downed airman's transmitting range are trees, vines, foliage. In Vietnam, for example, the jungle can consist of three layers of almost impenetrable foliage. The effect of this cover is not yet fully known but the best educated guess of the survival and electronics experts is that the deepest jungle decreases your transmitting power by one-half. This could mean that your range from ground level is decreased to 21 miles with the aircraft at 1,000 feet.

All this adds up to the possibility that the best place to hide may not be the best place to transmit. When you add that it is also not the best place to get picked up, well, it means you should begin to exercise your skill and training to improve your survival situation.

A final factor which you must understand: On "sweep tone" your transmission is more quickly identified by the receiver, more easily recognized as a distress signal, and much more easily homed in on. A rule of thumb is to use "sweep" until you have the rescue bird in sight.

The Air Force places a high value on your survival and, for this reason, usually gives you "belt and suspenders" in survival radios. Currently, the Radio Beacon Set, AN/URT-21 (or equivalent), is located in your parachute and activates automatically in bailout. Excellent! But remember that this beacon operates on the same guard channel as does your URC-10 or RT-10. If you dispose of your parachute for any reason, be sure to deactivate or destroy (dependent upon the situation again) the transmitting ability of this beacon if you plan to use your survival radio. The beacon's transmission can block or garble your voice and seriously affect your sweep tone.

Finally, and we hope you never need to apply this information, we must discuss how best to dispose of the URC-10 or RT-10 radio in case your need for it ceases or if your capture is imminent. In our last paragraph we will discuss how very resistant this little radio is to applied destructive force. To effectively damage it with bare hands is practically impossible. Simple tools such as rocks, heavy limbs, or hammer can do the job but will take you a while and you'll make plenty of noise, usually too much if your situation is critical. Also, as you've been taught in survival schools, you must always think of escape if you are captured. Therefore, separating the radio and battery is the best step to take. Bury each separately in a manner and relationship to each other that only you know. Try to orient yourself so that you can locate one of the spots again. It may be only a remote hope but *hope* will be your most valuable mental asset in the difficult time to come.

If time does not permit planning, separate the battery and radio, break off the antenna of the radio as close to the case as possible, and dispose of the battery and radio sections separately by burying, submerging in the largest pools of water available, or flinging them in opposite directions. Any and all effective means must be used to eliminate the possibility of the enemy's compromising the radio for disastrous use against your buddies.

The URC-10 (RT-10) has been built to take it. Parachute opening shocks, hard knocks, and scramble evasion tactics should not impair its operation. (In your training you should have seen the set with its back off and observed its components embedded in foamed plastic.) Still, some care should be given the unit, as reports from all over the world say that, next to the parachute, this radio is your most valuable survival tool. Take care of it and it will take care of you.

KEEP POSTED ON AR 95-63

CW2 Harry O. Pierce

AS AN ARMY aviator, you probably know that AR 95-63, dated 15 February 1966, has many things to say to you about the Army aviation instrument program. Provisions of AR 95-63, dated 18 February 1960, and AR 95-67, same date, have been incorporated into the new AR 95-63.

But you are also aware there has been one change since its publication, and that a Department of the Army TWX 765017 has made new provisions? This TWX has had a considerable influence on how to apply AR 95-63 to oneself.

There are now two categories that must be kept in mind when one reads the regulation: Have you recently served in Southeast Asia or not?

For instance, provisions of paragraph 2c of AR 95-63, which requires aviators to re-establish instrument qualifications within 90 days of the expiration date of instrument tickets, have been waived for aviators returning from Vietnam, Laos or Thailand. These returnees now have 6 months after reporting to a new unit in which to renew their instrument tickets. This waiver applies to those who were on duty in Southeast Asia in PCS or TDY status.

Other Army aviators must re-establish instrument qualification within 90 days of expiration of their instrument tickets or face the consequences of being temporarily suspended from flight status and placed before a flying evaluation board. The one exception to this provision is that aviators in assignments where instrument qualification is not required (para 2b, AR 95-63) must re-establish instrument qualification within 90 days after reporting for duty in an assignment which requires such qualification.

Another provision of AR 95-63 to consider is para 6g pertaining to expired instrument cards. This paragraph stipulates that procedures and requirements for re-establishing instrument qualifications are the same as for reissue provided requalification is established within 90 days following expiration of ticket. Again, this paragraph has been waived for aviators returning from Vietnam, Laos or Thailand.

In all other cases, procedures for re-establishing expired instrument qualifications will be the same as for initial issue. The main point to consider here is that if instrument qualification has not been renewed within 90 days of expiration, aviators must then meet the prerequisites for an initial issue card. For this, paragraph 6c (2) requires a minimum of 20 hours of hooded or actual weather flight time within the 12 months preceding date of instrument flight examination. Ten of these 20 hours must have been flown in the aircraft category (airplane or helicopter) in which the initial instrument card is sought. For initial rotary wing tactical instrument cards, one-half of these minimums can be logged as copilot time under actual instrument conditions and by link or flight simulator time. Once more, these requirements have been waived for Southeast Asia returnees.

Just as a suggestion, many aviators find it rather difficult to overcome the obstacle of acquiring that 20 hours of hooded or weather time to qualify for an instrument renewal in the form of an initial issue. Keeping in mind that someday we will all have to renew that instrument ticket, regardless of the manner in which it expires, a knowledge of the provisions of AR 95-63, as modified by TWX 765017, will make it just a little less painful to renew our instrument cards by planning for this eventuality.

Mr. Pierce is assigned to the Plans Branch, Operations Division, Dept of Maintenance Training, Ft Rucker, Ala.

A quarter century of change in military primary trainers is represented by the Army's new Cessna T-41B (foreground) and a PT-17 biplane used by cadets of the old Army Air Corps. The T-41 is an off-the-shelf version of Cessna's commercial Model 172. It is performing missions of primary and advanced student pilot training and installation support roles for the Army.