UNITED STATES ARMY

MARCH 1967

AVIATION DIGEST

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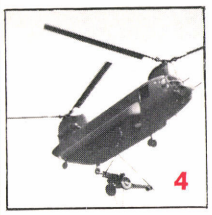

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The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other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

The DIGEST is an official Department of the Army periodical published monthly under the supervision of the Commandant, U. S. Army Aviation School. Views expressed herein are not necessarily those of Department of the Army or the U. S. Army Aviation School. Photos are U. S. Army unless otherwise specified. Material may be reprinted provided credit is given to the DIGEST and to the author, unless otherwise indicated.

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Use of funds for printing this publication has been approved by Headquarters, Department of the Army, 29 December 1964.

Active Army units receive distribution under the pinpoint distribution system as outlined in AR 310-1, 20 March 62, and DA Circular 310-57, 14 March 63. Complete DA Form 12-4 and send directly to CO, AG Publications Center, 2800 Eastern Boulevard, Baltimore, Md. 21220. For any change in distribution requirements, merely initiate a revised DA Form 12-4.

National Guard and Army Reserve units submit requirements through their state adjutants general and U. S. Army Corps commanders respectively.

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Army Helicopter Training --Yesterday and Today

Colonel George W. Putnam

The views expressed in this article are those of the author and do not necessarily represent the official position of the United States Army Aviation School or the Department of Army. Colonel Putnam is now commanding the Division Artillery of the 1st Air Cavalry Division. He is a former Deputy Director of Army Aviation and, more recently, Assistant Commandant, United States Army Aviation School.

IN 1964, THE United States Army Aviation School developed and submitted a Program of Instruction for an advanced flight training course designed, among other things, to qualify newly graduated Army helicopter pilots for assignment directly to operational Army aviation units in Vietnam. This recommendation triggered a thorough, though quick, look at the Army's initial entry helicopter training course. Two related factors prompted the analysis; first, rotation policies and the ever-increasing commitments of Army aviation in Vietnam would soon require that all newly graduated Army Aviators be assigned directly to Vietnam with as little intervening time after graduation as possible; and, second, the new course would require additional critical resources in aircraft, instructor pilots and dollars, much in demand elsewhere.

From the analysis came one fundamental fact which dominated completely all of the other considerations. The Army's initial entry helicopter flight training program of 32 weeks and 216 flight hours did not qualify the graduate to fly any of the operational helicopters in, or then expected to be in, Vietnam.

From this fact came a clear-cut objective: to revise and reorient the initial entry training program so that its graduate would be qualified to perform operational missions in Vietnam (and less clear cut, but essential) with an absolute minimum of in-country training and indoctrination. The challenge was unique and accomplishment of the task would be time-consuming. It was unique because no other service sent newly rated pilots direct to combat (always there was an intervening period of advanced or unit training of one sort or another); time-consuming because different aircraft would be required in the advanced phases of training and much new equipment, such as helicopter weaponry and navigation aids, was needed.

From that beginning came eventually the Army's 16/16 concept of helicopter flight training initiated with Class 66-1 at the United States Army Primary Helicopter School, Fort Wolters, Texas, in July 1965. To highlight the dominant features of the new course, the following table compares the old 12/20 concept (12 weeks at Fort Wolters and 20 weeks at Fort Rucker) with the new 16/16 program. (See chart p. 2)

In addition, all performance objectives, lesson plans, and concurrent training were examined to ensure compatibility with the mission at hand: training aviators for Vietnam. When the review revealed otherwise, the item was revised or eliminated. Simply stated, if training could not be utilized during the tour in Vietnam, it would most certainly be forgotten, and, therefore, was considered not productive. Cold weather operations was one example.

Twelve classes, or more than 2,700 aviators, have now been graduated from the new course and eleven of these classes, or about 2,400 aviators, are currently serving in Vietnam. The twelfth class, of about 300, is due to arrive momentarily. Since practically all of these are operational UH-1 pilots or copilots, a safe conclusion would be that nearly all cockpit-seat UH-1 pilots now in RVN are new graduates of the 16/16 course.

The question then becomes: How are these new graduates measuring up to the course objectives?

To begin with, what are the standards for graduation? In considering this question one must recognize that flight grading consists of a series of subjective judgments with literally dozens of variables affecting a particular grade. The only really unquestioned grade is the unsatisfactory given when the student commits a dangerous act – an act that might, in the opinion of the instructor pilot, have resulted in

damage to the aircraft, its occupants, or both. And, even here, the timid or overly cautious instructor pilot can cloud the issue by taking control of the aircraft prematurely. An interesting observation on flight grading, given more in earnest than jest, was made by a high-ranking naval officer with many years 'experience in flight training during a conversation with me some months ago. His view was that flight grading was more witchcraft than science, and far more influenced by variables than even an academic solution to a classroom tactical problem.

But back to standards! During the primary phase of 110 flight hours at Fort Wolters the student must obtain passing grades from his instructor and, additionally, complete three check rides—pre-solo, primary and advanced—each given by specially selected check pilots. The last two of these are administered by trained standardization check pilots who carry no students but administer check rides to all. On each of these, the student must receive a passing grade. If not, he is evaluated, to determine whether he should receive more training or be eliminated. In the advanced phases at Fort Rucker, the same principles apply, but the student must pass four check rides—basic instruments, advanced instruments, contact (UH-1 transition) and tactics.

Now, have the schools lowered their standards because of the pressures of Vietnam and the shortage of pilots?

Let's start by looking at attrition. Ten years ago flight training input for the average class exceeded those being graduated by from 25 to 35 percent. Invariably, about 2/3 of the losses resulted from flight deficiencies and the other third from other causes. In one particular WOC class, which I recall, the attrition was 65 percent of the input. Why, then, is attrition now averaging less than half that experienced ten years ago?

There are many reasons:

• Many of the officers now complete ROTC flight training during college. Those who can't fly, become airsick, or simply lose interest in flying, don't apply for flight training when called to active duty.

• The long-term noncommissioned officer used to be commonplace in Warrant Officer Candidate training; now he is the unusual exception. Not that the experienced NCO was an undesirable applicant; the exact opposite applies—he was and still is a highly desirable entry. But, the unadorned fact is that the motivation for many NCO applications at that time was either a desire for transfer or to improve status, rather than the fundamental requirements—a desire and a motivation for flying.

• The harsh, Prussian-type orientation of the WOC course was modified. An obvious result was a reduction in self-initiated eliminations.

• Arbitrary standards were ignored. Training was shaped to the individual, and now the Army has many, many fine pilots who did exceed, for example, a former limitation of 10 hours pre-solo before they were able to fly alone.

• Last, and the most overriding

	12/20	16/16
1. Preflight (for WOCs only)	4 weeks	4 weeks — Concentrate academics more on map reading navigation, weather, and other aviation subjects.
2. Cross-country dual	2.5 hours	4.3 hours*
3. Cross-country solo	3.5 hours	18.5 hours*
4. Low-level navigation	1 hour	4.5 hours*
5. Night flying	12.5 hours	30.7 hours
6. Instrument qualification	No	Yes (50 hours)
7. Tactical applications of instrument flight	No	Yes
8. Low-level autorotations	No	Yes
9. Flight at maximum gross weights	No	Yes
10. Formation flight-day	3 hours	7.5 hours*
11. Formation flight-night	0	1.5 hours*
12. Helicopter gunnery training	No	Yes
13. Survival, escape & evasion	24 hours	26 hours
14. Unit type field exercise	3 days	8 days (in an RVN environment)
15. Decca training	No	Yes (beginning March 67)
16. Crew training	No	Yes
17. Full UH-1 qualification	No	Yes

*Instructional flight hours only. They do not include the many hours of practice of these important flight maneuvers during flight to and from training areas, during practice airmobile operations, etc.

influence of all, was the Army's decision to permit enlistment of otherwise qualified high school graduates specifically for flight training. One need only attend a WOC graduation party, or talk to the highly motivated WOC sons of business executives, farmers, bank presidents, Air Force generals, plumbers, and career Army men, to recognize the popularity and across-the-board appeal of the Army's WOC flight training program. It is certainly one of, if not the most, popular military training programs ever initiated.

All of these factors have caused a dramatic reduction in attrition during primary training at Fort Wolters. On the other hand, the low attrition in helicopter training at Fort Rucker has been relatively constant for many years. Never, in the past five fiscal years, have losses been more than 2.5 percent or less than .6 percent of input. As of January 1967, attrition at Fort Rucker for FY 67 stood at 1.5 percent. And here even the most persnickety nitpicker would have to agree that a variation from year to year of less than 2 percent is insignificant as a factor in evaluating quality.

In fact, attrition at Fort Rucker from class to class, while programmed at 3 percent, is not predictable. In one class, 100 percent of those entering will be graduated; in another, ten or twelve may be lost for a variety of reasons, among them disciplinary, injury, self-initiated elimination, flight deficiency, etc.

One could conclude from the foregoing that quality has really improved due to more demanding requirements and higher standards for completion. But, the ultimate question is: What is happening in Vietnam? From the CONUS training point of view, a completely objective approach—keeping in mind time, dollars, length of tour, etc.— would be to graduate a new Army Aviator qualified to be a copilot in Vietnam for his first six months with the potential of becoming first pilot, or aircraft commander, for the last half of his tour. The fact is, however, that the new graduate in RVN is becoming an aircraft commander on an average of only two to three months after arrival —some with as little as one month's experience. Is this a tribute to previous training, an indication of operational shortages, or an indictment of the commander in RVN?

The first really applies. It *is* a tribute to training.

Another pertinent conclusion was drawn from an analysis of noncombat UH-1 accidents in Vietnam over a recent three-month period. Then, although most of the UH-1 pilots in Vietnam were new graduates, they caused less than half of these accidents. But, in mitigation, one really cannot draw meaningful conclusions from aircraft accident statistics without detailed analysis of the cause factors for each accident. As a sidelight, however, the analysis did indicate that if a new graduate were to have a noncombat accident, it would probably occur during his first four months in-country.

Last, with respect to quality, we have the judgments of the users—the commanders in Vietnam. I'll quote a few of many comments received, as well as one from a new pilot himself.

Brigadier General G. P. Seneff (CG, 1st Avn Bde): "The product you are sending us is superb."

Colonel L. S. Browne (former ARVN Division Advisor): "A short note to tell you about your people over here. As you have heard before, your guys are doing an outstanding job. Not only do they transport my troops, they furnish fighter cover, medevac, R&R flights, close-air support. You name it, they will do it."

Colonel H. K. Joost (former CO, 145th Avn Bn): "I have the highest praise for the enlisted, warrant and officer product that is being received in Vietnam. He arrives there not only well-trained and indoctrinated, he is also highly motivated—which can only be attributed to the personal attention he receives while at the School."

Colonel J. Marr (CO, 17th Avn Gp): "There is no question but what we (the Army) are graduating the most highly qualified aviator in the history of the Aviation School. All he lacks is experience, and in the final analysis there is no substitute for that and he can't get it in school. He comes here well qualified to become a proficient combat aviator in a short time, but there is no way he can be one when he gets here."

Warrant Officer W. L. Jackson (Army Aviator, 9th Cav Sqdn): "In twelve years in the Army, never have I seen training fit the requirement so well. We did things during the tactics phase at Fort Rucker exactly like we do them here. The only differences are that here you have rougher terrain, worse weather, more flying and you get shot at."

And now for a really subjective judgment . . . as Assistant Commandant, USAAVNS, I had direct responsibility for the advanced flight training of most Army Aviators now in Vietnam.

I felt then that their training was good; now that I'm serving with them, I've found no reason to change that view!

Colonel J Elmore Swenson

Training an AIRMOBILE COMPANY

This article is pegged specifically at helping the UH-1 and CH-47 unit commanders and staffs in readying a CONUS aviation unit for deployment.

MUCH HAS BEEN said about the best means to prepare an Army aviation unit for deployment. But with the exception of an article appearing in the September 1966 AVIATION DIGEST, much less has been written on the subject. The Department of the Army and Hq, USCONARC have now decentralized the activation and fill of airmobile companies throughout CONUS. The 10th Aviation Group will therefore no longer be the sole tactical organization training base for these units.

To facilitate spreading the know-how of activating, training and deploying aviation units, the 10th Aviation Group has a rush project underway to up-date documentation of the entire airmobile activation-through-deployment cycle. "Guide for Activation, Equipage, Training and Deployment of Aviation Units" was approved for reproduction and distribution in January 1967. Pending publication and distribution of the guide, however, this article should pass on a few time-saving "tips." It is pegged specifically at helping the UH-1 and CH-47 unit commanders and staffs in readying a CONUS aviation unit for deployment.

Commanders interested in these tips should be focused on training their units on a decentralized basis sans the aid of more than a nominal number of skilled cadre. This system may appear to be the "new look" in airmobile unit activation, fill, training and deployment, but it is actually nothing more than a slow-down-to-normal process. The normal training process is thoroughly covered in Army Training Program 1-77 for airmobile (lt) companies and a Third U. S. Army program of instruction for medium helicopter companies. These references provide the best known departure point since they are based on the self-training process wherein a unit is filled with TOE equipment before or as it trains.

Certain characteristics or weaknesses in the ATP should be recognized as requiring modification to meet the requirements of specific programs. These follow:

- The ATP does not include area orientation type subjects.
- The ATP is based on 18 weeks of unit training time with TOE and personnel (70 percent normally considered minimum fill necessary).
- The ATP unit training phases (team, section, and platoon) are based on a certain minimum of MOS-qualified/school-trained personnel in the hard skills such as helicopter mechanic, radio mechanic, or technical inspector.

These points are stressed not to highlight weaknesses at the ATP per se, but to indicate the need for certain modifications (modification authority for deviations to the ATP is contained in paragraph 4 of the appropriate program in effect).

The most significant lessons learned in the Group have been to *expect*: changing requirements in both POR and area orientation type subject material; the variability of training periods allotted; and a critical shortage/

CH-47 Chinook crews of the 200th Aviation Company (Medium Helicopter) practice with "piggy-back" loads of 105 mm howitzer and tandem-rigged ammunition at Fort Benning, Ga.

COL Swenson is CO, 10th Aviation Group, Ft Benning, Ga.

Training an Airmobile Company

slow-down in school trained filler personnel in the hard skills. The 10th Aviation Group training supervisors, including those in its subordinate 37th and 44th Battalions, have thereby gained a wealth of experience in training flexibility as shown by a local "new look" in master training plans (fig. 1).

This flexible training management device was developed within the Group for determination of milestones in an airmobile unit's training cycle. It is adaptable to either light or medium helicopter companies. It is adjustable to variations in either personnel on station date (POSD), aircraft readiness date (ARD), equipment readiness date (ERD), or personnel readiness date (PRD).

Note, however, that the training portion of the cycle may begin at any time after passing 50 percent personnel fill and when at least the equivalent of a composite flight platoon in equipment has been received. An intensive OJT program will not be profitable until a cross-section of TOE for both service platoon and TC detachment is on station. While awaiting the POSD milestone, maximum emphasis is placed on individual filler training qualifications and personnel actions; i.e., one-time training requirements as shown on DA Forms 20 and 66, a review of medical qualifications (assigned or potential crews), and initiation of personal affairs actions.

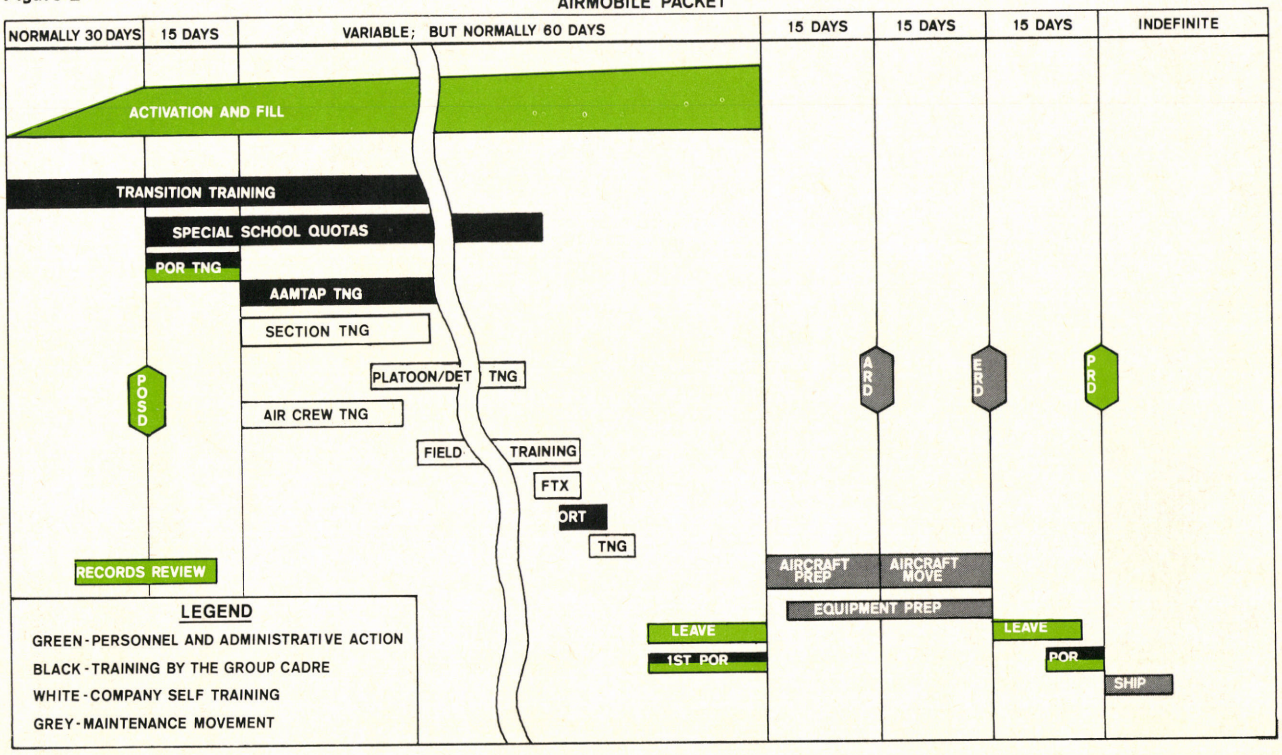
Aviator transition training should begin at the earliest date to provide the nucleus of an operational flight platoon. As the first aircraft is received, potential crewchiefs should begin immediate OJT up to 3 per aircraft under the supervision of an experienced crewchief. The first session of mandatory POR subjects should occur earlier in the fill cycle if the company is being trained as part of a battalion. A consolidated input would justify recurring cycles of POR training under a battalion committee if other critical maintenance and flight training functions are to continue.

Surely, the training most critical to the success of the unit mission is that which welds a team capable of performing tactical airmobile assaults. For the "slicks" this teamwork is developed through perfection of formations, control, and timing of assaults into unimproved areas. For the medium (Chinook) company, the perfect training vehicle for teamwork is practice of accuracy in the placement of an artillery battery into its firing position (s) with ammunition and crews, using the "piggy-back" principle of external loads.

The most difficult portion of this team training for both Chi-

Figure 1

MASTER TRAINING PLAN
AIRMOBILE PACKET



nook and Huey companies is the conduct of gunnery training. An infantry company is not considered combat ready when all its personnel are qualified in their individual weapons. Likewise, individual weaponry qualification is only a part of the necessary gunnery training in an airmobile company. Door gunner training is not as difficult to accomplish as training of the armed helicopter pilot and crew training, but both types create almost insurmountable problems for a separate company if the self-training process is used. It is in the solution to the gunnery training problem that 10th Aviation Group personnel have developed the greater expertise. During the activation, fill, training and deployment of approximately 20 airmobile companies from Fort Benning, a wealth of gunnery information and experience has been accumulated.

First, it has been learned that most of the problems result from a combination of shortages, such as: lack of adequate range facilities or existing range facilities not available; inadequate ammunition allowances; a shortage of qualified armament maintenance personnel; and experienced gunnery instructors. In decentralized training facilities, post range control personnel will not be familiar with aerial gunnery requirements from the safety standpoint and will tend to overemphasize the safety fan. A summary of the most pertinent gunnery procedures used at Fort Benning are restated below, since they are not necessarily incorporated in current regulations or training media.

Facilities. Range safety requirements for initial firing of students are as shown in figure 2. On this range, the students must prove their ability to keep all impacts within 500 meters longitudinally and 200 meters laterally of the target. When the instructor pilot has satisfied himself that the student (s) can accomplish this (usually within one day's time), then the criteria shown in figure 3 satisfies range safety requirements for subsequent periods of firing.

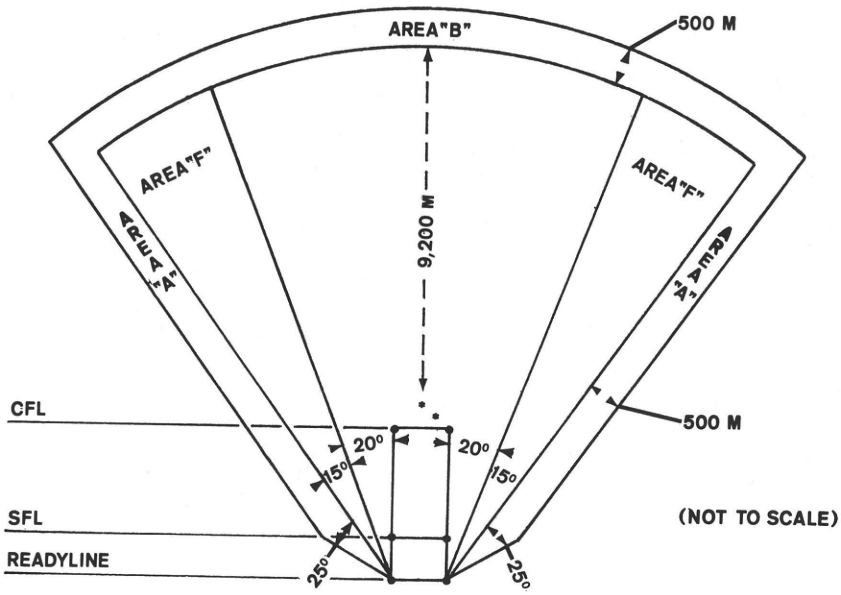
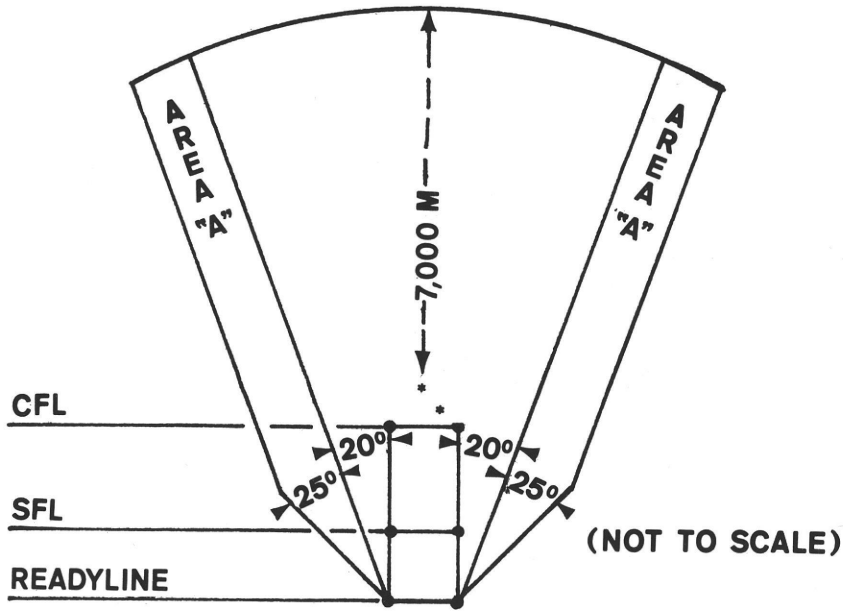


Figure 2 ▲ is a reprint of a drawing appearing with "Rotary Wing Armament Training" (Jan 1965 DIGEST) with some marginal data eliminated for simplicity

Figure 3 ▼ is a reduced fan for 2.75" rockets. It was approved by the Safety Division, Headquarters, U. S. Army Materiel Command on 8 October 1966, provided the specified safety control plan is rigidly adhered to.



Ammunition. The following ammunition allowances are considered a minimum to accomplish the desired degree of individual and fireteam training:

• 7.62 mm (linked) 7,000 rds per aviator; 4,000 rds per door gunner.

Training an Airmobile Company

• 2.75″ Rocket, FFAR, 112 rds per aviator.

• 40 mm cartridge, 450 rds per aviator.

Safety Control Plan. The following procedures are used to implement and/or amplify local range regulations:

The range control officer (RCO) may control the ranges and range firing from an aircraft or from the ground, but must have radio contact with all aircraft conducting firing and be in a position to maintain visual contact. He will not be in one of the firing aircraft.

All firing will be conducted in the firing lane between the Start Fire Line (SFL) and the Cease Fire Line (CFL). Easily identifiable markers will be placed on the ground to indicate the limits of SFL and CFL. All firing will be conducted under the direct supervision of an instructor pilot after being cleared to fire by the RCO.

The minimum slant range from the helicopter to ground burst for the 2.75″ rockets and 40 mm grenades will be 300 meters. No target will be overflown at less than 300 feet absolute altitude.

When firing the modified range (fig. 3), targets will not be engaged beyond 1,250 meters with the M-60 machineguns, or 3,000 meters with 2.75″ rockets.

During door gunner firing, there will be positive communication between the pilot and student gunner, a safety officer will be aboard with access to all firing systems in the cargo compartment, and an IP will be aboard to ensure that no firing is conducted when the aircraft is off course or in an altitude/position that could cause impacts outside the impact area.

The 10th Aviation Group has recently received numerous visitors involved in airmobile unit training from various CONUS installations. They were warmly welcomed and wherever possible given training material and briefings in their areas of interest. The 44th Battalion, moreover, has provided airmobile company support to alerted units of the CONUS divisions. The battalion has also conducted a complete gunnery training program for aviators and door gunners from these divisions.

It is hoped that in addition to visits to the 10th Aviation Group the soon to be published guide and this article will provide a ready reference for all. Meanwhile, the 10th Aviation Group stands ready to share experience and assist all others responsible for future training of airmobile units.

UH-1Ds of the 176th Aviation Company (AML) participating in advanced unit training (airmobile assault) at Fort Benning, Ga.

ANNUAL AWARD
Monthly Winner
CONTEST

Someone Had Tried

TO KILL ME

Major Charles W. Watkins

WHEN I WENT through helicopter transition back in 1957 most of the flight maneuvers for the OH-13 called for 3100 rpm. You could depend on that instructor to roll his eyes to the tachometer many times during the flight period and remonstrate, "3100, 3100." Another thing I did not forget was "rotor in the green." Always keep your rotor in the green. If you have to redline a gauge, pick one of the others, but keep your rotor in the green.

Then why was that unfaithful needle dropping? Was there something wrong with the stupid instrument? The crewchief was going to hear about this. Inefficiency on his part. But wait! Both needles, still joined, were falling from 3100 rpm!

At this time my heart should have been pounding in my chest. Adrenalin should have been racing through my blood and cold sweat popping out on my forehead. As the OH-13 stopped flying, taking on the characteristics of a rock, and began its rapid descent toward mother earth, my thoughts should have been of my family. Did I leave my wife enough insurance money? What would she ever do without me?

None of these things happened to me. What did happen was that the OH-13 I attempted to hover settled back down to the ground, not 600 feet but about 6 inches. My forehead was not covered with perspiration but wrinkled as my mind puzzled what had happened. Since then the event has taken on a much clearer realization: SOMEONE HAD TRIED TO KILL ME!

Let me tell you my story. I did not hurry out to the airfield on a hot summer day. The scene was Germany on a cold winter day. The reason I did not hurry to the airfield was the falling snow and ground fog that filled the sky with zero-zero conditions. My boss and I were to fly to the division headquarters airfield, pick up another OH-13 helicopter, and fly out to the field to support a combat command for a week.

It was the middle of the after-

MAJ Watkins is assigned to the 205th Aviation Company, Fort Sill, Okla.

I was shocked into action as my boss called, "You're on fire!"

noon before the weather lifted to helicopter minimums. With about 2½ hours of daylight left we had just enough time to pick up the other OH-13 and join the ground unit in the field. Arriving at the headquarters airfield I completed administrative arrangements for the loan of the OH-13 and filed a new flight plan for the two 13s. Preflight and runup were normal with no problems. We were on our way to the field.

We never made it. Within 20 miles of the field location, the weather became worse. Faced with making a decision, we turned our aircraft away from the bad weather. Following the path of good weather we found ourselves in a valley heading back to the home station. We would spend the night with our families and pursue our military task in the morning. The decision seemed right as we arrived at the home airfield after dark with snow and ground fog closing in fast.

We congratulated ourselves on our astute judgment and decision-making ability. The helicopters were shut down on the ramp and wheeled inside the hangar to protect them from the cold and to make starting easier in the morning. We could refuel in the morning. The hangar was constructed with a low ceiling for small airplanes; the main rotor blades of the helicopters could not be tied down inside without hitting the rafters.

Early the next morning the weather was flyable. The helicopters were rolled out onto the ramp, refueled, and preflighted. Runup was normal and all instruments were in the green. My boss was at a hover about 100 feet away, waiting for me to pick up and follow him in flight. It looked like a good day for flying.

This brings us back to the start of my story. As I pulled pitch for my hover, the OH-13 rose about 6 inches and settled back to the ramp with both tachometer needles falling. As I began to look at the other gauges to determine the cause, I was shocked into extremely fast action by my boss calling over the radio, "You're on FIRE." It is impossible to measure how many things can be done with such speed when the occasion presents itself. All switches were shut off, safety belt released, door opened, and myself propelled around the corner of the hangar in less time than it takes to tell about it.

I was unable to provide some pertinent information to the assistant division aviation officer. He wanted to know the transmission oil temperature at the exact time my boss was informing me the aircraft was on fire. This was also the time I was making an exit from the helicopter. All I could say was that all instruments were in the green when I attempted to hover. The "fire" turned out to be without flames but a great amount of smoke coming from the transmission housing when something inside, for some reason or another, decided to freeze the transmission.

I needn't have worried about my incomplete report to the assistant division aviation officer. In about two weeks a fellow aviator from the division headquarters airfield came to interview me and refresh my memory of these events in the form of an investigation. It seems the aircraft maintenance unit from higher headquarters, who were kind enough to replace the transmission on this aircraft, were curious about the transmission freezing. Their diagnosis indicated some foul play or lack of professionalism on the part of the aviator in regards to preflight/runup. The investigator wanted to know if at any time did I start the engine with the main rotor blades tied down.

Most insurance companies prescribe procedures to be followed after an accident: assist the injured and take names of witnesses. Many witnesses attested to the fact that at no time had I started the engine with the blades tied down. In fact, the blades of that helicopter had not been tied down from the time I received the aircraft until after the accident. I was exonerated.

Procedures and training will help eliminate an aviator's embarrassment of starting the engine with the main rotor blades tied down. One of the more effective procedures is to swing the blade 90° when it is untied. But as long as we have a main rotor system where the blades are tied down this type of accident can happen. Just one more reason for the use of a valid checklist.

The aircraft maintenance unit diagnosed the primary cause for the transmission freezing was the engine being started with the main rotor blades tied down. I believe them. A review of the maintenance records for this helicopter revealed no writeup for a start with the blades tied down. There is no doubt in my mind that someone had started this helicopter with the blades tied down. There is no doubt in my mind that by not writing this information in the book so appropriate maintenance action could take place, either by ignorance or embarrassment, SOMEONE HAD TRIED TO KILL ME.

FLYING IN EUROPE

Army Aviators assigned to USAREUR for a first tour find flying rigidly controlled. Those who were assigned to Europe in the '50s will find many changes in flying rules and procedures.

Lieutenant Colonel Donald E. Mulligan

ASSIGNMENT to Europe requires the aviator to learn new flying rules and to develop familiarity with differing weather conditions and terrain. For example, recent changes in night flying regulations for West Germany virtually eliminate night VFR flying except in local traffic patterns. Army Aviators assigned to USAREUR for their first tour will find that all flying is rigidly controlled. Aviators who were assigned to Europe during the '50s will find vast changes in flying rules and procedures.

For many years following the end of World War II, Allied military personnel were almost the exclusive users of European airspace. A few basic regulations governing Army aviation operations sufficed to ensure safe flying conditions. Gradually, as the various nations of Europe recovered from the ravages of war, commercial aviation developed and increased in tempo. Today the combination of European military and civilian aircraft constitutes a significant portion of the world's total aviation fleet.

As a result of this aviation expansion those few basic post WWII regulations gradually became inadequate. The most critical area of European aviation operations is in Western Germany where the majority of USAREUR's aircraft are based. This is a country, much the same in geographic size as the state of Arizona, over which operate military aircraft of all the NATO countries, commercial air-

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COL Mulligan is attending the Armed Forces Staff College, Norfolk, Va.

lines from all over the world, private aircraft, and local sports flying clubs. Within 50 nautical miles of Heidelberg are 28 established airfields. Without adequate regulatory procedures aeronautical chaos would reign. Consequently, Army aviation regulations have become more complex in the past few years. This situation, coupled with the Communist demonstrated intention of destroying any U. S. military aircraft flying over Soviet bloc countries, places unusual demands on the aviator assigned to USAREUR.

Department of the Army recognizes that it is impossible to design a regulation for worldwide application to Army aviation. Therefore, most Army regulations in the 95-series contain a provision which permits major commanders to publish implementing instructions or regulations. In the case of USAREUR this was accomplished with the publication of USAREUR regulation 95-5, Regulations for U. S. Army Aircraft and Aviators.

This document is the basic flying regulation governing Army aircraft flights throughout Europe, the Middle East, and Africa. It was designed as a supplement to existing Army regulations and provides the greatest possible latitude for peacetime operations that the various European nations and existing treaties permit. USAREUR regulation 95-5 contains only those items which experience dictates must be regulated and does not repeat regulatory procedures of other publications. In spite of this concept, the document is lengthy and demands detailed study on the part of any aviator who operates aircraft under its provisions.

A significant portion of the publication is devoted to operations within the Central European Buffer Zone and Air Defense Identification Zone (ADIZ). To reduce the possibility of an inadvertent overflight of the East German or Czechoslovakian borders, operations in the ADIZ are limited to the minimum essential missions. An aviator who unfortunately finds he has flown into a Soviet bloc country is faced with a number of unpleasant possibilities. First is the very real possibility of being shot down by Soviet bloc air defense elements; next follows the embarrassing international publicity and complications for the United States government; and if he is fortunate enough to have survived, there will be numerous boards of inquiries including a flight evaluation board.

Creation of the Central European Buffer Zone resulted from the loss of two USAF aircraft early in 1964. It was designed to ensure that military aircraft operating near sensitive borders remain under positive navigational control at all times. The principal means of identifying aircraft is through the use of transponders. Squawking the wrong mode and code or failing to follow your flight plan will result in NATO air defense elements intercepting your aircraft. Strict compliance with the provisions of USAREUR regulation 95-5 ensures successful completion of assigned missions with no embarrassment to the aviator or the U. S. government.

Operating an aircraft in the continental United States requires the aviator to adhere to rules in both military publications and those of the Federal Aviation Agency. Operations in Europe differ because each nation publishes its own rules of the air. Most countries are members of the International Civil Aviation Organization (ICAO) which attempts to standardize aviation rules and regulations. Standardization becomes difficult since each nation reserves the right to publish additional rules for its own airspace. Consequently, the Army Aviator must be familiar with current U. S. military regulations, ICAO rules, and rules of the air of the country over which he is flying. Differences in rules and regulations can lead to potentially hazardous conditions. For example, one country issues altimeter settings measured above mean sea level while another gives a zero setting for the airfield elevation.

Fortunately, the English language has been adopted as standard for ICAO radio communications. However, difficulties still exist, since the majority of traffic controllers speak English with an accent. This complicates copying of difficult ATC clearances or entering traffic patterns at strange airfields. Failure to understand a clearance can lead to a dangerous situation. There is no ready solution to this problem and it takes time for the new aviator to adjust to the language problems. The best solution is to pay close attention to instructions being issued by controllers.

To properly prepare newly assigned aviators for operations in Europe, USAREUR regulation 350-5, USAREUR Training Directive, requires a 10-hour flying orientation for all aviators. This training includes flying with experienced personnel and visits to various flight control agencies. In addition to this training each newly arrived aviator must attend

USAREUR Regulation 95-5 governs U. S. Army flights in Europe, the Middle East, and Africa

a two-day classroom indoctrination course. Both of these requirements must be met before the aviator is permitted to fly solo. At the conclusion of this training, aviators are prepared for both IFR and VFR flying in Europe.

Army Aviators operating military aircraft crossing international boundaries must be familiar with the provisions of the USAF Foreign Clearance Guide (FCG). This publication is composed of two versions; one is unclassified, the other classified. FCG contains essential information on such items as customs requirements of all nations in the world as well as entry and departure requirements for U. S. military aircraft.

Many countries require prior notification of military flights and some other nations can be entered only after issuance of a diplomatic clearance from the destination country. Awaiting receipt of diplomatic clearances can delay departure of a flight for as long as 21 days. To prevent an embarrassing situation, it is essential that all requirements of the FCG be complied with before departure on an international flight. Some NATO countries modify entry requirements for military aircraft of member nations, but FCG requirements apply in the majority of cases.

It becomes apparent that the average aviator does not have time nor access to all published material to become intimately familiar with the various rules and regulations devised for operations in Europe. One of the tasks of the clearance officer at Army Flight Operations Facility (AFOF) is to become an expert in European flying regulations. It pays to pose any questions to AFOF before departing on a flight because that organization has the resources to provide you an answer.

A good example of a difference between flying in CONUS and Europe is the military flight plan. To assist the various ICAO member nations in transmitting U. S. military aircraft flight plans it became necessary to replace the DD Form 175 with a flight plan in a format compatible with ICAO transmissions systems. This resulted in the three U. S. military services designing a flight plan which differs in form and content from the DD Form 175. All U. S. military aircraft flying in Europe use USAFE Form 249 which has provisions for entering the standard flight plan information but contains additional requirements over those required in CONUS flight plans. The different format and additional items make it compatible with ICAO systems.

Adverse weather is a major factor which should be taken into account by the aviator while flying in continental Europe. Germany and France lie on roughly the same latitude as the northern border of the USA. This, coupled with its geographic location near large expanses of water, results in generally poor flying conditions. Winter weather in Europe is characterized by prolonged periods of low ceilings and reduced visibilities coupled with freezing levels at or near ground level. An aviator's first year of flying in Europe will expose him to weather conditions which require careful study before he departs on a flight.

If you are a seasoned veteran of European flying and are returning for another tour, this article will probably provide a certain amount of nostalgia for the "good old days." If you are an aviator coming to Europe for your first tour there is probably a certain amount of anticipation for what the future holds. In either case, this article will serve as a brief indoctrination. Flying in Europe demands a completely professional approach to the execution of responsibilities as an Army Aviator.

CH-34s land troops during maneuvers in Europe

MEDITERRANEAN ADVENTURE

Major K. R. Jones

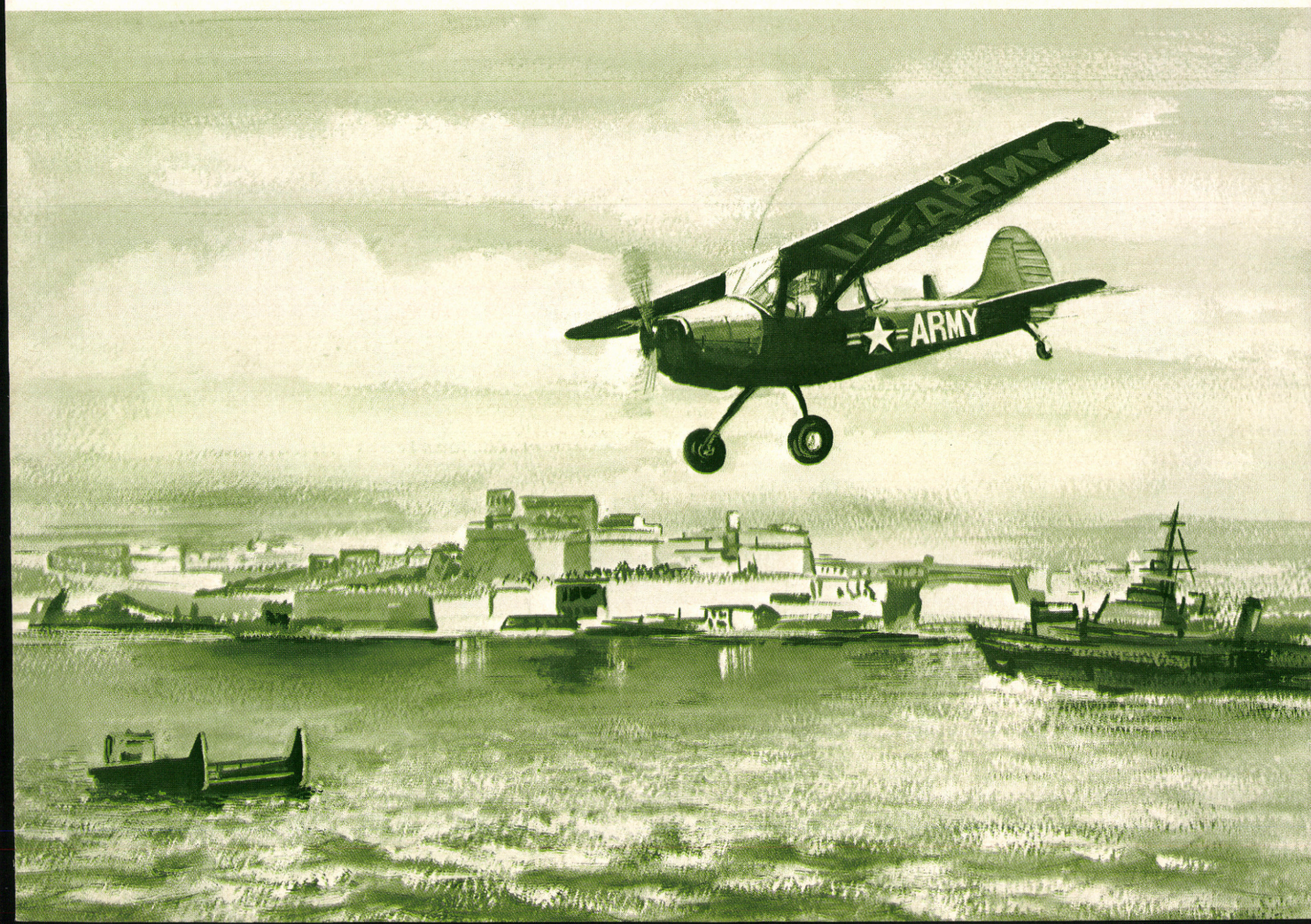
I WAS ASSIGNED to an Army Map Service project in Libya, and it was a pleasure to be spending 30 carefree days touring Europe with my family. As the end of my leave was fast approaching, I began to make plans for the return trip to Tripoli. A telegram from my unit arrived, directing me to pick up a TO-1D at Coleman Barracks, Mannheim, Germany, and deliver it to my unit in Libya. Free transportation for me. That sure was a welcome to my shattered budget.

Two days after receiving the telegram I was at Coleman Barracks having my first look at a TO-1D. Of course I had flown the O-1A and did not anticipate any trouble with the D model. A fast check with pilots who had flown the D produced some recommended power settings. I signed for the aircraft, filed a flight plan and departed on an uneventful flight to Lyons, France, where I sent the required RON message and spent the night.

The next day I departed Lyons early, flew to Nice, refueled and flew on to Rome. I refueled at Rome and departed on the first overwater leg of the flight, to Palermo, Sicily. Here I refueled, sent the RON message and headed for the hotel.

Early the following morning I prepared a flight plan for a direct flight to Wheelus Air Base, Tripoli, Libya. I checked the weather and started to file the flight plan. The man at the counter, upon discovering who I was, presented me with a message that instructed me not to go beyond Malta without an escort. I changed the destination and ETE on the flight plan and sent a message to

The one hour flight to Malta was a breeze but problems loomed ahead



Wheelus requesting that the escort meet me at Halfar, Malta.

The one hour flight to Malta was a breeze. After landing I went to the operations office to check on the ETA of my escort. Evidently my message had not arrived at Wheelus. An escort was not on the way.

I obtained permission to use the hot line to communicate with Wheelus. I made arrangements to meet the escort at Point Beta, the approximate mid-point between Tripoli and Malta.

A request for fuel revealed that the lowest octane available at Halfar was 115/145. Well let's see, I had flown for one hour, two hours to go and that left an hour and a half reserve (I thought). I rapidly filed a flight plan and departed south along the airway. A few miles south there were scattered clouds at my flight altitude. I began to climb to the required distance above the clouds. The cloud cover below me turned solid and rose at the same rate the aircraft was climbing. When I reached 14,500 feet, the cloud layer leveled below me. I elected to continue south along the airway and let down at the first opportunity.

An hour after departure I tuned the predetermined frequency on the radio and called the escort. I got an immediate reply, and after a few minutes I sighted the Air Sea Rescue amphibian directly to my front. I told him that all was well with me and that he might as well return to Wheelus. He circled around me and headed south along the airway.

As the amphibian was fast disappearing in the distance, the pilot started to tell me something about an unreliable bird dog (the ADF, not the O-1) due to thunderstorms. I heard only the first part of his sentence. The engine had quit. In much less time than it takes to tell about it, I switched fuel tanks, turned on the boost pump, pushed the mixture rich, put on full carb heat, and checked to see that the mags were on BOTH.

I reached for the door with one hand and the mike button with the other. As a 3-3 aviator I had no intention of staying with the plane in the clouds below. That parachute and the attached rubber raft looked better to me than riding the O-1 through the clouds to the Mediterranean below. As I started to talk to the pilot of the amphibian, the engine caught and ran smoothly. I explained my circumstances to the pilot and asked him to say again about the thunderstorms and unreliable bird dog.

The remainder of the flight was uneventful, although I spent an hour anticipating how it would feel to be floating in a rubber raft or being a meal for the sharks. As I neared the African continent, the clouds ended like a cliff. When I knew that I could not fail to make the runway with a dead engine, I pulled the throttle back and started a descent from 14,500 feet.

Upon landing, I confirmed my suspicion that I had allowed a tank to run dry, though the fuel gauge indicated several degrees from the empty mark. Approximately 4 gallons remained in the other fuel tank.

Why didn't I discover that the fuel gauge was inaccurate? Why didn't I fly to another airport on Malta to obtain the 80 octane fuel that was used in the O-1 at that time? Why had I failed to properly recheck the weather before departing Malta?

Most important of all, why had I failed to get a proper checkout with an IP in the D model before taking the flight? Then I would have known, among other things, that the aircraft didn't have the fuel endurance of the O-1A.

I have asked myself these questions many times since that day, and I often remember the incident when I file a flight plan. That incident taught me an unforgettable lesson about proper preflight preparation and flight planning.

Near the African continent the clouds ended like a cliff

MAJ Jones was project officer, Operations Division, Dept of Maintenance Training, Ft Rucker, Ala., when he wrote this article. He is now serving in Vietnam.

Students and graduates of the Basic Avionics Maintenance Officer Course at Fort Gordon, Ga., are proud of their motto.

"Never An Aircraft Down For Avionics"

Lieutenant Samuel C. Wilson and Lieutenant Norman E. Colten

Saigon Tower, this is Fang One. Over.

Saigon Tower, this is Fang One. Over.

Several more attempts to contact the tower failed, so CPT Flip Hazzard switched to his emergency radio, contacted Saigon, and landed. After closing out his flight plan, the captain walked over to a large van, marked "007th Signal Detachment (Avionics)" above the door. Stepping inside, he walked to Lieutenant Cancel's desk and collapsed into a chair.

Alfred B. Cancel, 007th Signal Detachment commander, peeked around a 2-foot stack of paper and greeted his visitor, "How did it go today, Captain?"

"Al," the captain began, a bereaved look upon his face, "today was the third time this week that my UHF went out."

Lieutenant Cancel took notes as his visitor expounded upon the many "afflictions" of his unit's aircraft. After the captain left, Lieutenant Cancel called over his NCOIC, Sergeant Goodwood, and asked, "Sergeant, please explain what the captain was talking about. When it comes to these names and nomenclatures, I'm lost!"

As Army aviation grows, the complexity of the electronic communications and navigation equipment aboard each aircraft expands to meet the new demands. To meet its field needs, the United States Army Southeastern Signal School, at Fort Gordon, Ga., has increased the capabilities of its enlisted avionics courses—both in scope and training.

Many of these enlisted personnel are forming the nucleus of new units. With the formation of these avionics signal detachments and their deployment to Southeast Asia, one weak link became apparent: detachment commanders assigned to these newly formed units, or sent to fill vacancies in the field, were out in the cold with respect to aviation and avionics.

In April of 1966, the Southeastern Signal School saw the beginning of BAMCO. The Basic Avionics Maintenance Officer Course is specifically designed to train selected officers to assume command of avionics detachments. This unique four week course covers five main areas in its program of instruction. Light observation and light transport aircraft, phases I and II, occupy most of the first week, with the emphasis on the individual communications, navigation, and flight control systems. Then aircraft configurations are examined, and finally, an equipment serviceability criteria evaluation is performed on each aircraft by the students.

Next, the students move into phase III, command surveillance aircraft. The same system of teaching applies in this annex, with individual system and aircraft configurations discussed, and, finally, ESCs performed. Throughout these phases of training, constant stress is placed upon the maintenance responsibilities of direct support and general support avionics units, as applicable to present configurations and also those

LT Wilson and LT Colten are instructors, Avionics Department, U. S. Army Southeastern Signal School, Ft Gordon, Ga.

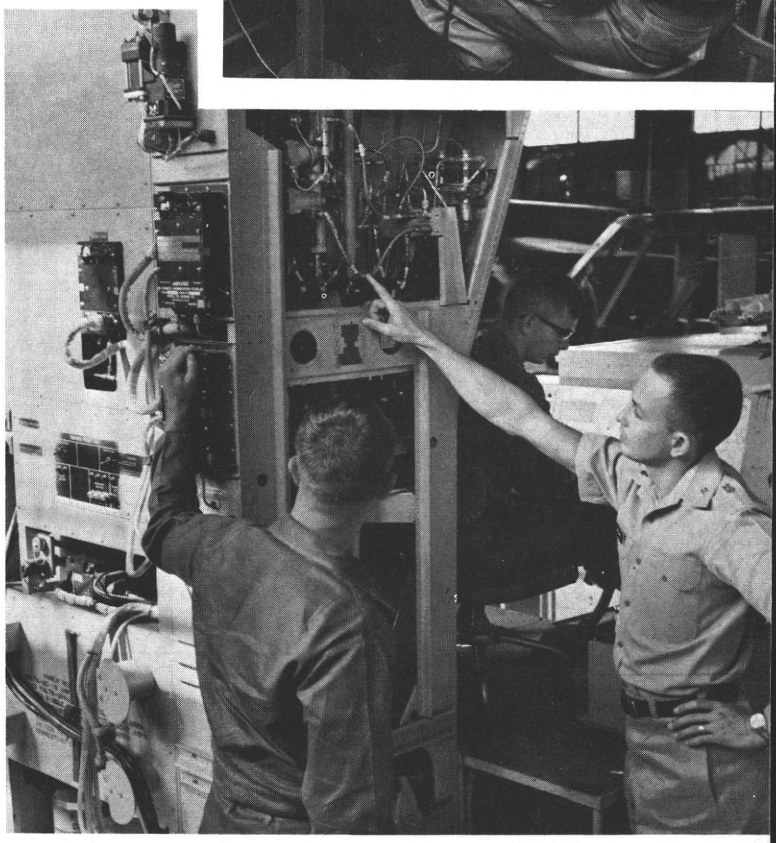
configurations planned for future procurement.

By the middle of the third week, the students have moved into phase IV, a variety of ground and tower communications and navigation equipment. Ground control radar and the newest family of landing control centrals complete this week. The fourth week is devoted entirely to the vast area of administration and supply. An attempt is made in phase V to present all problems normally facing the incoming officer of a typical avionics detachment. The property book, TOE equipment, and the personnel structure of various avionics detachments are examined. The commander's responsibilities, mission, organizational maintenance procedures, and 101 helpful tips from ex-commanders, now instructors, take each student through the assumption of command. Finishing out the instruction is MILSTRIP and the repair parts supply system.

After seeing our first three classes of ten through, and with a few minor changes to the program of instruction, it is felt by the BAMOC faculty that each graduate officer will be able to immediately function as a detachment commander.

As the graduates departed Fort Gordon for their field assignments, the roar of automobile engines could not drown out the BAMOC motto: "Never An Aircraft Down for Avionics."

Right: Students learn operational check procedures and configurations on a table before going to the aircraft.
Lower left: BAMOC students performing equipment serviceability criteria evaluation on Army aircraft.
Lower right: An instructor discusses the Chinook SAS and speed trim systems.



Airmobile Firepower—

In July 1965, an article in AVIATION DIGEST reflected early enthusiasm and hope for air assault artillery. The findings and evaluations were based on the 11th Air Assault Division mobility tests during the Carolina maneuvers. Now the test of time and evidence of combat experience can be added. The article which follows does this in a professional way.

When the 1,000,000th round was fired by the 1st Air Cavalry Division Artillery on 11 November 1966, it represented 14 months of reliable combat support for the sky troopers in Vietnam. It also represented remarkable operational readiness across the 250 kilometer depth and 200 kilometer width of the division's area of commitments in the II Corps tactical zone, a readiness demonstrated repeatedly by rapid deployments, in all directions.

Experience to date has shown that the sky troopers do well at finding the enemy; can be assaulted to any terrain of the varied geography found in Vietnam; their supporting firepower can be placed wherever needed; and the logistical support can back them all up with responsive facility. This composite package of reconnaissance, assault, combat support, and responsive logistics gives the 1st Air Cavalry Division's maneuver commanders heretofore unmatched potential for creating and exploiting tactical advantage on the battlefield.

The "first model" of the air assault division has performed beyond expectations. The potential of follow-on or retrofit designs of air cavalry organizations is beyond measure, but undoubtedly below conscious expectation, at this time. Continued imaginative attention and progressive effort will yield further significant rewards in terms of battlefield superiority.

WILLIAM A. BECKER
Brigadier General, USA
Assistant Division Commander
1st Air Cavalry Division

Hallmark of the 1st Cavalry Division

COL William F. Brand, Jr. **LTC Morris J. Brady** **MAJ E. K. Johnson**

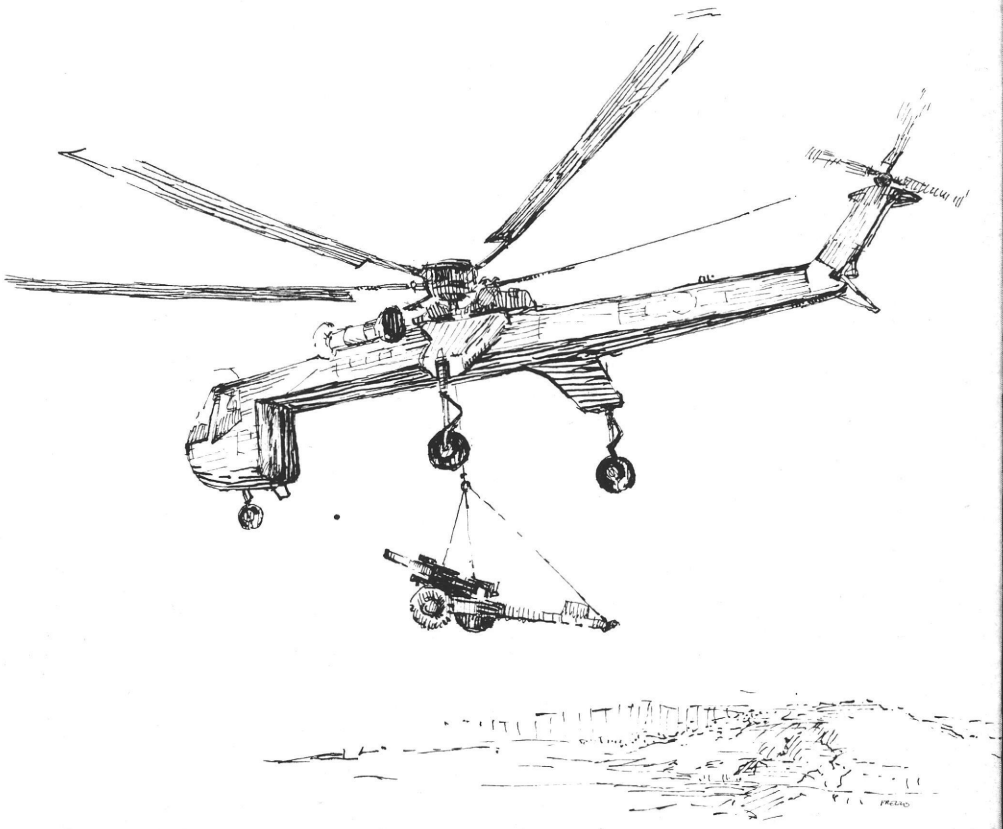
THE HISTORY of the Army's most unique experience in firepower, the 1st Cavalry Division Artillery, is brief but bold. Born as a concept, the division underwent exhaustive tests as the Southern United States witnessed the spawning of an airmobile unit that early in 1965 became the 1st Cavalry Division (Airmobile). The newly formed division proudly accepted the dashing traditions of the 1st Cavalry, translating these into modern airmobile versatility. In July 1965, the division began a movement to contact that carried its colors halfway around the world.

In anticipation of the job at hand, and realization that hard hitting cavalry tactics would be the key to success, the First Team's artillery punch was tailored to meet the challenge. Normal general support firepower, including the Little John Battalion, was left behind and the burden of providing responsive reinforcing fires fell squarely on the Aerial Artillery Battalion.

The First Team, a lean but lethal package, stripped of impedimenta to meet the demands of counterinsurgency warfare, came to stay. Gone was the fat—prime movers stayed behind; vans were deleted; equipment was especially designed to be compatible with Army and Air Force aircraft. New generations of combat equipment waited to be unleashed by the division's airmobile agility. The division was collapsible, prepackaged and ready to meet the call for widely diverse operations over a far-flung area. The Army's new family of radios, compact, light, and long ranged, became key items. Missing were the luxuries of living; personnel included only those needed. The voids thus created were filled with the satisfaction of being lightning swift and deadly effective.

On arrival in Vietnam, the division was faced with the task of establishing a base of operations that would enable its combat elements to move quickly into any zone within its area of tactical operations. The historic village of An Khe, astride highway 19, in the central highlands, was selected. In addition to its central location, An Khe was selected because the area is not scourged by the full brunt of Vietnam's biannual monsoons, thereby allowing the division to capitalize on every hour of flyable weather.

From An Khe, the Cavalry's influence spreads eastward through the Deo Mang Pass from the median plateau of the central highlands to the coastal plains of Qui Nhon, and westward over the Mang Yang Pass to the upper highlands of Pleiku, Darlac, and



A CH-54A Flying Crane airlifts a 155 mm howitzer into combat

Luxuries of living were missing

Northern Kontum Provinces. Sandy coastal plains, tropical forests, impenetrable jungle with 100-foot canopies, and precipitous mountains typify the terrain in the division's area of operations. This was "Charlie's" back yard—a Viet Cong stronghold that had sheltered an elusive, highly mobile, native enemy since before the signing of the 1954 Geneva Accords.

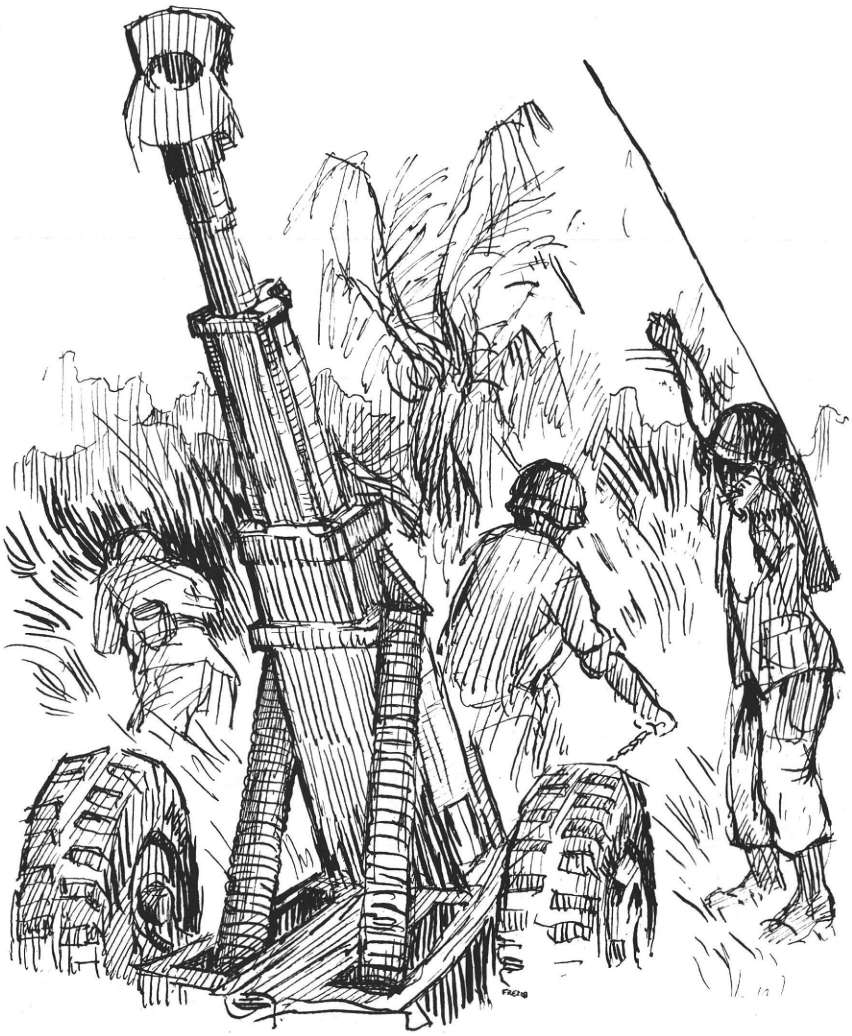
The enemy was a highly organized, well trained force dedicated to a master plan designed to tear South Vietnam from east to west along highway 19. In concert with this plan, the Viet Cong and the Army of North Vietnam had massed large forces for strikes against the Plei Me and Duc Co Special Forces camps—the first phase of his planned sweep to the east. The arrival of the "Horse Soldiers" upset Hanoi's timetable and at D plus one year has changed the face of the war in the highlands from a grand strategy involving large massed enemy forces to a small, fluid, piecemeal commitment of enemy manpower.

The division's early combat operations in the Chu Pong Massif, along the Ia Drang Valley and the Cambodian border, announced in bold type the presence and effectiveness of airmobile firepower. Typical of the enigma attached to counterinsurgency warfare is the fact that the division's firepower was most effective when the combat elements of the division were on the defensive. This paradox was best described by a beleaguered paratrooper who happily reported: "The poor bastards have us surrounded again!"

Regardless of where the Horse Soldiers rode their helicopters to find the enemy, division artillery's Chinook-transported howitzers were emplaced to fix and destroy him. Batteries of the new, lightweight M-102 howitzers, now being used by the three direct support artillery battalions, were emplaced on mountain peaks and in positions blasted and hacked out of trackless jungle. Encircling enemy forces were pounded from distant, mutually supporting positions and from within the surrounded perimeter. A highlight in airmobile artillery displacement came when four 155 howitzers were airlifted into combat operations for the first time in Vietnam. During the division Masher-White Wing Operations, giant CH-54 Flying Cranes moved the general support firepower, in four sorties, using improvised slings.

The ever-changing situation inspired the "Redlegs" of the First Cavalry to devise and employ new and unique tactics. Fires were de-

Batteries were placed in positions blasted and hacked out of trackless jungle



COL Brand was commander, 1st Cavalry Division Artillery; LTC Brady was commander, 2nd Battalion, 20th Artillery, 1st Cavalry Division; and MAJ Johnson was liaison officer, 2nd Battalion, 20th Artillery, 1st Cavalry Division, when this article was written.

livered over all quadrants of the compass, requiring the use of 6,400 mil firing charts. Artillery position areas were dispersed to ensure support for widely separated units. These same positions had to allow for massing of all available fires over the entire area of operations.

Use of interdiction fires was of significant value against an enemy that capitalized on hit-and-run tactics. Planning for these fires presented a major challenge to the artilleryman since hard, timely intelligence information was rarely available. The fire planners had to search for information, analyze terrain and enemy tactics in planning fires to destroy his supplies and demoralize his forces. Conventional artillery, unexpended TAC Air, and aerial artillery were used in the interdiction role.

The value of well planned, timely interdiction fires was attested to by prisoner of war reports. On one occasion, a prisoner stated that a battalion commander of the Quyet Thang Regiment and a force of 20 personnel were killed by heavy interdiction fires. The wily Cong soon learned to fear the Cavalry's massive firepower and quickly countered by moving as close to the friendly forces as possible, in "bear-hug" fashion, to evade heavy volumes of indirect artillery fire. To cope with this, extensive use was made of direct fire and close-in defensive concentrations.

High density of aircraft over the division's area of operations required the cannoneers to devise yet another special technique that allowed for smooth and coordinated fire support while aircraft operated within and around the area. This system, called "Fire Fly," gave priority to artillery fires and required aircraft to coordinate their flights with the direct support artillery battalion.

This was "Charlie's" backyard

Additionally, every howitzer crew checked the sky forward of the muzzle before pulling the lanyard.

Countermortar fires, needed to ensure base security, presented still another special problem to the division artillery planners. In this case, heavy reliance had to be placed on detailed terrain studies and intimate knowledge of the enemy's mortar tactics. When combined, these elements formed the basis of "Quick Fire" — a system that provided instant reaction to place large volumes of counterfires on likely or suspect enemy mortar positions. As information on the active mortar positions is received the countermortar fires are refined to destroy the actual mortar location. The immediate reaction of all available artillery is known to have curtailed several mortar attacks. Conventional countermortar fires are habitually reinforced by the direct fire aerial artillery and at the appropriate time the enemy is pursued by fire — as well as by assaulting air cavalry troops — by directing all fires against his likely escape routes.

Relative freedom of the An Khe base from enemy mortar attacks seems to be creditable testimony to the effectiveness of the Cavalry Division's defensive fire plans. This deterrence is undoubtedly reinforced by ground patrols and by the nightly presence of a mortar patrol aircraft from the Aerial Artillery Battalion. This aircraft continuously surveys the surrounding countryside, alert for flashes from enemy mortar tubes. The aerial artillerymen are always ready to answer such audacity with rocket fire while alerting their ground comrades of the threat and possible requirement for "Quick Fire."

The key to successful employment of firepower in the First Cavalry Division to date has been directly attributable to the artilleryman's aggressive ingenuity. His unique use of airmobility led the Viet Cong to christen the First Team's artillery "The Frog Artillery." Selection of widely separated and isolated position areas compounded the problems of providing position area security and clearing and coordinating fires. At times artillery units were

Divarty's mobility made the forward observer's job tougher

The M-22 provides the 1st Cav with a bunker-busting punch

required to provide their own security and did so with great success over short periods. Ideally, artillery units were collocated with infantry reserve elements. In addition, airmobile artillery batteries conducted leap-frog moves from one position to another, never occupying a single position long enough to present a lucrative target.

The familiar term "FEBA" was missing from the combat jargon of the division, and heavy emphasis had to be placed on no fire lines that took the form of boxes and circles. Because of this situation, the role of the forward observer and artillery liaison officer became tougher, more challenging, and more exacting than in any other war. The liaison officer had to feel the pulse of the operation and make constant revisions as the fire support needs of the ground commander changed. The forward observer was faced with problems of orientation and coordination: Where am I? — Where are the friendlies? Once these questions were answered, the observer learned to adjust artillery by sound or in conjunction with an aerial observer. The forward observer quickly became the Army's counterpart of the forward air controller, guiding and adjusting the most versatile and effective weapon in the division artillery's arsenal: aerial artillery.

On numerous occasions, Major General Harry W. O. Kinnard, speaking of concepts developed during Air Assault II, indicated that his gravest concern centered on the aerial artillery. On his departure from the First Cavalry Division in June 1966, General Kinnard said that of all the innovations of the Airmobile Division, the Aerial Artillery Battalion had proved to be the most gratifying. Aerial artillery's demonstrated ability to support diverse operations and simultaneously undertake independent operations within and outside the division's area of operations supported General Kinnard's remarks.

Capitalizing on airmobility, the Aerial Artillery Battalion operated with virtual disdain of terrain, weather, and the cumbersome logistical problems that are associated with the movement of conventional artillery. The constant threat of road ambush had little significance to the rocket firing helicopters. The entire battalion could be instantly displaced with minimum concern for intricate movement plans, route reconnaissance, or the detailed coordination normally attached to such moves. Of special interest to the ground commander was the speed and freedom of movement characteristic of aerial artillery. Rapid reaction and demonstrated first round accuracy formed the basis for a deep and lasting camaraderie between the aerial artillerymen and their supported ground elements.

The Aerial Artillery Battalion was found to be best employed in the reinforcing role with each aerial artillery battery enjoying a habitual association with one of the three direct support artillery battalions organic to the division. Committed brigades have learned to rely on the highly responsive fires of the "Armed Falcon." This reliance is typified by the action at landing zone X-ray during the first Chu Pong — Ia Drang campaign. In this historic action the cavalrymen found themselves surrounded by a regimental size enemy force employing bear hug tactics that initially ruled out the use of conventional artillery support.

Aerial artillerymen responded to the situation and provided airborne control for the ground forces, enabling them to establish a well defined and cohesive perimeter. Once this was accomplished, the airborne Redlegs set to work placing the aerial rockets within 50 meters of friendly elements throughout the day and seemingly endless night. As a result of this fierce 24-hour clash and in mute testimony of the effects of coordinated fire support the enemy was forced to withdraw, leaving 634 dead on the battlefield. It was estimated that 581 additional enemy dead were carried off by the retreating enemy.

Again at landing zone Eagle, the far-reaching aerial rocket ships answered the call when reconnaissance elements of the division, operating well beyond the range of conventional artillery support, were surrounded by a numerically superior force. As the only fire support available, aerial artillery remained constantly on station, delivering over 1,400 rockets into the jungle sanctuary of the Cong. These decisive, close-in fires turned the encirclement into a grave tactical mistake for the Viet Cong force. Not only did the enemy fail to destroy the outnumbered Americans but the wake of the enemy retreat left 122 bodies around the perimeter.

The Flying Falcons learned to lavish special attention on the life blood of their operation — aircraft fuel and the 2.75″ aerial rockets. The flow of these essential items is maintained by divisional lift elements, who have earned the admiration and respect of the Aerial Artillery Battalion.

The bunker-busting punch of the aerial artillery is in their

M-22 (SS-11) wire-guided missiles. This weapon has been employed with deadly accuracy on many occasions as in the instance when a U. S. Special Forces sponsored unit called for the M-22 against the heavily fortified gates of a Viet Cong controlled village. The flying cannoneers destroyed the heavy gates with two missiles and gained access to the village without causing needless injury or death to the inhabitants.

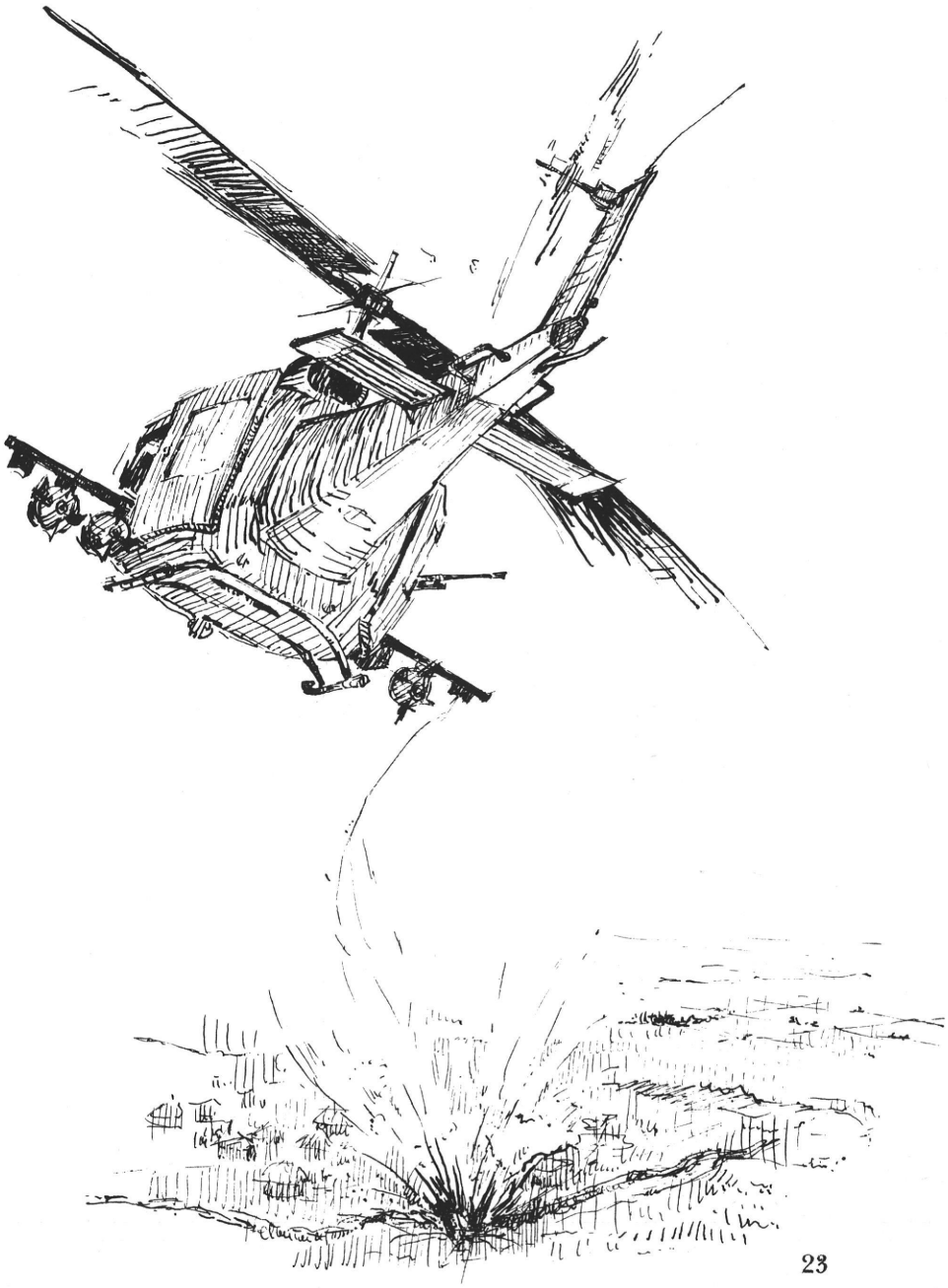
The deadly roar of aerial rockets over the First Team's battlefield has become a common and comforting sound to the sky troopers. The call sign "Armed Falcon" is a byword in the central highlands, synonymous with highly responsive, accurate and lethal firepower.

Any discussion of airmobility must consider the effects of weather. No one can dispute that weather has long been the bane of those who travel the skyways, or that it is a major consideration in the planning and execution of airmobile operations. The admission that weather is a limiting factor is no more surprising than the fact that jungle expanses are formidable barriers to the foot soldier or that rivers form imposing barriers to armor units.

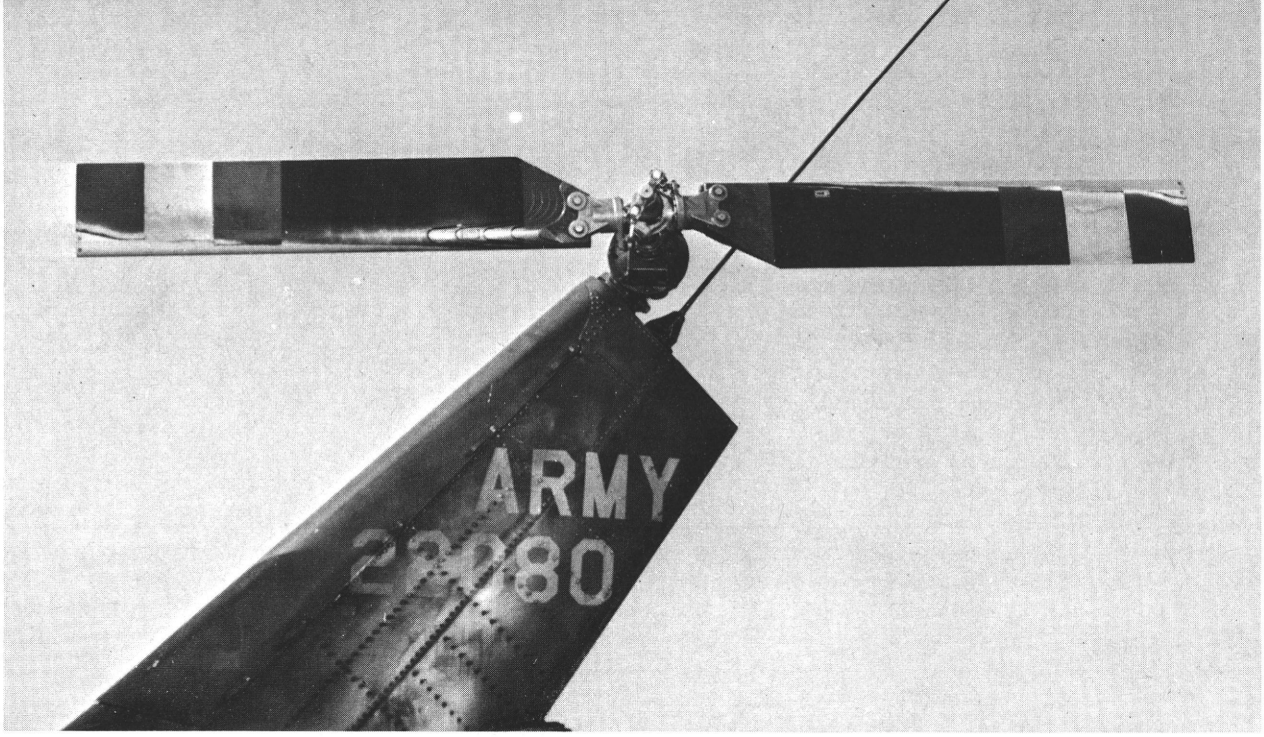
Weather has occasionally caused the postponement of an operation, but rarely has it caused a cancellation. The balance between airmobility and weather is found in improvisation. Operations to date in the central highlands have sustained the value of the helicopter and the professional attributes of the aviator who has learned to operate under adverse weather conditions.

In the final analysis, at D Plus One Year, it can be stated that airmobility has been a decisive instrument in the hands of aggressive, visionary commanders. Ground elements, moving to battle through the skies, need never travel without decisive firepower. The conventional and aerial artillery organic to the First Cavalry Division has conclusively proved that it can match the movement of its supported ground forces in speed and efficiency with little regard to the limitations of terrain and weather. The First Team's artillery has written a proud record as the forerunner of future division artillery concepts.

One year ago, the central highlands represented a serious threat to the Republic of Vietnam. Today, the "Cav" stands poised to destroy the Cong anywhere, anytime. The mettle of the enemy has been tested in the central highlands and, by his choice, confrontation has all but disappeared. The Horse Soldiers must now search to destroy.



Aerial artillery breaches the walls of a Viet Cong village



Additional Distractors To Tail Rotor Failure

Captain Earl Webb

JUST A TAIL ROTOR failure alone is a bone-chilling thought to any single-rotor helicopter pilot, even under the most ideal circumstances.* Add a few additional distractors, such as being over unfriendly territory, surrounded by unfriendly people, and having all the crewmembers slightly wounded, then the "chill factor" is lowered almost to the freezing point. I had the misfortune to experience two antitorque failures while flying the UH-1B in Vietnam. "Additional distractors" caused me to deviate considerably from the procedures outlined in the operator's handbook.

* See "Inflight Tail Rotor Failure in the Iroquois," January 1967 DIGEST.

The UH-1B operator's handbook states that in event of tail rotor failure you should reduce the airspeed to 50-60 knots (IAS) and enter autorotation. My experiences should not cause you to deviate from the standard emergency procedures. I share them with you only in case you find yourself with a tail rotor failure and no place to land immediately.

Let us first examine some of the possible tail rotor failures before we look at mine. First, and most serious, you could lose some of the hardware (tail boom, pylon, etc.). This would cause a serious center of gravity problem in addition to loss of directional control. The decision to continue flight or enter autorotation would depend on the amount of control you have over the ship. Another possible failure is the loss of power to the tail rotor. An example would be a loss of the 90° gear box or some of the tail rotor shaft. Another failure would be loss of directional control only. An example is loss of the tail rotor cable.

My first tail rotor failure was caused when a bullet severed the tail rotor cable, and on the second instance a bullet entered the 90° gear box, causing a partial

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loss of power to the tail rotor. In both instances I was over hostile terrain and about 20 minutes to a secure airfield. I might add that I had previously considered these possible failures and had done some practice landings without using the pedals. I learned from this practice that the UH-1B starts to yaw to the right under power at approximately 50 knots.

The first failure occurred during a rocket pass at an altitude of 200 feet. We had two other aircraft down in the landing zone and a real hot fight on our hands. All of the crew aboard my aircraft had been wounded, although not seriously. We recognized the loss of directional control while firing our rockets. The rockets firing caused the nose to yaw 30° each side of our flight path. An immediate turn was made at 80 knots and the crewchief sighted the bullet holes and the loose cable flapping. He could also see that we had lost no hardware and still had power to the tail rotor.

We had good control over the aircraft so we continued our rocket passes. The area was real hot and our ordnance was sorely needed. After expending our ordnance (four passes) we departed for home base. Several practice approaches were made at altitude to verify when the nose started to yaw under power. Our aircraft streamlined nicely at 70 to 80 knots and the aircraft started to yaw between 40 and 50 knots at 85 percent N1. Nearing the airfield, a decision was made to execute a running landing at approximately 50 knots. The copilot read off the airspeed on final until touchdown was made. Touchdown power was maintained and the aircraft started a gradual left turn of 20°. The aircraft was brought to a smooth halt by slowly reducing the collective pitch. Other than 39 bullet holes and worn out skid shoes there was no damage to the aircraft.

The nose started a yaw to the left

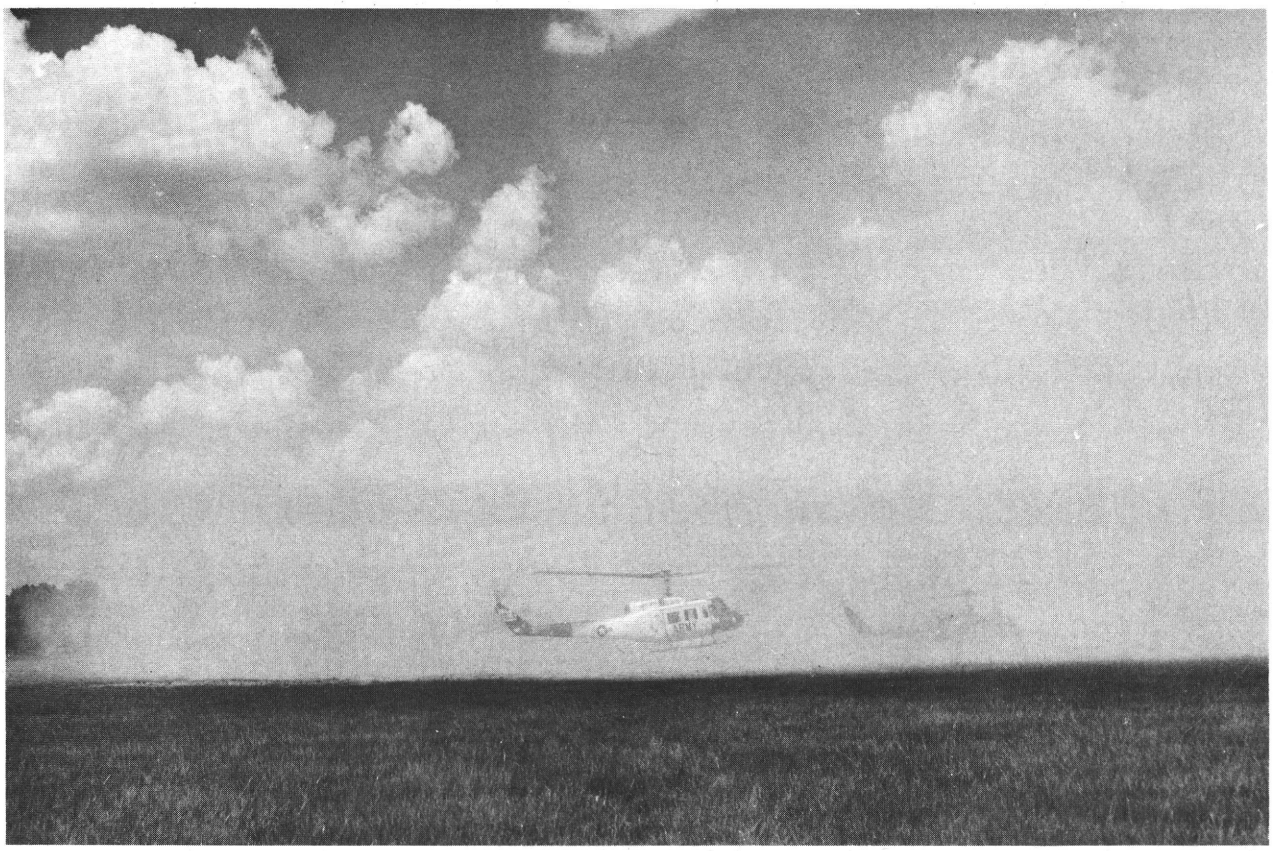
The second failure was caused by a bullet going through the 90° gear box. This failure was more violent because of the intermittent operation of the gear box. The tail rotor would work properly at times, and then bind and then surge again. Remembering how well the first emergency had worked out, I decided to try the same technique again. We headed for home base, practicing altitude approaches on the way. The nose started to yaw to the right under power at approximately 50 knots as the first aircraft had. An approach was started at 70 knots with a gradual deceleration to the touchdown speed of 50 knots. Again the nose started a yaw to the left. I applied some additional pitch and the aircraft yawed back to the right. A gradual decrease in pitch and gentle closing of throttle brought the aircraft to a smooth stop in the center of the runway.

I would like to offer the following points for you to remember if you find yourself with a tail rotor failure and no place to land immediately.

- The UH-1 flies well at 70-80 knots (IAS) without tail rotor control.
- The UH-1 starts to yaw to the right under power at speeds below 50 knots (IAS).
- A power running type landing can be controlled by a combination of cyclic, pitch and throttle.
- A go-around can be made from this type approach. Once you have entered autorotation with a tail rotor failure, you are pretty well commited to a landing.

I would like to add that the only reason for my deviation from the operator's handbook was the "additional distractors" I have mentioned. In any emergency you will probably be better off following the established (and practiced) procedures.

We had good control . . . so we continued our rocket passes



UH-1 ENGINE INLET AIR PROTECTION

Major William H. Edwards, Jr.

EXPERIENCE gathered from air assault exercises and tactical airmobile operations in Vietnam has identified a problem of foreign material being ingested by engines on UH-1 helicopters. Engine failures and engine surges (compressor stalls) have occurred on aircraft operated in sandy or dusty terrain or over freshly cut grass.

To solve this problem the Army is currently installing a device known as a barrier filter on all UH-1D helicopters. In the near future, however, all UH-1 ( ) helicopters will be equipped with an inertial-inlet type separator (particle separator) as soon as these devices are produced. Both devices have been tested in the severe environments of sand, dust, and cut grass. Results of tests are of interest to Huey pilots and those commanders responsible for planning and conducting tactical operations.

When design specifications for the T53 gas turbine engine were developed in the mid-1950s, the developers did not envision modern airmobile operations involving the use of large formations of helicopters operating from unimproved areas. During airmobile operations, rotor wash from the helicopters at times creates dense

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clouds of dust. Relatively large-size sand particles are picked up in these clouds and then ingested by the engines. The nature of the particular operation often forces the helicopters to remain in this adverse atmosphere longer than during routine helicopter operations, thereby increasing ingestion of these foreign particles. Erosion of engines from such ingestion is responsible for subsequent engine surges.

Even though the T53 engine has proved its reliability in over a million hours of operational employment, one may question why the engine does not appear to be able to withstand these tactical environments. The answer is that sand and dust requirements during engine development are far below those encountered in the field today.

Original specifications for sand and dust ingestion called for the engine to operate successfully in an environment with sand particles up to 200 microns in diameter, with concentrations of 0.0015 gram per cubic foot, for 10 hours. In recent tests, sand samples taken in tactical formations showed average concentrations varying from 0.003 to 0.005 gram per cubic foot, with an average of 60 percent by weight of the sand particles larger than 200 microns. Operational environments can be far more severe than design specifications anticipated.

The T53 engine has also experienced some catastrophic failures after operation over freshly cut grass. Ingested grass lodged on the inlet guide vanes. This grass blockage restricted the air flow and resulted in rapid pressure oscillations within the compressor. These oscillations induce harmonic vibrations in the second-stage compressor blades which, in the presence of any minor imperfections, result in a stress level sufficient to produce a fatigue fracture. The separation of one second-stage blade will produce an engine failure.

The U. S. Army Aviation Test Board tested filter and separator devices

To protect the T53 engine from these hazardous environments, the barrier filter was installed on UH-1D helicopters. (The problem appeared initially to be more severe in UH-1D helicopters than in UH-1Bs.) At a later date, an inertial particle separator, which in laboratory investigations appeared to be more efficient than the barrier filter, was developed to solve the ingestion problems of the T53 engine.

Testing

The United States Army Aviation Test Board was assigned the task of conducting comparative testing of the engine inlet air barrier filter and particle separator to determine which device was more suitable to provide protection for the T53 engines of UH-1 ( ) helicopters. During these tests three helicopters equipped with new calibrated engines were hovered in formation over a loose sandy soil until engine surge was encountered. One aircraft was a standard configuration UH-1D with no engine inlet protection. The other two aircraft were each equipped with engine protective devices.

The engine with no protective device surged first. The UH-1D equipped with the barrier filter experienced engine surge after a 60 percent longer time than the standard configuration UH-1D, while the helicopter equipped with the particle separator survived 234 percent longer in the sand environment. After the engines surged, they were returned to the manufacturer for analysis. For additional comparative information, a factory calibration and compressor inspection was also performed on the engine equipped with the particle separator at the same sand-exposure time that had caused engine surge to the barrier filter protected engine.

Inspection of the unprotected engine showed massive damage throughout the compressor section. In particular, the first-stage compressor blades had severe impact damage from large particles of sand. The entire engine was eroded by the ingested sand and exhibited a substantial loss in performance.

The engine protected with the barrier filter had much less damage in its compressor section. Condition of the compressor blades showed that the barrier filter had effectively diminished the amount of contaminant ingested by the engine and, in particular, had prevented the passage of large particles of sand. The engine's performance deterioration was indicative of one that had surged, but it had survived in an adverse environment for a 60 percent longer period of time than the unprotected engine.

Intermediate engine calibration and inspection of the particle separator engine (performed at the same sand-exposure time that the barrier filter engine experienced surge) revealed that this engine could still meet new engine specifications for engine performance and compressor blade tip clearances. Although there was some erosion within the engine, it was insufficient to affect materially the engine's operation.

Final inspection and calibration of the particle separator engine showed engine operating characteristics and erosion damage simi-

lar to the barrier filter engine. Some erosion damage was slightly more severe than the barrier filter engine, but it was attributed to the much greater time the particle separator engine was exposed to the sandy environment.

Engine-survival times during the comparative test were extremely short (a maximum of 7.67 hours of sand exposure for the particle separator engine). However, this was an accelerated test in which the aircraft were flown at maximum gross weight, on days with a density altitude of 2,200 feet, in the worst possible sand by mineral content and size distribution that could be located at Fort Rucker. The time accumulated on sand-exposure flights could be related statistically to operational experience with field engines exposed to sand and dust environments throughout the world. On the basis of the erosion observed in these engines, valid test results were obtained.

The barrier filter and particle separator also demonstrated a solution to the grass ingestion problem in this test. Two UH-1D helicopters, each equipped with a barrier filter and a particle separator, hovered over a cut-grass field for over two hours. The external screen assembly of the particle separator and the barrier filter screens were completely covered with grass, but no engine failure occurred. Although the engines operated with less efficiency, there appeared to be no danger of a flame-out. Practically no grass was ingested during this flight period.

Engine Surge

Much has been written about engine surge since gas turbine operation has become commonplace in Army aviation.* Engine surges have proved particularly troublesome in UH-1 helicopters, on occasion resulting in serious damage to the airframe. In general, engine surges which occur with N_1 speeds below 85 percent are not particularly dangerous. However, engine surges at N_1 speeds above 85 percent can be disastrous.

Engine surges in sand-eroded gas turbines result from a combination of variables. Sand ingestion will seriously damage the compressor section of the engine as well as wear the turbine portions of the engine. Thus, compressor efficiency deteriorates at the same time as the turbine's ability to convert the energy of combustion into useful work diminishes. Since this damage decreases the horsepower output of the engine for a given gas-producer speed, the pilot increases the fuel flow to the engine to demand sufficient horsepower to accomplish whatever maneuver is desired. The increased fuel rate for a gas-producer speed increases the possibility of an engine surge.

Gas turbine fuel flow is programmed to the engine by the fuel control. In uneroded engines the fuel control meters the fuel passed to the engine to ensure that the engine accelerates or operates in a surge-free regime. As erosion occurs in an engine, the maximum fuel rate that an engine can maintain without surging is diminished. Since the fuel control is scheduled to provide the correct fuel rate for a healthy or uneroded engine, it will continue to provide fuel at a constant rate. When the fuel rate for a given gas producer speed exceeds the rate that the engine can maintain surge-free operation (such as in a sudden or jam acceleration), an engine surge occurs.

Indications that an engine is going to surge are subtle, unfortunately, and are hard for the pilot to detect. Aircraft instrumentation makes it difficult to anticipate an engine surge. The indicators on aircraft instrumentation are high exhaust gas temperatures and low torque, but these indications are common to other engine maladies. *What is of real importance, however, is that most pilots are unable to recognize some engine surges even when they hear one.*

Since the noise from an engine surge may vary from a mild pop to a loud explosion, knowing when a surge is most likely to occur will aid the pilot in detecting one. The explosive type of surge naturally is never ignored. Unfortunately, when this type of surge occurs, the damage is already done. The mild pop-type surge is of greater interest in detecting an engine that is about to fail.

A pop-type surge is easy to ignore or to attribute to other causes, such as blade flexing or compressor bleed band actuation. Although the pop-type surge is not very loud, it is loud enough to detect directionally from the engine area. It may occur in engine accelerations or decelerations and it is loud enough for the pilot to hear while wearing a flight helmet. The pop-type surge may possibly be confused with the compressor bleed-band closure, but it is louder than bleed-band closure and generally occurs after the bleed band has closed.

If an engine is suspected of being eroded to the point of surge, a simple check may be made to determine if the engine will surge:

- Operate the engine at 6600 rpm and above 80 percent N_1 for one minute and then, using the twist grip, decelerate as rapidly as

*"What Is Compressor Stall?" *United States Army Aviation Digest*, May 1965.

possible toward flight idle. When N_1 reaches 65 percent, accelerate as rapidly as possible to 85 percent. Repeat this procedure several times. If surge is imminent, the engine should surge during acceleration.

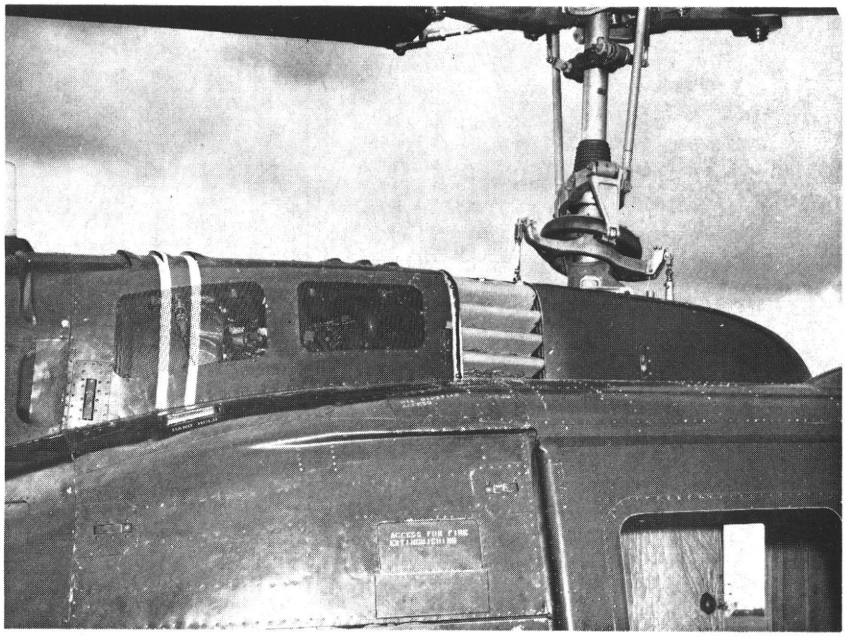
• Operate the engine at 6600 rpm and 85 percent N_1 for one minute and then, using the beep control, slowly beep the N_2 speed down to minimum rpm. Continue slowly to decrease the N_1 speed until the bleed band opens (approximately 75 percent N_1). Engine surge will occur during the deceleration at N_1 speeds immediately greater than the bleed-band opening point.

If engine surge is encountered in flight, the best remedy is to lower the collective or roll off the twist grip to decrease the amount of fuel flow to the engine. Consistent with flight safety, the more rapidly the fuel schedule to the engine is reduced, the less severe will be the consequences of the engine surge.

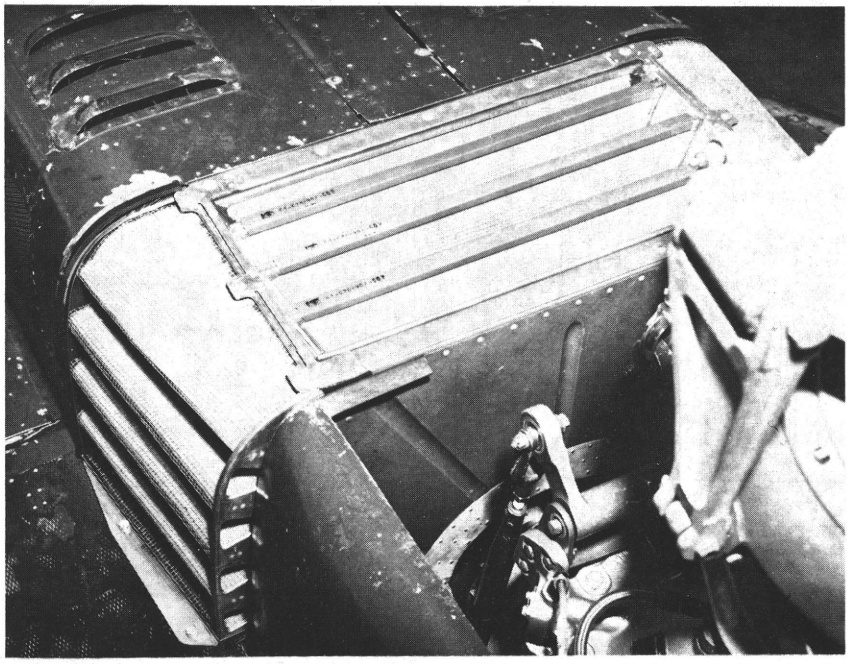
The Barrier Filter

The barrier filter is a louvered protective device mounted to the airframe of the UH-1D helicopter. It is composed of two layers of 1/4 inch-thick polyurethane foam mounted by 4 x 4 x 0.028 inch stainless steel screen. The outside layer of foam has 30 pores per lineal inch and the inside layer has 45 pores per lineal inch. The screens operate on the same principle as the automobile dry-air filter. Direct support maintenance can install the filter in 5 man-hours. It adds 6 pounds to the weight of the UH-1D. An electrical warning system activates a warning light on the annunciator panel of the aircraft when the filter is clogged. This light illuminates when a pressure drop across the screen is equal to or greater than 10 inches of water. When the light is on, an emergency situation does not necessarily exist; however, the pilot should realize that the engine will experience at least an 8 percent loss in available power.

The salient features of the barrier filter are its simplicity of operation, installation, and maintenance. It has proved itself capable of extending engine service life by 60 percent over unprotected engines exposed to adverse operating conditions. One would expect a loss in available horsepower and a subsequent increase in specific fuel consumption because of the apparent restriction to the air flow to the engine by



An overall view (above) and closeup (below) of the barrier filter mounted on the UH-1D



UH-1 Engine Inlet Air Protection

installation of the filter. However, testing the barrier filter on the UH-1D helicopter has revealed that this is not the case. The apparent inconsistency is attributed to the relatively inefficient air flow through the louvers in the standard configuration UH-1D air-inlet louvers without a barrier filter. One must remember, however, that these tests were made with *clean* filters and a marked decrease in performance can be expected with dirty filters.

Several limitations to this device should be kept in mind. The filter is only a retaining device and must be kept *clean* to function properly. If the filter becomes clogged with sand or dust, it will pass some of the contaminants into the engine by the sifting effect of the low-frequency vibration of the airframe in flight. Also, when the filter is dirty, or clogged with grease or oil residue, it decreases engine efficiency and longevity.

The filter should be cleaned by shaking and occasional washing with a detergent solution. The frequency of washing and cleaning should be dictated by the local conditions; however, the importance of its cleanliness cannot be overemphasized. Filters can be reinstalled wet and allowed to dry on the aircraft. Normally, a crewchief can clean the filter in 20 minutes. Under no conditions should the filter be cleaned with compressed air, since the air will rupture the polyurethane elements.

When the barrier filter is exposed to sand and dust and then to moisture, mud forms in the filter. The filter must then be washed before it will operate efficiently.

The service life of a barrier filter is limited by the amount of contaminant to which it has been exposed and the climate in which it is operating. At each periodic inspection filters should be inspected for indications of wear or holes. Replacement screens should be installed as necessary.

There are no provisions for anti-icing or deicing the barrier filter. There is no means to bypass these screens while in flight if ice should form on the barrier filter. Aircraft equipped with a barrier filter should not be flown where inflight icing conditions could be encountered.

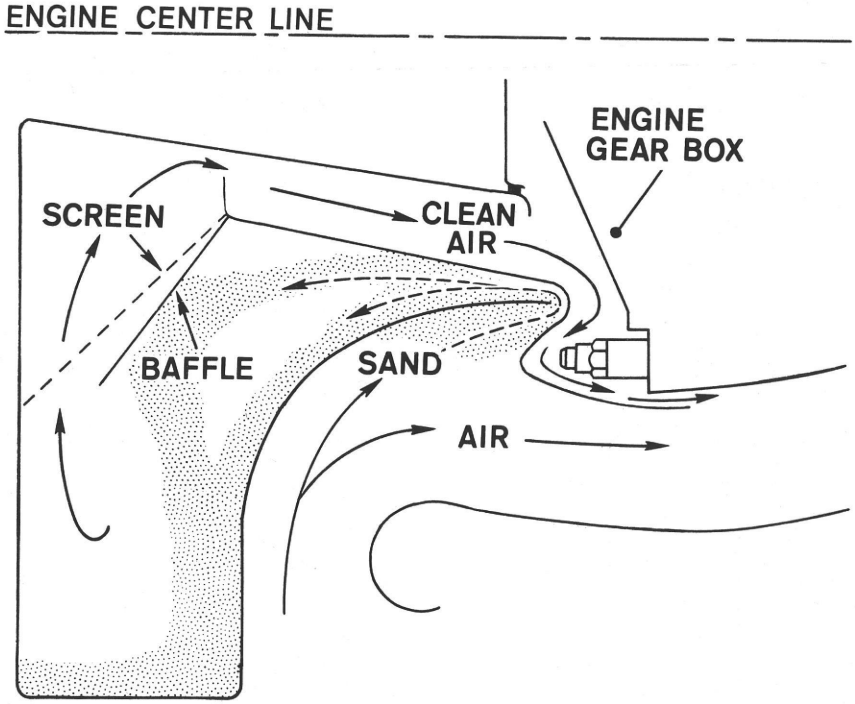
The Particle Separator

The particle separator is an inertial-inlet type separator which can be installed on the UH-1 helicopter in the field. The particle separator is attached to the engine inlet housing of the T53 engine by a clamp. An external screen assembly with doubled layered inlet airscreens is attached to the airframe to replace the standard-configuration engine inlet assembly. The external screen assembly offers additional protection to the engine inlet from sand, rags, grass, and any other types of foreign objects. These installations add approximately 20 pounds to the weight of the UH-1D and the UH-1B.

Air enters the particle separator radially and is redirected at a 90° angle into the engine inlet housing. During this sharp turn, sand particles are centrifuged into the separator chamber and are collected in the chamber after impinging on the baffle and screen assembly. A 5 percent secondary airflow circulation exists in this chamber, and is redirected into the engine inlet after passing through the screen assembly. The screen is capable of retaining contaminant particles of 80 microns in size and over.

The particle separator has shown that it can extend engine service life by 234 percent over that of the standard configuration UH-1 helicopter engine in ex-

Principle of operation of particle separator



treme environments. Additionally, studies of sand particle sizes retained by the particle separator have shown that it is far more efficient than the barrier filter in retaining all size sand particles.

Installation of the particle separator has slightly more effect on engine operating characteristics than the barrier filter but not enough to change overall helicopter capabilities or performance. The internal screens of the particle separator are not subject to clogging during normal dry operations; therefore, the engine suffers no loss in performance from clogged screens after exposure to sand or dust.

Cleaning the particle separator is more difficult than cleaning the barrier filter. The sand retention chamber of the particle separator must be emptied of the retained contaminants; however, it does not have to be cleaned as often as the barrier filter. Unless extremely dusty conditions are encountered, the particle separator should not have to be cleaned more often than at each intermediate inspection. At each periodic inspection the particle separator should be

Engine inlet problems are fewer, but still have not been eliminated

completely disassembled and inspected for leaks and broken internal screens. With minor maintenance, the particle separator should have a practically unlimited service life.

If a particle separator is exposed to sand and dust and then moisture, mud will form on the internal screens of the separator. This mud will block the secondary airflow within the particle separator and render the device ineffective until the screens are washed.

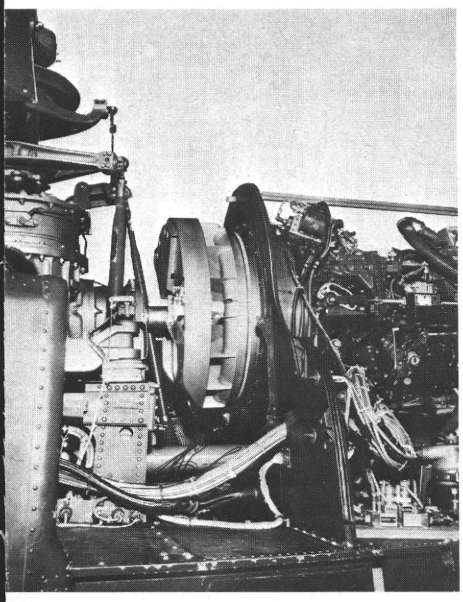
The particle separator and external screen assemblies have no anti-icing or deicing capabilities. There is no way to bypass the external screen if it were clogged with ice. Aircraft equipped with the particle separator should not be flown where inflight icing hazards exist.

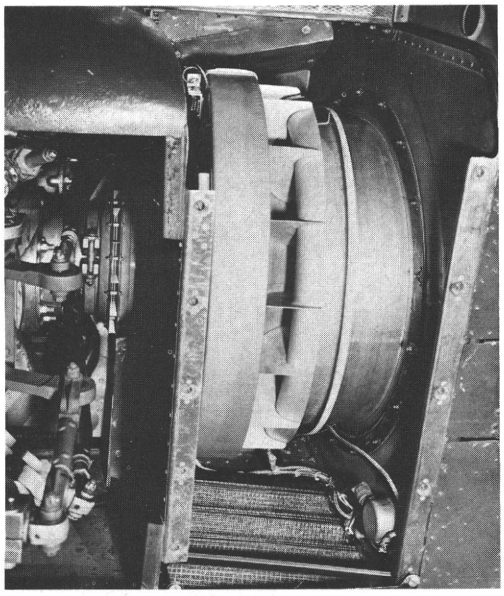
Both the moisture exposure and icing problems of the particle separator are subjects of product improvement programs and can be expected to be corrected soon. To solve the critical problem of sand erosion in the UH-1 engines, early models of the particle separator will not have the improvements necessary to correct moisture exposure and icing hazards. These early models of the particle separator will be modified at a later date.

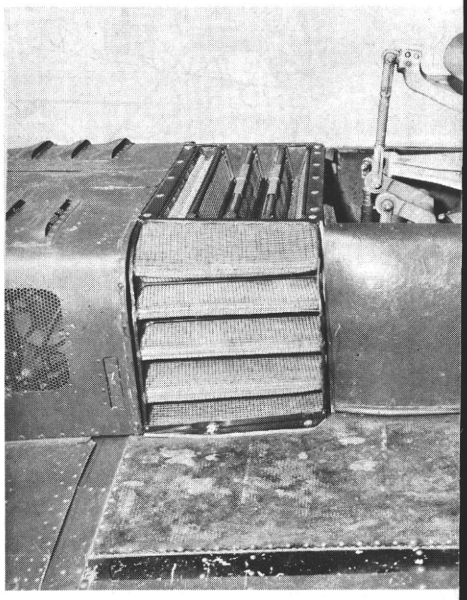
The barrier filter has already proved itself with the 11th Air Assault Division and in Vietnam. It is now being installed on all UH-1D helicopters. The particle separator will ultimately replace the barrier filter and be installed on all UH-1 helicopters.

Engine inlet problems have been diminished by the use of these devices, but have not been eliminated. The particle separator will extend engine service life in adverse environments, but it too has a limit to its efficiency. Only prudent planning by pilots or commanders to avoid operation in an unfavorable atmosphere can extend engine service life to the design limit.

The particle separator is mounted on the UH-1B (left) and UH-1D (center). The external screen assembly cn the UH-1D (right).







HUNG OUT ON A LINE

Reprinted from Flight Safety Foundation Exchange 66-406

THERE ARE strikes, strikes . . . and strikes! One type is the "if-you-don't, I-won't" tool of organized labor; another is what the batter gets when he expects an inside fast ball and is tossed a slow curve instead; and the third is that scourge of airmen—the wire strike. Unlike the batter who "suffers" a strike when he misses, the airman suffers a strike when he doesn't miss—the wire, that is.

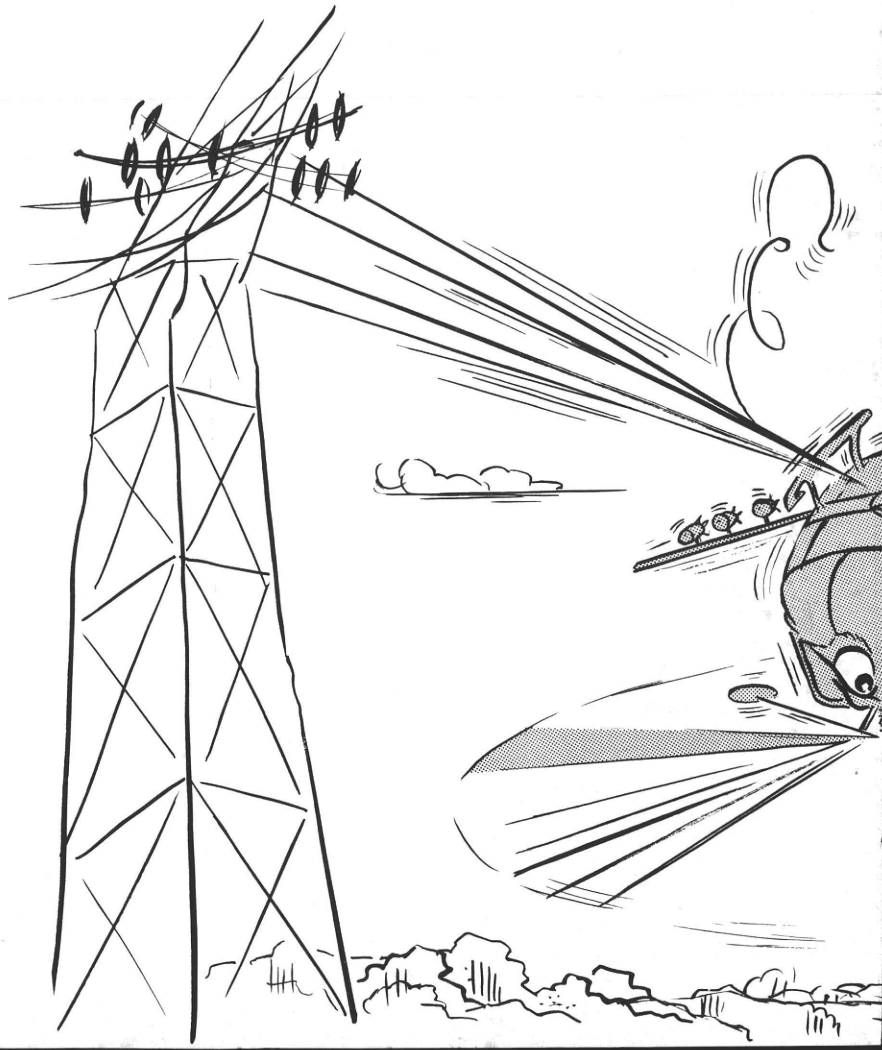
Wires have been the "unseen" nemesis of many a fixed-wing mogul and copter chieftain intent on accomplishing a mission. That telephone line that's here today probably didn't exist yesterday . . . and won't tomorrow if it's near a landing pad frequented by pilots too occupied to case the area before jump-off or hover-in.

Power companies, whether full-fledged utilities or militarily utilitarian, have a knack of stringing lines across rivers, along roads or through wooded areas and countrysides that too often border on landing zones. To add more glue to this sticky situation, such lines often are strung low enough to the ground, the water or the trees to be almost completely invisible. Although not intentionally camouflaged, these wires, cables or lines blend into the background in a manner to be envied by the owner of a "hot lines" bookie joint or the purveyor of illicit goods, liquid or alive. It's these that pilots MUST stay alert to—the wires!

A courier copter pilot and his observer recently were en route to an LZ on a practice mission, stateside. On the way, the pilot decided to try a simulated forced landing, but during power recovery the copter struck wires and crashed in an open field. The hard landing snapped off the tail boom and rotor, collapsed the main rotor and the centerline structure below the transmission and support mounts, and bottomed out the crew seats. Result: back injuries to both airmen, and one destroyed helicopter.

A careful perusal of the area would have disclosed evidence of the wires if not the wires themselves. Even though wires are difficult to see, signs hinting of their existence are usually evidenced. A pole, for example, or a house or building in the vicinty to which a power and/or telephone line probably runs. Certainly, location of a house or building in the vicinity should serve as a warning, and this warning should be sufficient to put into motion the airman's alertness, his search efforts, and all actions based on the premise that wires ARE there. Here again is where "assuming an All Clear" does exactly what the word a-s-s-u-m-e can do . . . "make an ASS out of U and ME!"

In another wire strike accident —and there have been and continue to be many—a whirlybird

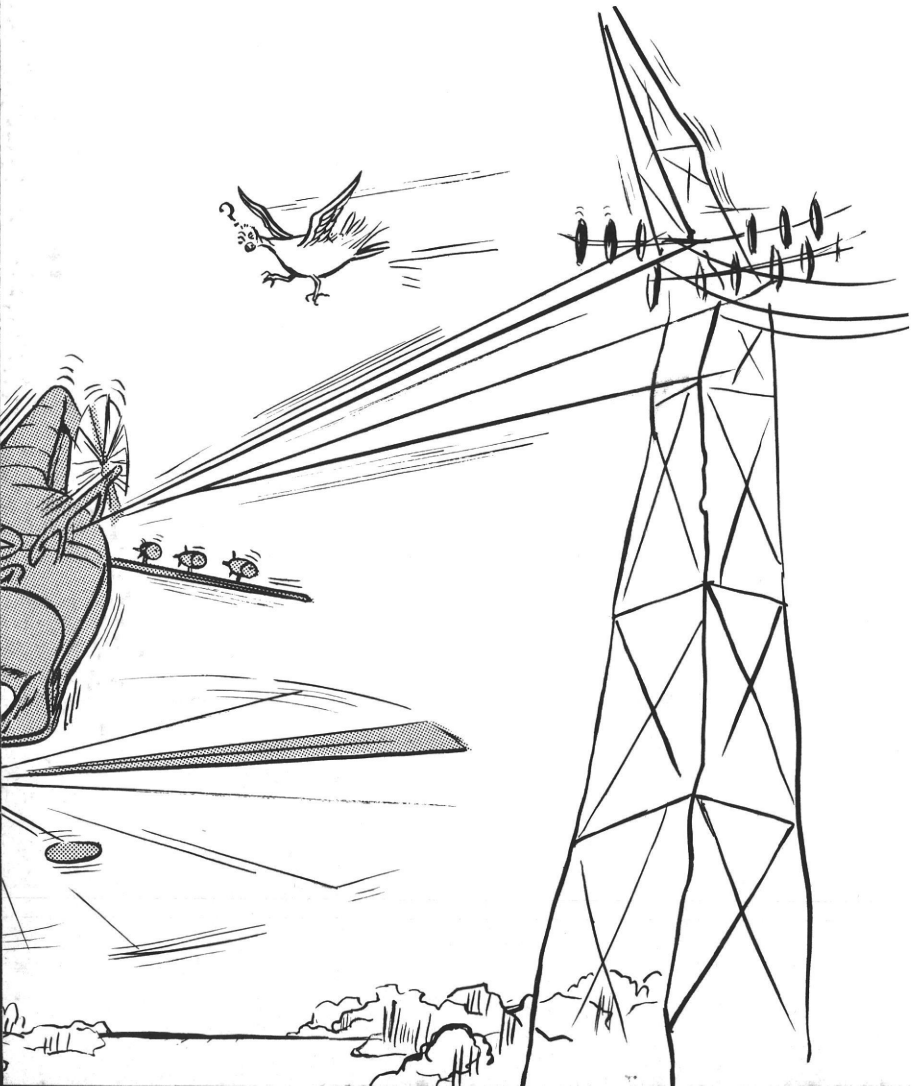


The telephone line that's here today probably didn't exist yesterday

was being flown some 50 feet above a lake when it struck high tension power lines. It immediately went into a severe cyclic flare, the main rotor blades chewing off the tail boom like a hungry DEP TRAI just back from the boonies with a lot of funny money in his jeans. The copter went in, nose down, and sank in 25 feet of water. Despite a broken leg and severe lacerations, the pilot got himself out of the burbling bubble and was taken ashore by a nearby swimmer. His crewchief didn't make it.

A contributor to the "add-insult-to-injury" section would be the copter driver who attempted to hover but his reluctant wagon kept settling back to earth again. He finally tried a "running" takeoff but again no luck. On the fourth try his whirlybird lifted a little, then rolled into wires bordering the zone and went over on its rotor. While the "injury" part was the wire strike, the "insult" segment was the fact that the copter also proved to have been overloaded by several hundred pounds!

Another wire wrangler was a helo hotshot who had been so long in the land of rice paddies, bamboo and monsoons that he had forgotten wires were "in" on this side of the Pacific. He was bamboozled by them when he returned for stateside duty. With a couple of VIPs on board on a personnel ferry mission down Alabama way, our veteran of many missions "on the other side," decided to make a low approach to the landing area and deliver his passengers practically at the door of the company headquarters. His intentions were good, but unappreciated as it turned out. His main rotor cut wires that wiped out communications at field headquarters, turned the copter 90° to the right, and dropped it—whamoo—in a clump of scrub oak bordering the landing area. The copter was down for several weeks, while the pilot and his VIP passengers preferred standing for several days.



Helicopters, however, are not the only victims of such no-see attacks. A twin-engine Mohawk was on a low-level surveillance photo mission. It was early in the morning and a light rain was falling . . . in short, the stage was set for a wire strike, and it struck. The Mohawk hit a power cable, severely damaging the aircraft's empennage, fuselage, wing assemblies and props. The aircraft went in, but security was on the side of the two-man crew: no personal injuries other than wounded pride. Uncle Sugar's bill, however, would have bought a lot of tickets home.

Undoubtedly, the time of day and the precip abetted this wire strike, but the mission itself suggested the extreme essentiality of caution. Had the crew kept that ogre called "wires" constantly in mind, it might have added just enough altitude to eliminate all chances of wire strike, and still accomplish their mission by-the-book. After all, aerial cameras today can tell as much from 500 feet up (and even higher) as they do "low down." But if "low level"

Tangling with wire may result in just a hard landing (above) or embarrassment (below), if you're lucky

it has to be, keep wires and lines in mind . . . and just being suspicious may help you miss them.

In two other strikes by fixed-wing aircraft one occurred when an aircraft was taxied into a telephone pole in a confined area, and the other occurred when the pilot let the Bird Dog drift left during takeoff. It struck wires, stalled to the ground, cartwheeled 180° and came to rest as the messiest pile of airplane junk ever carted away.

The why's of all these accidents could be anything from complacency to sheer fatigue (mental not metal) but the fact remains . . . they NEEDN'T have happened. Keeping to the task at hand could have staved off these costly slips. Fatigue is a factor all men must face, but when the life you save may be your own the battle can be won via determination, i.e., determination to stay ahead of

the aircraft; determination to stay alert; determination to do the job successfully and safely—for the sake of the kids and family.

Recently, we heard of a development that may serve to call attention to wires. An extremely lightweight product known as styrofoam is being considered. The idea is to form discs, or perhaps large balls, of this product and hang them from any wires that might present obstacles to fixed-wing or helicopter operations, or ships either, for that matter. Brightly colored, these featherweight balls or discs would show up against any background and attract sufficient pilot attention to obviate their being run into. In some areas metal discs or balls were tried but these proved heavy and also were subject to arcing when hung on electric wires or any lines, particularly during electrical disturbances. Power companies long have been reluctant to add weight of this dimension to their wires, nor are they inclined to sit still for unnecessary arcing incidents. But the plastic just might work. We hope so. In the meantime . . . stay alert to the existence of wires, all types, and stay alive through that alertness and considered caution.

It struck the wires, stalled to the ground, cartwheeled 180° and came to rest as the messiest junk pile ever carted away

REPORT ON WIRE STRIKES

In October 1962 MG Delk Oden noted that "wire strikes are on the rise again."

The year he made this statement there were a total of 43 wire strikes, 32 of which were rotary wing and 11 fixed wing. True to General Oden's warning, wire strikes did continue to rise. In 1963, 50 strikes were reported. In 1964, however, it looked like Army Aviators had begun to wise up because the number of strikes dropped to 37. But in 1965 we set the all-time record with 61 strikes in one year, almost 5 a month. Of these 45 were rotary wing and 16 fixed wing. The number of strikes in 1966 is not yet available for publication.

Wire strike accidents can be reduced by thorough ground and air reconnaissance of flight paths. Also continued emphasis on pilot education and air discipline and proper flying altitudes will reduce wire strikes.

crash sense

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

THE CASE FOR BY-THE-BOOK MAINTENANCE, SUPERVISION, AND INSPECTIONS

THE DECEMBER 1966 issue of Crash Sense gave the details of a maintenance caused accident in which five people—a mechanic, a maintenance supervisor, a technical inspector, a crewchief, and a test pilot—overlooked crossed servo hydraulic lines which resulted in a CH-34 accident. The description of one accident of this type may invite the belief that it was an isolated case, highly unlikely to be repeated. Unfortunately, this is not the case—

ACCIDENT NUMBER ONE

OH-13S courier pilot: "At 0730, I went out to the aircraft and made a close preflight inspection. The only discrepancy I noted was a loose bolt on the damper to stabilizer bar at the stabilizer bar connection. I had the crewchief tighten the loose bolt, started the aircraft, and was off at 0755.

"My first stop was a relay site on an island. From there, I proceeded to a detachment helipad, and landed at the brigade helipad at 0845. During this portion of the flight, I experienced no unusual vibrations and had no indication that anything was wrong with the aircraft.

"I departed at 0850 and headed back to the home field. Approximately 15 minutes after takeoff, my passenger and I began to discuss the collective pitch stick which was moving up and down approximately 2 inches in a slow movement. I told my passenger that I had seen OH-13s do this before and that it was not abnormal. At this point, the aircraft began to bounce severely. I entered autorotation, but did not shut off the engine; nor did I roll off the throttle. I made an emergency call, giving my approximate position and call sign. The aircraft was bouncing so bad that I could not stay in the seat, and I was having a hard time keeping my feet on the pedals. The only instrument I could see clearly was the engine/rotor tachometer. I saw that the engine needle was on zero and the rotor needle was in the vicinity of 260-270 rpm. I thought perhaps the collective was not all the way down, so I checked it immediately and found it was on the bottom stop.

"I received an acknowledgement of my emergency call, but I was unable to transmit again. The rate of descent seemed to be increasing on the way down. I turned to the left into the wind and began to look for a place to land. The vertical bounce was so severe at this time that I could not read any of the instruments. I do not know what my rotor rpm was, but I believe it was much lower than the 260-270 that I first saw after entering autorotation.

"At approximately 40 feet, I began a flare and made my pitch pull at 10-15 feet. All I remember is complete astonishment because I felt no resistance to the collective and the rate of descent did

not appear to be affected. I only remember feeling the aircraft hitting the ground one time. My helmet was torn off by the impact and was 10 feet to the right front of the ship.

"I saw that the aircraft was resting on its right side, and heard gasoline pouring out of the tanks, so I released my seat belt and got out. I moved about 15 feet away, then realized that my passenger was still in the wreckage, so I called to him and he got out. We went back to the aircraft, got the fire extinguisher, and turned off the switches. . . ."

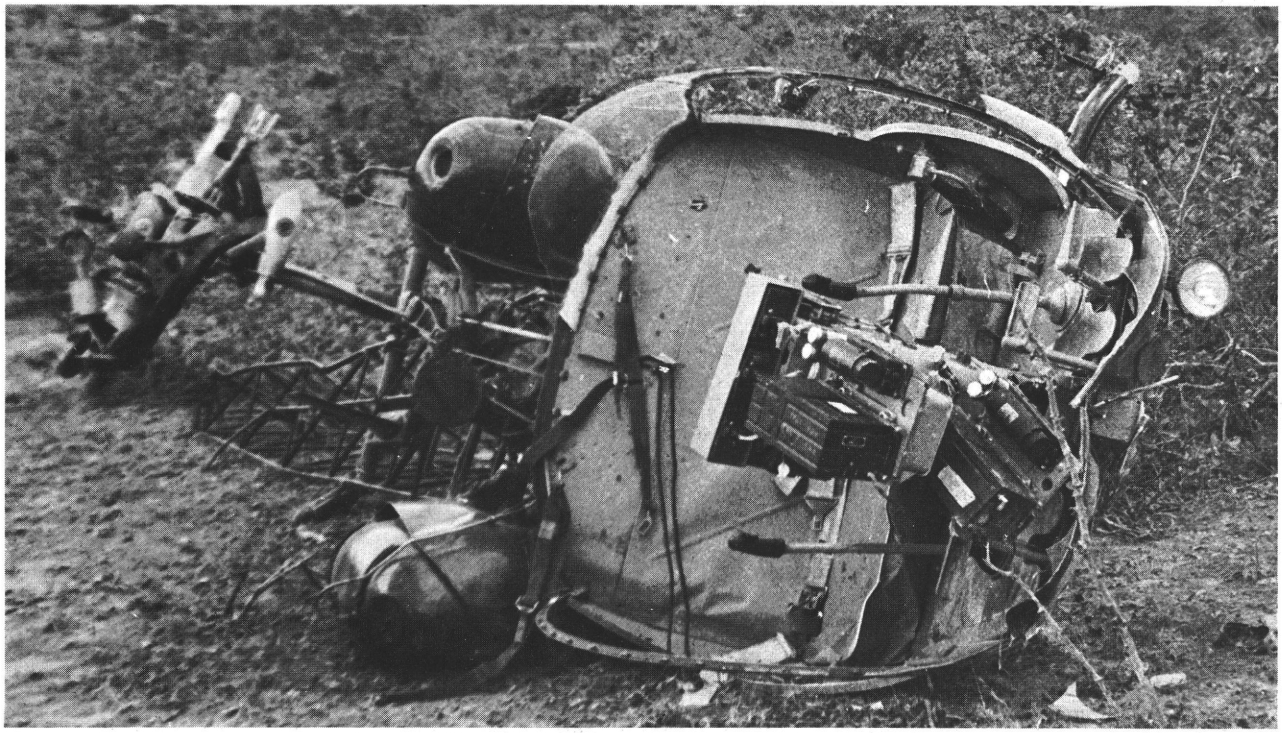
Despite the loss of his helmet, the pilot and his passenger escaped with minor injuries. The aircraft was a total loss.

Investigation narrative: "The aircraft was thoroughly inspected by the investigation board, a technical inspector, and a technical representative of the manufacturer. This inspection revealed that the nut which secures the swivel swashplate link (P/N 47-150-246-3) to the wobble ring pin (P/N 30-729-476-1) was missing. The condition of the threads on the pin [undamaged] indicated that the nut had backed off. Marks on the fiberglass carburetor air intake and lateral cyclic control horn indicated these items were struck numerous times as the rotor turned prior to impact.

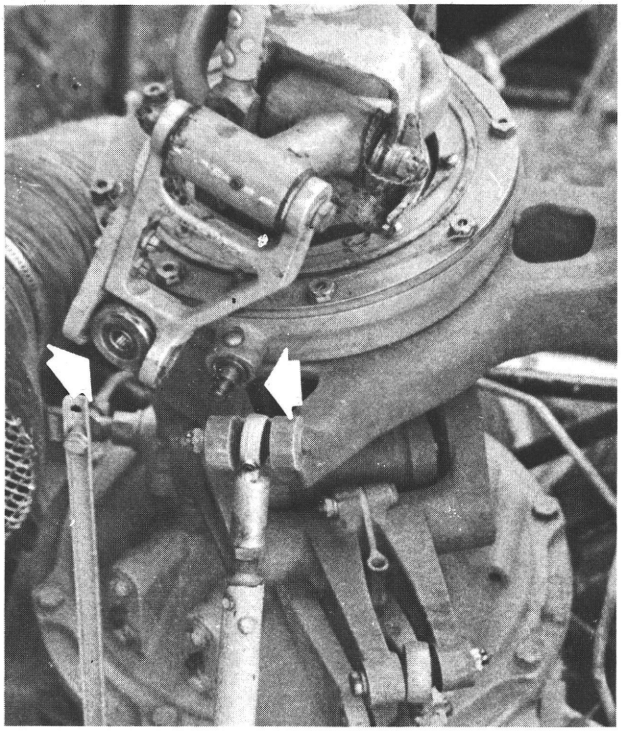
"Inspection of the aircraft records showed the swashplate assembly had been replaced 8.2 flying hours prior to the accident. These records also revealed that the aircraft had developed a 1 to 1 lateral vibration after a 20 minute flight on the day prior to the accident.

"The pilot stated that he had noted no unusual vibration until after he departed for the return flight. He also stated that he had not checked the nut that secures the swivel swashplate link to the wobble ring pin during his preflight.

"Interrogation of the crewchief revealed that a 1 to 1 lateral vibration had been reported after 20 minutes flight the day before. The organizational technical inspector and the crewchief inspected the aircraft, paying particular attention to the stabilizer and dynamic stop systems. This inspection



OH-13S landed hard and rolled to right side due to partial feathering of yellow blade, partial loss of collective, and low rotor rpm



Arrows show swivel swashplate link and wobble ring pin disconnected. Note undamaged condition of threads on pin, indicating that nut which secures pin to link had backed off.

revealed no discrepancies. The technical inspector recommended that the aircraft have a test flight to try to further determine the cause for the vibration. The crewchief stated that he prepared the aircraft for a test flight the next morning. However, the records showed no entry requiring a test flight, nor any indication that a test flight was performed.

"Interrogation of a mechanic revealed that he started to build the swashplate assembly up under the supervision of his shop foreman, but did not complete the buildup. He reported that this was his first buildup since he graduated from school. He did not know who completed the job.

"The maintenance supervisor stated that he supervised the buildup of the swashplate and that he had the technical inspector make in-progress inspections. He further stated that the work was correct.

"The technical inspector was questioned with regard to his inspection of the work performed on this aircraft. He stated that he inspected the swashplate during and after the completion of the buildup, and after the installation. He further stated that all safeties and cotter pins were properly installed. He also stated that new pins were used throughout."

Investigation analysis: "When the nut securing the swivel swashplate link to the wobble ring pin vibrated off, it allowed partial feathering of the yellow blade, and caused partial loss of collective and low rotor rpm. The investigation failed to establish whether the cotter pin was installed during the buildup of the swashplate or whether it was improperly installed and came out.

"The mechanic responsible for the assembly of the swashplate was inexperienced and was taken off the job prior to completion of the buildup.

"Engine stoppage was caused by the severe vibration, probably affecting the carburetor mixture and air adjustments. Engine failure was not considered a contributing factor to this accident.

"The owning organization did not perform a thorough inspection upon receiving the aircraft from the supporting maintenance unit before placing it in service."

Cause factors: "Failure of the mechanic to install or properly install the securing cotter pin.

"Failure of the maintenance supervisor, technical inspector, crewchief, and flight crews to detect the absence or improper installation of the securing cotter pin."

ACCIDENT NUMBER 2

Twelve days after the OH-13S accident, a UH-1D pilot was undergoing a qualification checkride.

Pilot: ". . . I spent about 15 minutes in hovering exercises, including two hovering autorotations. We then flew in closed traffic and made three normal approaches. The IP then demonstrated an autorotation which was well executed with a straight smooth slide of about 30 feet.

"The IP gave me control of the aircraft and I ran up the rpm, checked the instruments, and prepared to come to a hover to make a clearing turn. Pitch application and control movements were normal, with the aircraft facing into the wind. As it either became light on the skids or began to become airborne, it rolled violently to the right. I pulled pitch and applied left cyclic in an effort to right the aircraft and prevent the main rotor blades from striking the ground. This action was accompanied by the aircraft rolling left (probably due to overcontrol), a 90° left turn, and pitching to a nose low attitude. The IP overrode me on the controls and set the aircraft back on the ground, where it rapidly settled on a slant to the right aft side.

crash sense

"I remained in the aircraft to maintain left cyclic and prevent the main rotor from striking the ground while the IP jumped out to check for fire. I shut the aircraft down and remained at the controls until the rotors stopped.

"In looking over the aircraft after the accident, it appeared that the fuselage had been incorrectly strapped to the aft cross tube and that the longitudinal curved flange which is supposed to sit between the double nipples on the saddle had been mounted in such a manner that it rested off the saddle on the cross tube to the right side. It was evident that the fuselage had slid to the right along the cross tube and came to rest with an approximate 18 inch displacement from the proper longitudinal axis. . . ."

The pilot and IP escaped injury, but damages to the helicopter totaled $8,941.40.

Investigation board analysis: "Upon removal of the aircraft to the field maintenance facility and placing it on hydraulic jacks, it was discovered that the front left mounting point of the structural beam (cradle) was resting on the front left bearing strap inboard of the four lateral retaining lugs. The right cradle was positioned at an extreme right displacement, between the four lateral retaining lugs of the right bearing strap.

"Due to the damage in the vicinity of the rear cross tube, it could not be determined where the rear cradle had rested prior to the accident.

"The landing gear was removed. Upon examining the front and rear cross tube bearing straps, it was observed that no paint scratches were in evidence between the lateral retaining lugs on both fore and aft left bearing straps. Paint scratches would be present if the left fore and aft cradle had rested between these lugs. Instead, very definite cradle marks (scratches) were seen inboard of the four retaining lugs on the edge of the left bearing straps. When the right bearing straps were checked, paint scratches were clearly evident between the four retaining lugs next to the right outboard pair.

"From these findings, it was definitely concluded that the forward cradles of the aircraft were improperly positioned prior to the accident. The rear cradles were most probably improperly positioned, evidenced by the positions of the scratched cradle marks on the bearing straps.

UH-1D slipped all the way down cross tube and came to rest on skid tube. Pilot was able to prevent rotor striking ground by using left cyclic during shutdown. Grass in rotor path was cut 1-2 inches from ground.

"When the right rear lateral retaining lugs were examined, it was noted that both outboard lugs were gouged, with the paint worn off the inboard sides, and the forward lug was bent out 15-20 degrees.

"Examination of the 2408-13 for the day before the accident revealed that, prior to a test flight for replaced blades, it was determined that the cross tubes were bowed beyond tolerance and should be replaced. No special inspection for a hard landing was made at this time, as might be called for by a discovery of this type. The quality control officer and test pilot made the request to change the landing gear. . . .

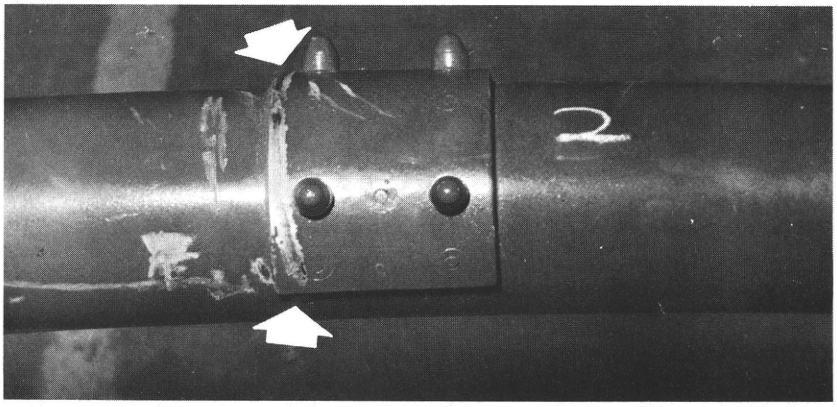
"The helicopter mechanic who performed the removal and replacement of the landing gear stated that this was the first time he had ever replaced a landing gear. . . .

"The technical inspector who checked the completed installation and signed the work off as okay on the 2408-13 stated that he was not rotary wing qualified, nor had he had landing gear installation experience. . . . The reason for this technical inspector's assignment to this job was that he was the only technical inspector immediately available when the work was completed. . . .

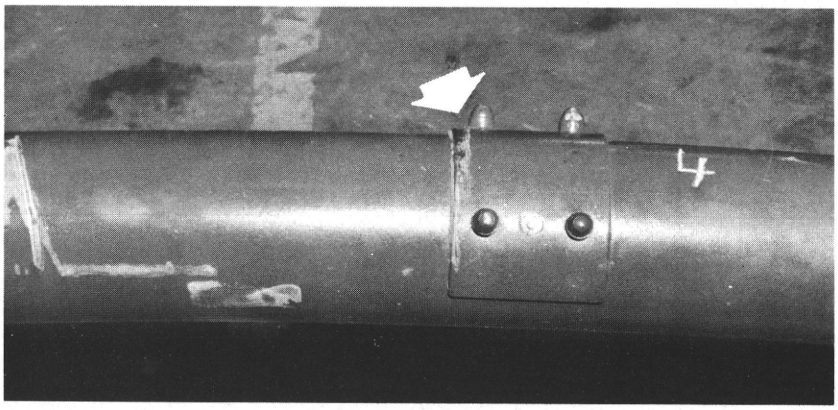
"The quality control officer and test pilot of the maintenance unit stated that the unit had a training program in effect for technical inspectors. He stated that the technical inspector who okayed the UH-1D landing gear had not participated in the program to date and had in fact just completed the fixed wing course of instruction. At the time of the accident, this unit had 12 assigned technical inspectors, six rotary wing and six fixed wing.

"The NCOIC of the quality control section was interviewed. He stated that the assignment of a technical inspector not qualified on the aircraft to be inspected was rare. In this instance, due to the nonavailability of a rotary wing inspector and the fact that the component to be checked was not a flight control, he made this assignment. He further stated that he was on the ramp while the test pilot was making his preflight, and that he had checked the skids and cross tubes for proper installation. Due to the circumstances involved, the board questions the thoroughness of this check."

"Inspection of the work by a nonhelicopter trained technical inspector was contrary to the maintenance unit SOP."

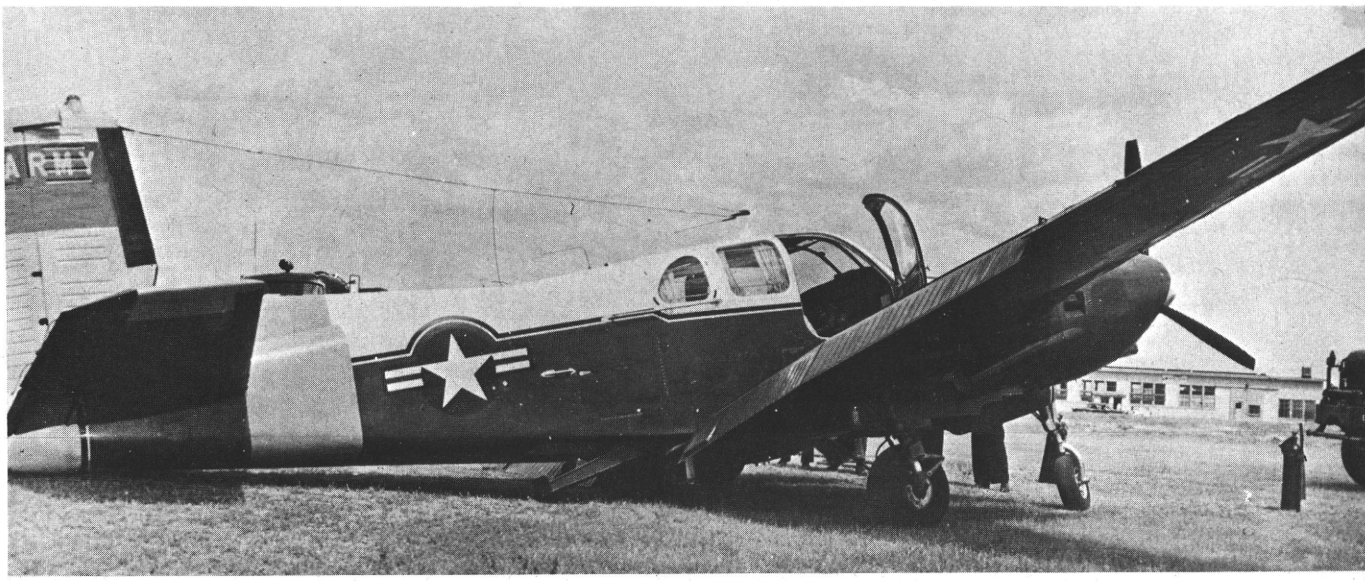


Front cross tube left bearing strap shows no cradle scratches between four lateral retaining lugs. Arrows show cradle scratches on bearing strap inboard of retaining lugs.

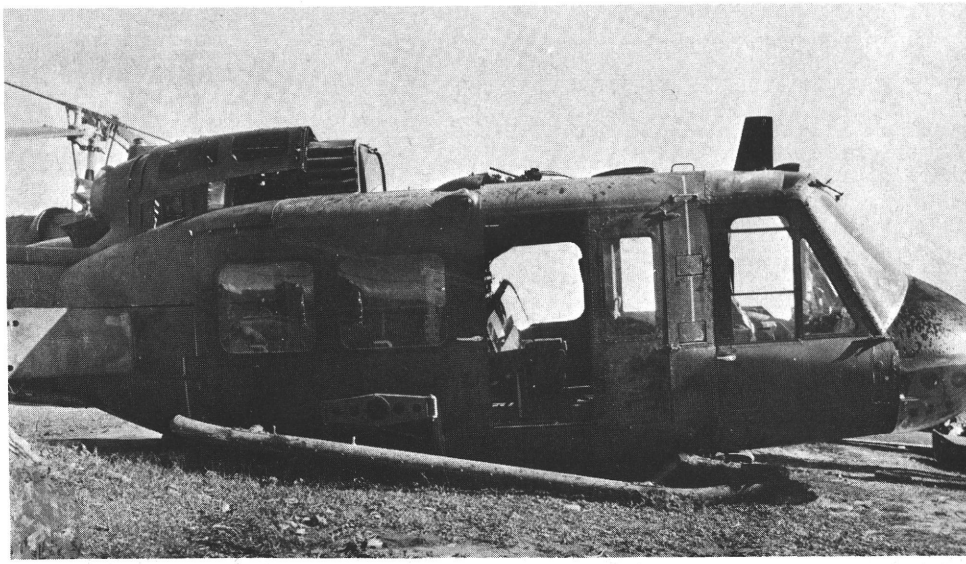


Rear cross tube left bearing strap shows no cradle scratches between four lateral retaining lugs. Arrow shows cradle scratches on bearing strap inboard of retaining lugs.

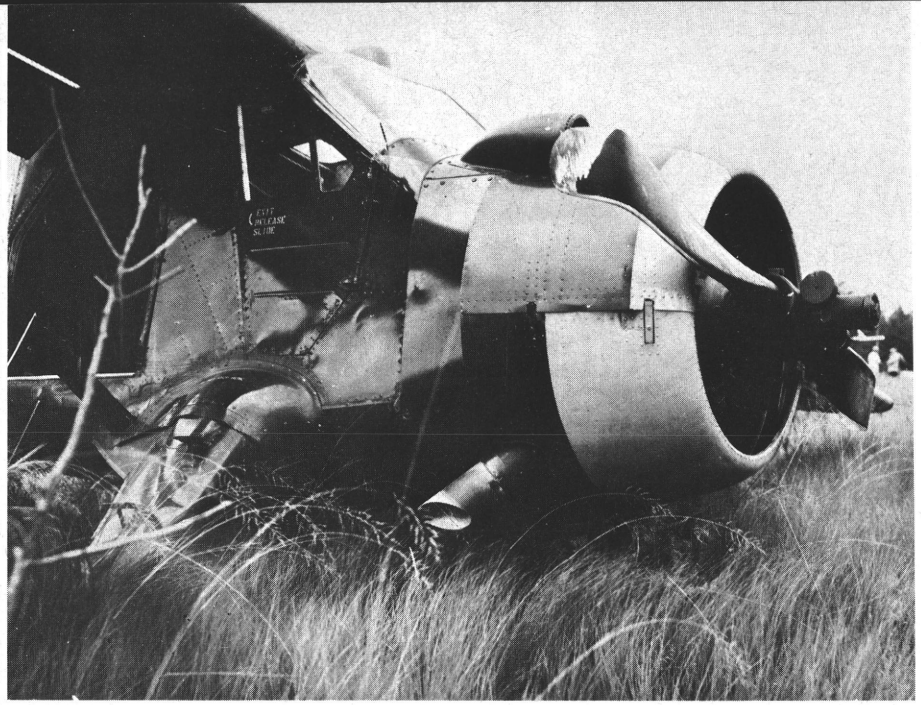
Accident number 3. OH-23 transmission failure was caused by loose screw left in transmission during overhaul.



Accident number 4. Excessive breakaway torque of landing gear clutch caused overstress and failure of landing gear actuator support assembly.

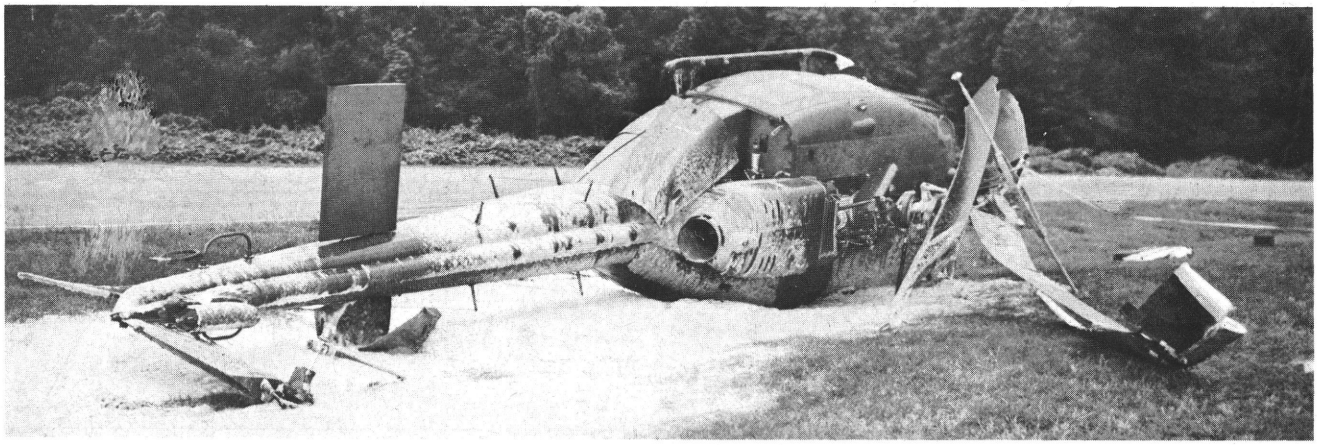


Accident number 5. Improper installation of tail rotor bearing set and improper torquing of retaining nut resulted in loss of antitorque control. Accident resulted.



Accident number 6. Improperly rigged fuel control cable caused fuel starvation which resulted in engine failure and accident.

Accident number 7. Murphy (backwards) installation of transmission to engine drive shaft resulted in this accident.

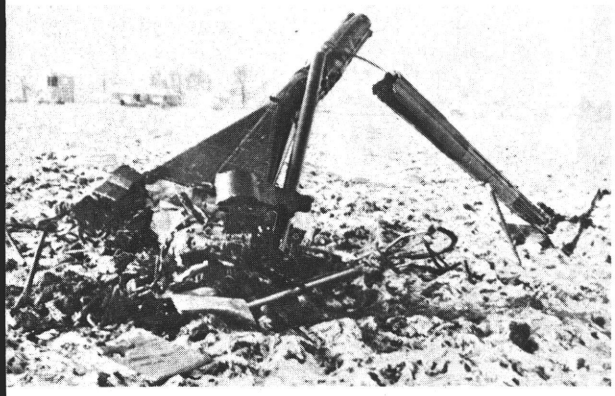


Accident number 8. Use of improper bolt to attach tail rotor grip assembly to tail rotor control link and improper torquing of bolt resulted in loss of antitorque control and accident.

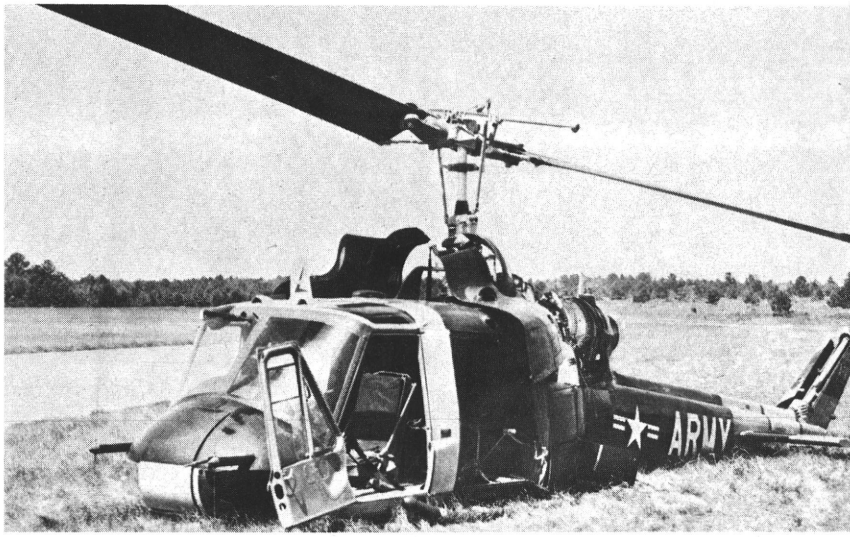
Accident number 9. Improper installation of fuel line quick disconnect caused fuel starvation and engine failure which resulted in this accident.

crash sense

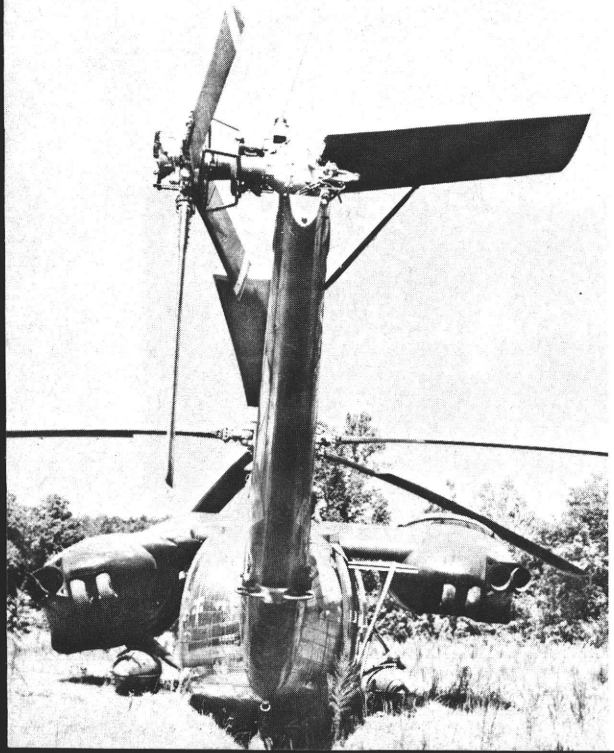
Accident number 10. Improperly installed clutch assembly caused sudden rotor engagement during start.



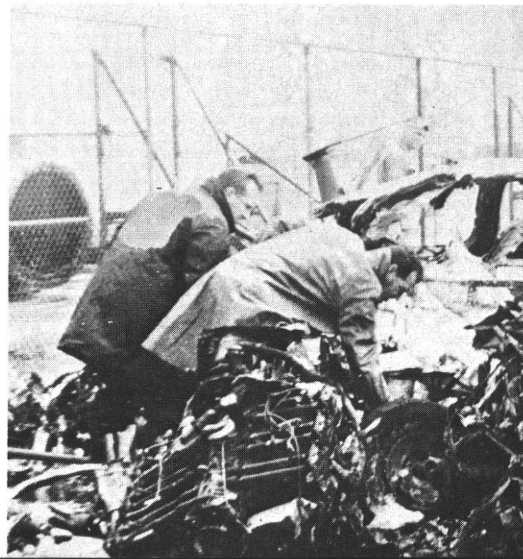
Accident number 11. Bolt attaching longitudinal cyclic control rod assembly to wobble plate backed out. Caused by reuse of self-locking nut which vibrated off.



Accident number 12. Failure to install firewall brace assembly locking pins resulted in firewall brace assembly striking drive shaft and tail rotor failure. Accident was result.

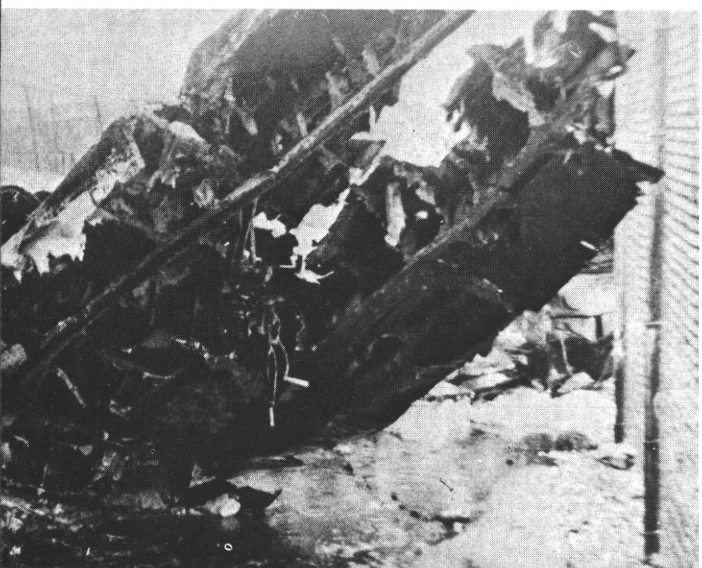


Accident number 13. Improper torque of retaining bolts allowed bolts to come loose and drop out of retaining nut plate of flight control support assembly, resulting in loss of antitorque control and accident.



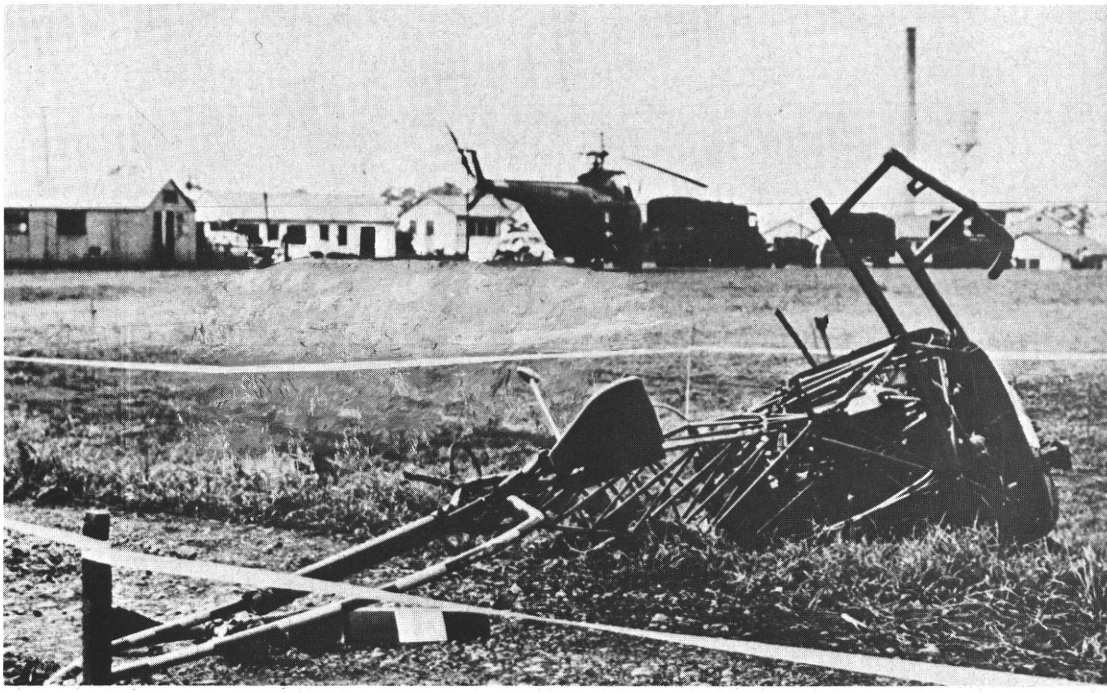
Accident number 14. Reuse of self-locking nut which came loose and dropped out caused throttle linkage to become disconnected at carburetor. Accident resulted.

Accident number 15.
Nineteen inch fuel hose was installed in place of required 21" hose. Resulting stress caused hose to break and fuel sprayed on engine, causing fire in flight.



Accident number 16.
Loose fuel line fitting caused fuel starvation. Aircraft crashed during takeoff and burned.

Accident number 17. Cable was wound backwards on tail rotor pitch change drum. Flight controls did not respond properly and crash resulted.



Accident number 18. Failure to install cotter pin resulted in loss of bolt in cyclic control system and crash.

the Army aircraft maintenance inspection system is designed to detect mistakes and correct them before they become accidents or potential accidents . . .

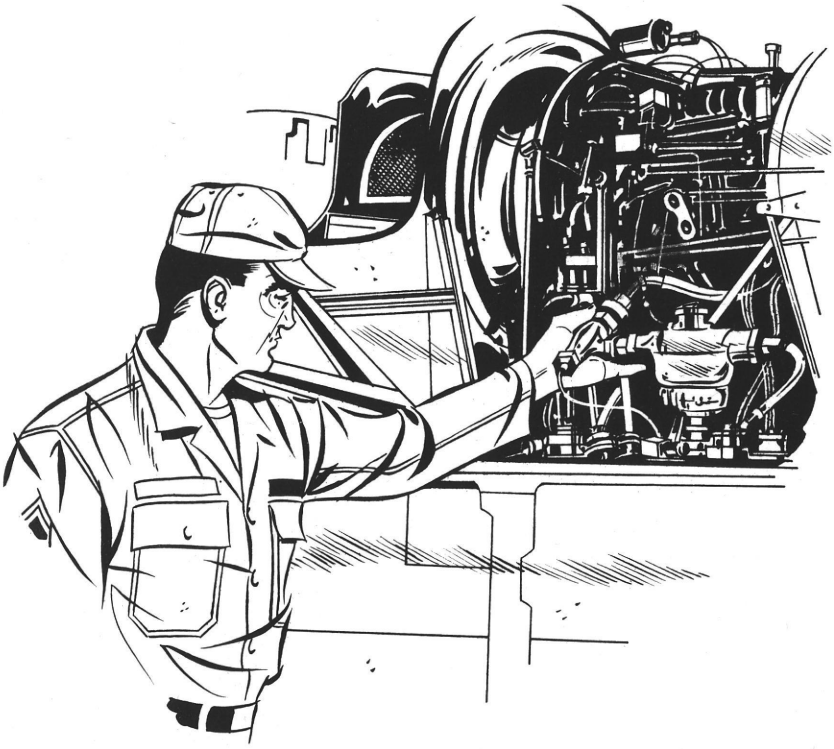
Once a maintenance mistake has been committed and allowed to go undetected, only circumstances and pilot skill can prevent an accident. The following mishaps in one recent month were caused by undetected maintenance mistakes. Fortunately, the circumstances were such that pilot skills were able to prevent these mistakes from becoming accidents.

A UH-1D landing approach was terminated and the helicopter was hovering between the runway and the ramp when a sudden snap was felt, followed by a spin to the right. The pilot held power, moved to level ground, and made a hovering autorotation. The UH-1D touched down on the heel of the left skid while turning to the right. This mishap resulted in incident damage to a cross tube. It was caused by improper installation of the tail rotor thrust bearing set. A washer seized to the inner race of one bearing, placing extreme pressure on the retaining nut. The nut sheared the cotter key and backed all the way off.

A UH-1B pilot smelled smoke, landed, and found a fuel leak caused by a loose line at the fuel manifold.

An O-1A pilot felt severe control stick vibrations and fore and aft pressures during takeoff. Hanging on, he managed to maintain control and flew around the traffic pattern to land. It was found that the tab actuator plate under the right horizontal stabilizer had come loose and deflected downward. Three of the four screws holding the plate were loose and the plate was held only by the remaining screw.

A UH-1D pilot was on a night medical evacuation mission when the hydraulic warning light came on. He felt feedback in the cyclic, turned the hydraulic switch off, flew back to his home base,



Fuel leak in UH-1B caused precautionary landing.

and landed. This precautionary landing was caused by a ruptured hydraulic line due to friction between two hydraulic lines. The lines were improperly installed.

Oil was lost from the forward transmission of a CH-47A during takeoff, causing a forced landing and an aborted mission. This was caused by overtorqued retaining studs.

A U-6A engine ran rough and cut out intermittently. The pilot used the wobble pump to keep the engine going and completed a forced landing. Loose spark plugs and broken leads were found.

A U-8D engine backfired severely. The engine was shut down, the propeller was feathered, and the pilot completed a single engine precautionary landing. It was found that the valve rocker arms of one cylinder were installed in reverse. The intake arm was on the exhaust side and the exhaust arm was on the intake side.

Valve rocker arms of one cylinder installed in reverse caused U-8D precautionary landing

A UH-1C instructor pilot reported an electrical fire in the overhead DC circuit breaker panel and landed. The fire went out when the aircraft was landed and the power was cut off. It was found that the clamp holding the large insulated wire in the breaker panel was installed upside down. The clamp touched the cargo hook circuit breaker contacts, causing an electrical arc.

The Army aircraft maintenance inspection system is designed for mistakes and if everyone—maintenance supervisors, technical inspectors, crewchiefs, and test pilots—does his job correctly, maintenance mistakes will be found and corrected before they become accidents or potential accidents. However, this does not relieve aircraft mechanics of the responsibility for doing the best job possible. During this period of rapid expansion which often results in overcrowded facilities and the use of many inexperienced mechanics, everyone concerned with Army aircraft maintenance should adopt—

THE MECHANIC'S CODE

As a maintenance technician I recognize my obligations:

To the United States Armed Forces, who trust that I am technically qualified for the tasks expected of me.

To the aircrews and passengers, who trust their lives and safety to my mechanical skills.

To my organization, which expects me to be a professional mechanic as well as a good citizen.

To my fellow mechanics, who as team members must depend upon me for a task completed.

To myself, for the personal satisfaction of a professional job well done.

To discharge these responsibilities:

I will perform maintenance of the highest quality to assure the safety of every flight.

I will always be sure of my work, or when in doubt consult my supervisor.

I will strive to improve my professional skill by attention to duty and self-education.

I will not allow my personal desires or consideration to affect performance of duty.

I will never attempt to perform duty when my mental or physical condition might lead to maintenance mistakes.

I will keep my tools and equipment in first class condition to insure a job worthy of the professional mechanic that I am.

I pledge adherence to these principles to reflect credit to myself, my fellow workers and my profession.

—Adapted from the Flight Safety Foundation, Inc.

What's Wrong With This Picture?

If this aviator has a survivable crash or fire, the odds are that he will sustain fatal or crippling injuries which could have been prevented. See how many mistakes you can spot and check your answers on page 63.

DELAYED DECISION

indecision and inadequate supervision made this accident inevitable . . .

A U-10A PILOT was one of a flight of four U-10s undergoing field exercise training at an auxiliary airfield.

Pilot: "I had flown a mission and was forced to return to the auxiliary airfield because of thunderstorms and moderate turbulence in the area. I called operations, asked for landing instructions, and was given runway 16. I tried to land on runway 16, but was unable to due to a strong crosswind from the right. I made a pullup and asked for a runway more favorable to the wind. The operator cleared me to land on runway 22.

"After landing and taxiing back, I received a call from operations requesting me to have our four aircraft faced into the wind and tied down because of a tornado warning. I faced my aircraft into the wind and ordered the crewchiefs to face the other three aircraft into the wind and to tie them down good.

"There were two or three vehicles in the area, so I had a three-quarter ton truck driver take me to operations where I explained that I had cancelled my mission because of the thunderstorms in the area. The company commander made the decision to evacuate all aircraft to our home field, because he thought the tiedowns we had were not sufficient to hold the aircraft down.

"Another U-10A pilot and I got into the truck and had the driver take us back to the flight line. I was the first to get started and the first to taxi out. I called operations about four times and did not get any reply or takeoff instructions. I continued to taxi up the runway in the direction of runway 22 because the wind was coming from that direction.

"Before getting to runway 22, I found that the wind was raising my left wing up and I was almost burning brakes trying to keep the aircraft straight. The wind tried to weathervane the aircraft to the extent that I felt I could not make it to runway 22. At that time, I heard two other pilots talking over the radio to each other. They had decided to take off perpendicular to runway 16, heading west. I looked over to the left to see if the area beyond the runway was clear enough for takeoff in the event that the runway width was not enough. It seemed clear enough.

"I taxied to the other side of the runway and turned around, facing back into the wind. My tail wheel seemed to be a few feet from the edge of the runway and I was facing the general direction of west. I finished my before takeoff check and watched the other pilots take off perpendicular across the runway. They did not seem to have too much trouble getting off. . . .

"I pushed full throttle, releasing the brakes, and the aircraft seemed to get right off the ground. It felt as though I was off the runway before I even neared the edge. I had about three-quarters right rudder and did not feel any directional control problems. As I became airborne, a strong gust of wind seemed to pick up my right wing. I was correcting for this and it appeared the aircraft was responding when another gust hit me. With the controls all the way to the right, the gust took me over on my left side. The second gust was much stronger than the first. . . . I do not remember the left wing striking the ground. However, it was only a second or so between the first gust and the second. There were just not enough controls to hold the aircraft down. I had all the correction possible when it hit the ground.

"When the aircraft struck the ground, it dazed me. The diagonal safety belt caught me under the throat. By the time I got my senses back, the cockpit was full of smoke and I could feel heat. The smoke was so heavy that I could not see at all. I could think of only one thing to do—get out as soon as possible. I felt for my safety belt and unlocked it. The smoke was burning my eyes so that I had to close them. I felt for a hole and climbed out. I could not see where I was getting out.

"When I sensed fresh air, I ran about 50 yards,

cleared my eyes, looked back, and saw the aircraft go up in flames."

The pilot sustained first and second degree burns on his hands and face. He was not wearing gloves. The aircraft was a total loss.

Investigation board analysis: ". . . the fire started at some point between the time the left wing was ripped off and the aircraft came to rest facing west. The exact cause of the fire could not be determined. However, the board surmised it started when the fuel lines ruptured as the left wing was torn off. The entire cockpit was badly burned, particularly in the area of the left wing root. . . .

"Analysis indicated the aircraft was in the air as it passed over the edge of the runway. Approximately 35 feet from the concrete, the left landing gear contacted the ground. Marks in the grass showed the left wheel rolled on the ground in a left turn. Paint flecks were found along the track which matched paint scraped from the aircraft's left wheel hub. While the aircraft was traveling along the ground, the left wheel was almost rolled under. This conclusion was reached by examining marks made by the tire and scratch marks left on shrubbery by the left wheel hub.

"Pieces of the left wing tip and gouge marks in the sand indicated the point where the left wing scraped. The board concluded that the wind acting on the right side of the aircraft as it rolled on its left wheel caused the pilot to lose control and almost ground loop. When it lifted into the air the second time, and was broadside to the wind, the aircraft was probably at the mercy of the storm and no action by the pilot could have prevented the crash."

The board listed the following cause factors:

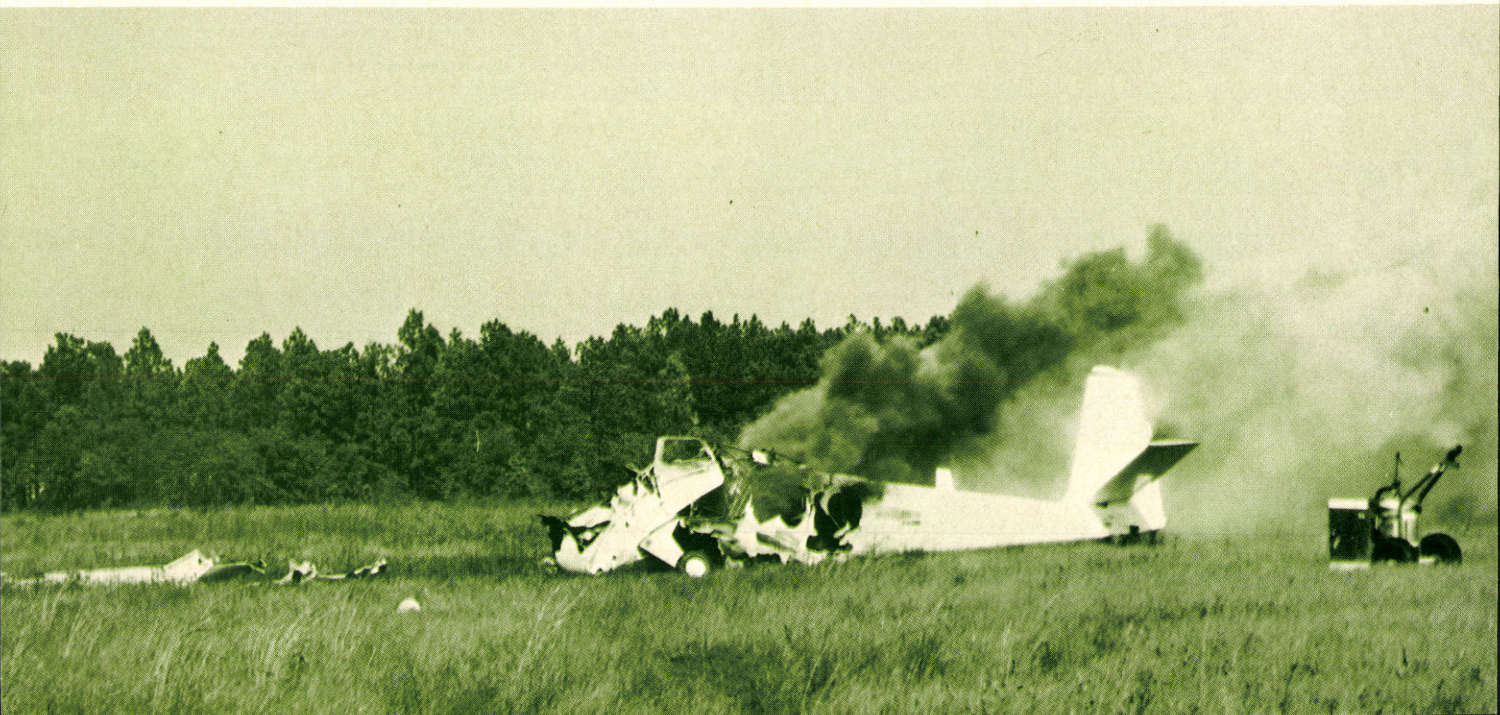
Operational— loss of directional control.

Weather— strong winds and extreme turbulence associated with the approaching squall line.

Supervision— company commander's decision to evacuate his aircraft under unfavorable weather conditions and failure to ensure that adequate tiedowns were available and properly placed to secure the aircraft.

Endorsing official: " . . . The accident cause factors given in this report are not considered to be complete. Indecision, vacillation, and inadequate supervision on the part of the aviation company commander are the basic acts that made this accident inevitable. The pilot's decision to take off during violent weather conditions was only the final act in the sequence of events that led to this accident. Even though the individual aviator is in command of his aircraft and must make the final decision to fly, it is felt that the order from his aviation company commander unduly influenced this pilot and left him little actual choice but to attempt flight under extremely hazardous conditions. The known frontal weather situation in the vicinity of . . . should have necessitated close and continuous attention to weather conditions by the aviation company commander. Upon receipt of the severe weather warning, this commander should have ordered an immediate evacuation. He should also have previously ascertained the inadequacy of aircraft tiedown facilities. . . ."

U-10A crashed and burned during attempted takeoff in strong winds and extreme turbulence from approaching squall line



pearls

personal equipment and rescue/survival lowdown

From October 1966 Approach

New Igniting Method For MK 13-0 Distress Signal

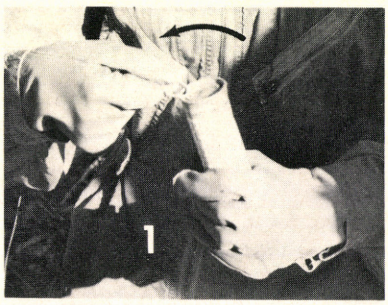
R. T. Frothingham
Research and Development Dept

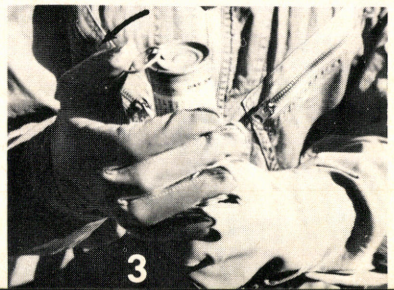
M. Gilpatrick
Quality Evaluation Laboratory Dept, NAD Crane, Indiana

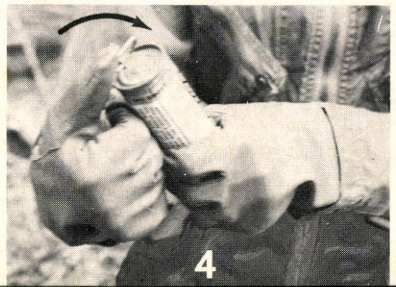
THE OLD FAMILIAR Mk 13 Day and Night Distress Signal (now officially Marine Smoke and Illumination Signal, Mk 13 Mod O) has been a trusted standby for many years as a Here-I-Am, Please-Come-and-Get-Me device for survivors on water and land. Recently, however, numerous complaints have been heard that, all too frequently, the igniting method as outlined on the signal body label doesn't work. Either the pull ring twists off entirely or the soldered seal simply refuses to separate. The end result, alarming if not slightly catastrophic to the would-be user, is that he doesn't get action. The signals themselves are very effective once they are ignited. The difficulty seems to lie in trying to ignite them in accordance with the printed rules.

A new igniting method has recently been developed at NAD Crane and has been incorporated in the first revision of NAVWEPS OP 2213, Pyrotechnic, Screening, and Dye Marking Devices, as change 1. In addition, appropriate steps have been taken to change the signal label to reflect this new method when new procurement of the Mk 13 becomes necessary. In the meantime, literally thousands of these signals are in the system, and not too many of you will get a chance to see OP 2213.

This new method rules out completely the igniting method as printed on the Mk 13 label. Tests have proved that the old recommended twisting force tears the pull ring off in too many cases and leaves you holding a signal that's not a signal because it cannot be ignited. So don't twist the pull ring with your thumb and forefinger as it says







on the can. Instead, bend it down over the rim of the signal body and then flip it back to its original position where the bend can be used as a lever to break the seal. Sounds simple, doesn't it? It has been shown to be almost 100 percent reliable. Step-by-step procedures for using the Mk 13 signal are as follows:

Choose the end suitable for the signal needed: smoke for day, flame for night. (Incidentally, the night flame end is identified by raised humps or projections around the circumference of the case, approximately 1/4 inch from that end.)

Remove the paper (or plastic) cap or cover from the end to be used.

Grasp the pull ring and flip it over the rim of the signal case as shown in photo 1.

Press down the overhanging ring with your thumb (photo 2) until the seal snaps, which it sometimes doesn't do. If the seal refuses to snap with this kind of force, continue pressing on the ring so that it bends over the rim and against the signal body as shown in photo 3.

Flip the bent ring back to the top of the signal and press down (photo 4), using the bent pull ring as a lever.

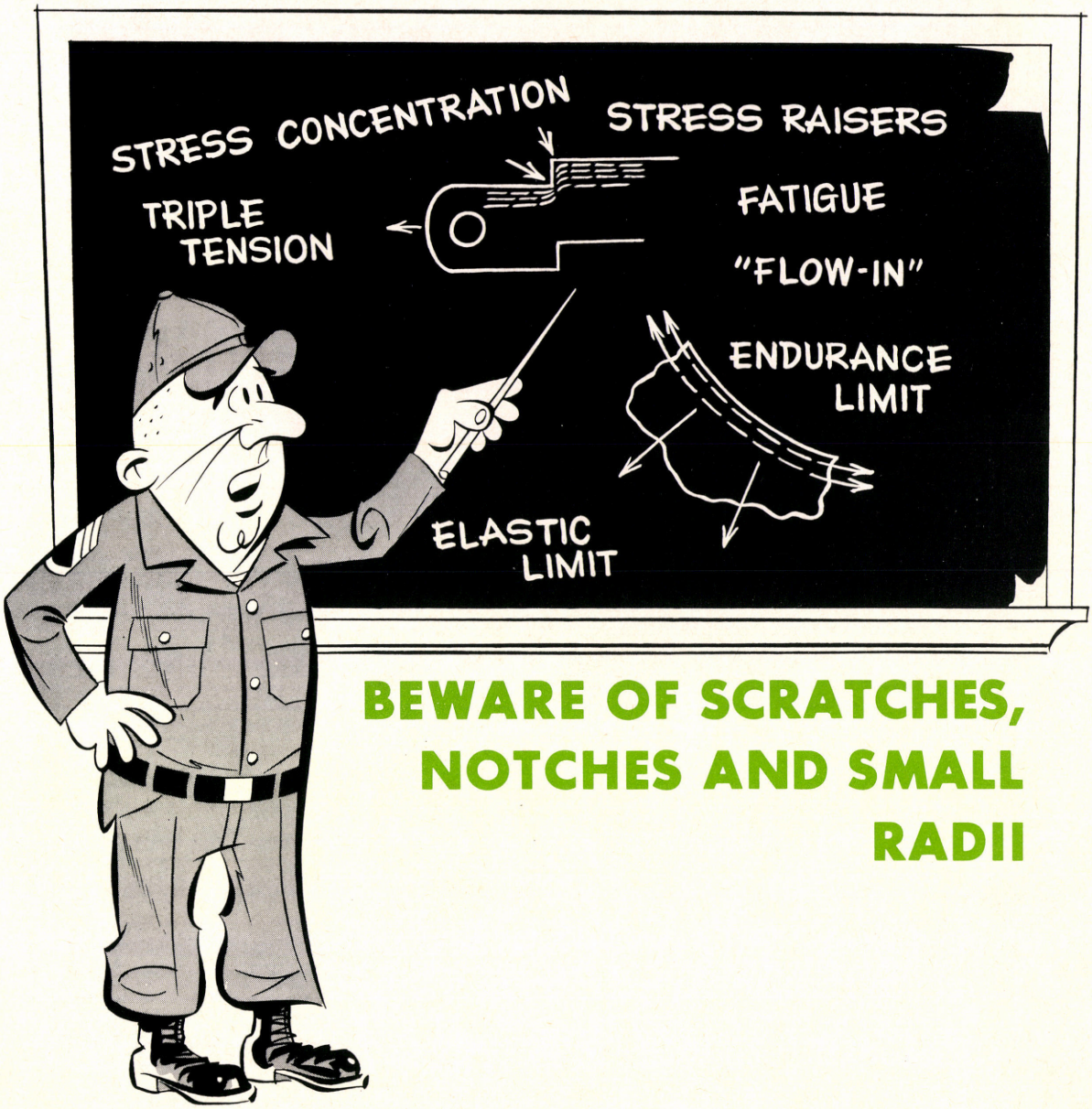
After the seal breaks, point the signal away from your face and body and give a sharp yank on the pull ring. This will ignite the smoke or flame composition, whichever you choose to use.

Hold the signal at an angle of approximately 45 degrees from the horizontal with your arm fully extended. The angle will keep hot drippings from burning your hand.

After using one end, dunk the signal in the water to cool it and save the other end just in case you might need it later. So that's it. The good old Mk 13 will do a good job for you if you don't twist its tail.

If you have a question about personal equipment or rescue and survival gear, write to
Pearl
U. S. Army Board for Aviation Accident Research
Fort Rucker, Alabama 36360

MAINTENANCE PERSONNEL



BEWARE OF SCRATCHES, NOTCHES AND SMALL RADII

. . . a general explanation of fatigue for maintenance personnel responsible for incorporating aircraft modifications and repairs

William H. Barthel

Deputy Director
Directorate of Research, Development and Engineering
U. S. Army Aviation Materiel Command

MANUFACTURER'S DRAWINGS, specifications, inspections, shop practices, etc., are all intended to conform to the best engineering and fabrication procedures and practices. But even with the best procedures and practices, repeated loads on aircraft parts arising from gusts, maneuvers, buffeting, landing and taxiing, gun firing, vibration, oil canning, etc., give the aircraft designers nightmares. With this in mind the men who actually maintain and operate the aircraft should know something about the reasons certain practices are good and others bad, and why such load conditions do cause problems.

One of the most frequent service difficulties in basic structure is the formation of cracks in highly-stressed structural parts which often lead to complete failure if not stopped in time. Both laboratory tests and service experience have shown that any manufactured part will fail after repeated applications of a stress substantially lower than the stress at which failure would occur under continuously increasing load. Such failure under repeated loading is called fatigue failure. The following explanation of this phenomenon is presented with the thought that through such a general explanation of fatigue maintenance personnel responsible for incorporating aircraft modifications and repairs may be able to do their bit to protect our aircraft against such occurrences.

A major contributor to this phenomenon are stress raisers which cause cracks and their subsequent propagation. Stresses are something like women; they don't like to be shoved around. If we don't lead them around corners gently enough they will "gang up" on us and cause trouble. Figure 1 shows what happens when we fail to lead stresses around corners or fail to round off a sharp corner by providing a sufficient fillet. The spacing of the dash lines (stress lines) shown on the sketch indicates the stress intensity. The closer spacing of these lines indicates a higher local stress intensity.

Note that it is much more important to round off the "re-entrant" or "internal" corner than the "external" one, as the stresses are low in the latter case. Anything that compels the stresses to make

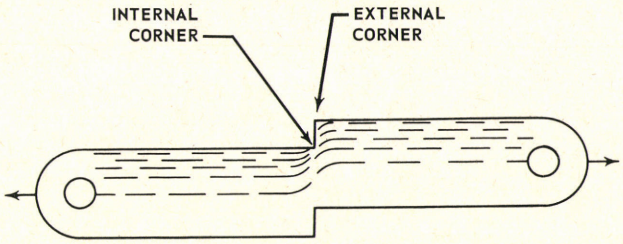


Figure 1A

NOTE: LINES SIMULATING STRESS SHOWN ONLY FOR ½ OF SECTION.

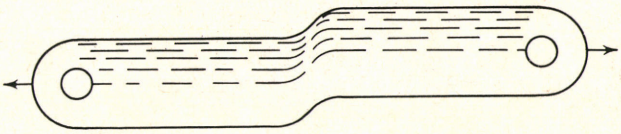


Figure 1B

MAINTENANCE PERSONNEL BEWARE

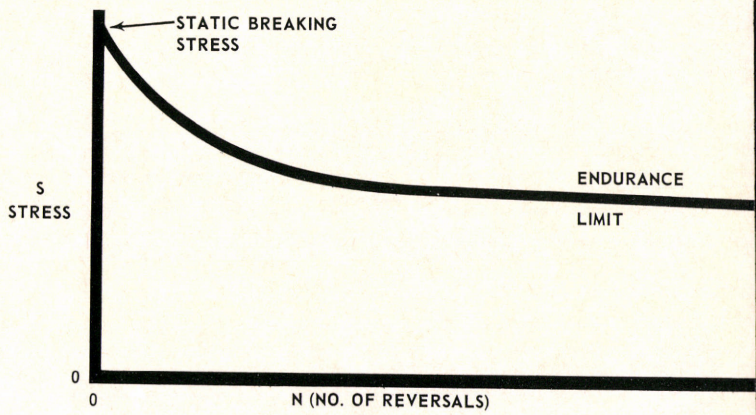


Figure 2

an abrupt departure from a relatively uniform distribution is called a "stress raiser." The "gang up" of the stresses in the corner of figure 1a is more properly called "stress-concentration." Even bolt holes cause considerable stress-concentration; flaws in castings have a similar effect; scratches in stressed plexiglass is another. Stress raisers can increase the local stress in a member to many times the average stress, depending on the sharpness of the notch or defect. So all you "tin benders," "hole drillers" and "rotor blade fixers," don't shove your drill or cutter sharply around corners. Be sure you have good fillet radii, sharp drills and cutters that don't leave burrs or grooves in material.

Fortunately, however, the bad effects of stress raisers do not always cause cracks. First of all, many structural members operate at low stresses, or have portions which are not highly stressed. In such cases the stress raiser, unless very bad, will not increase the stress to the breakout point. Secondly, the plastic properties of a metal tend to "wash out" the stress concentration as the stresses begin to exceed the so-called elastic limit. Any material that can be given a considerable permanent set without breaking falls in this category. For instance, stress-raisers would have very little effect on a soft material like lead, but would have a disastrous effect on glass.

The moral of this story is to make all rotor blades and helicopter transmissions out of lead. Therefore, no effect due to stress raisers. Seriously, steel and aluminum alloys come somewhere in between these two materials. An ordinary static test will usually indicate very little decrease in strength of an aluminum alloy or steel part which contains a stress raiser. This is because the material tends to "flow" before it actually breaks, thus automatically relieving the stresses at the point of concentration. But you "tin benders" can't figure on material "flow-in" when you're going around corners.

The real danger of stress concentrations is in connection with dynamic loads, which are of two general types. The first type is classed as vibration, in which loads vary rapidly over a considerable range. Such conditions are found in main rotor blades, propellers, engine parts, cowlings, transmission, etc. The net effect of such variations is to reduce the breaking stress of the material and also to make it less plastic. When these two results are combined with a stress raiser, things begin to pop sooner or later.

A small crack will form at the point of highest stress concentration and will begin to spread as the load continues to fluctuate. Sometimes these cracks are discovered before complete failure occurs, but in other cases the action is too rapid to be prevented. Manufacturers guard against such failures by using low allowable stresses in design, but if there happens to be a bad stress raiser present it is practically impossible to provide enough material to prevent cracking. The gradual reduction in breaking stress as the load reverses or varies is called fatigue.

Fortunately there is a limit to this phenomenon, so that structure can be designed to allowable stresses which are safe, no matter how many times the load reverses. This is indicated by figure 2, which is commonly called an S - N Diagram (S for stress, N for the number of reversals). The minimum is called the endurance limit. Parts designed on the basis of the endurance limit instead of the ultimate stress are theoretically able to withstand any number of stress reversals during the life of the aircraft. Actually they can do so only if there are no serious stress raisers in the highly stressed portions. Even corrosion sometimes acts like a

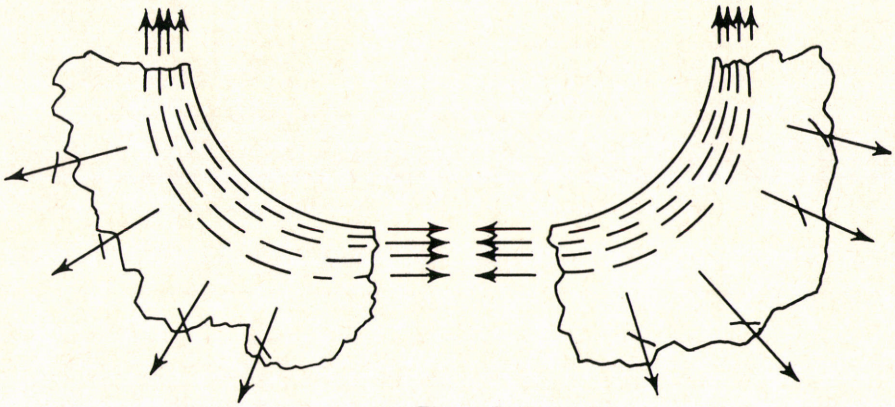


Figure 3

stress raiser and there have been actual cases in which corrosion, notches, and vibration all act together to cause failure.

Stress concentrations also play a major role in the design of equipment that is subject to impact loads. To withstand a severe impact without breaking a member must be able to absorb energy, that is, it must "give" under the impact. A brittle material (such as glass) is very poor in this respect as it develops high stresses without absorbing any appreciable amount of energy. The method of cutting glass illustrates this point very well. First a notch is scratched into the glass to produce a stress-raiser. Then the glass is tapped by a hard object, causing an impact. Because of this brittleness, the glass cannot absorb the energy of the impact without developing very high stresses. The scratch tends to increase these stresses many times and therefore causes the glass to break along the scratched line. Obviously the presence of stress raisers is bad for impact resistance, as the material will crack before absorbing much energy.

There is one other dangerous stress condition which greatly lowers impact resistance and this is referred to as triple-tension. Fortunately in Army aircraft components, this is not inherent in the design unless we consider hydraulic pressure actuators in this category. Research has shown that if we were to pull on a piece of material in all directions at once it would behave as an extremely brittle material, even though it had plenty of elongation (plasticity) in ordinary tension. The reason is simply: there is no way for the material to contract in one direction while it expands in another. Any condition which approaches triple-tension in actual design tends to lower the impact resistance. Another example of this would be a spherical shell under internal pressure, which would represent biaxial-tension, i.e., tension in two directions.

When we compel a tension stress to "flow" around a corner or radius we induce some additional tension stresses at right angles. This phenomenon is somewhat like that of centrifugal force and is illustrated by figure 3.

In summary, every man who works on a highly stressed part on any fixed or rotary wing aircraft should remember the following: Prevention is always the best cure. Experts have agreed that the best ways of avoiding fatigue failures in aircraft structures are: "Use no sharp re-entrant angles; use no thin outstanding legs on primary structure; polish every member subject to high alternating stress; when stress relief is made by undercutting, be sure to cut below the stress concentration that is to be relieved; polish the relief cuts; do not drop a wrench on crankshafts, rotor blades, or fittings; avoid clamping stresses." The best way of avoiding fatigue difficulties is to avoid unnecessary stress raisers on the drafting board, in the machine shop, in maintenance, and in inspection.

The most effective way to prevent failure of metals under repeated stress is to avoid notches. Every time we permit a notch to be present, we throw away one-half to two-thirds of the load-carrying ability we might have if we were more careful in design, in machining, and in inspection. This doesn't mean we must stop flying aircraft that have notches in primary structure. Probably such structure is more than adequate and possibly such a sharp edge or notch couldn't be helped. But basically, whether the notch is caused during design, whether it comes from a slip in the machine shop, whether it comes from accidental damage in service and turns up in inspection, a notch should be thought of as carrying a red flag that spells CAUTION.

WINNERS PLAY BY THE RULES

Ted Kontos

IT'S THAT TIME of year again. You can tell by the number of television demonstrator sets being returned to dealers, and by the absence of uninvited guests in homes with color TVs. Another football season is over. But is it? On the contrary, after 59 years and thousands of contests, the most important "ball" games are still in progress all over the world. Whether you realize it or not, *you* are a participant.

Organization of your team began on December 23, 1907, when sealed proposals for furnishing the Signal Corps with a heavier-than-air flying machine were requested on behalf of the Board of Ordnance and Fortification.

Since that time, the military aviation team has grown in size and ability to outplay and outclass all opponents. Its continued success depends on the same qualities that make any ball club great—the physical condition of players, training and experience, coaching staff, ability to abide by the rules of the game, and, most important, *teamwork*.

Like the player who fumbles the ball as he crosses the goal line, or the teammate whose clipping penalty nullifies a touchdown, errors cause severe penalties and lost ball games. Most occur from failure to follow the rules. One such example concerns a mechanic who kinked a flexible fuel line during installation. It failed during flight.

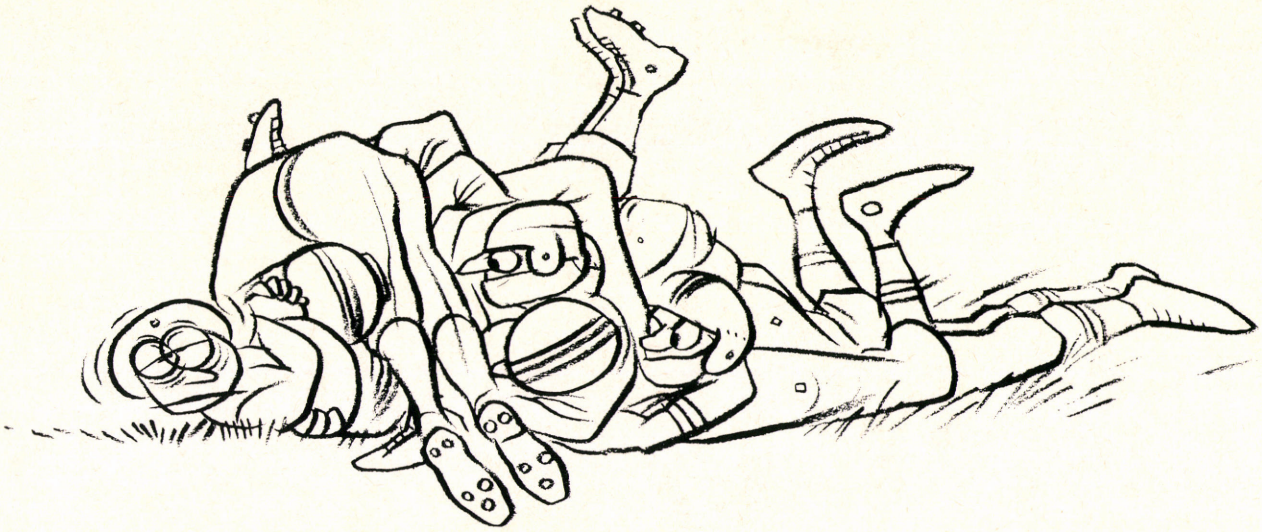
In other instances, hydraulic, oil, and fuel connections were not tightened. They came loose. Oil and hydraulic lines were improperly anchored or routed, resulting in chafing and failure. In each of these instances, flight was terminated by forced or precautionary landings. Causes of similar mishaps include inadequate electrical connections, crimped wiring, insufficient lubrication of bearings or other components, improper torquing, etc. Penalties for these types of errors are not always light.

Failure to properly torque and safety the outer lock nut on the hydromechanical clutch and fan assembly of a UH-19 allowed it to back off during flight. This caused a severe wobble to develop in the transmission drive shaft, allowing the main rotor blades to strike and sever the tail boom. The aircraft disintegrated in the air.

Overtorquing UH-1 rod end trunnion bolts or failure to torque the two bolts on each lug in succession resulted in cracking of the trunnion supports. These supports failed in flight, causing loss of control. A similar accident occurred when the dampner mounts of a UH-1 were improperly torqued.

In each instance, a successful flight was prevented by a personal error. Sticking to appropriate TMs would have prevented all of them.

Nor is the coaching staff immune to errors. One commander selected a highly qualified pilot for an administrative flight. Despite his qualifications, this pilot was suffering from physical and mental exhaustion, resulting from many hours of flight and loss of sleep while completing a previous mission. During a portion of the flight conducted under IFR conditions, the aircraft crashed. Investigation



led to the conclusion that excessive fatigue was highly instrumental in preventing the pilot from successfully completing his mission.

Another commander paired two inexperienced pilots for a field exercise. After landing in a confined area to pick up passengers, rotor rpm was lost during takeoff and the aircraft struck trees. Major damage resulted and four passengers sustained injuries.

One aircraft crashed during the night ferry mission when the pilot lost visual reference with the ground. The weather forecast called for low clouds, ground fog, and rain. The pilot selected for this flight was not instrument qualified and had not received any instrument flying training for two years before the accident.

Why were these men chosen? Why weren't fresh qualified replacements sent in? What is even more difficult to understand is why a quarterback, who will take every avenue of escape to keep from butting heads with an overgrown tackle, reason in reverse when it comes to flying. One pilot, calling his own plays, decided to undertake a night flight even though severe weather, with possible tornadoes, was forecast. His reason—to return a borrowed aircraft in time for use by the lending unit. The lending unit never received the aircraft.

Another veteran pilot, wracked by severe emotional problems, said nothing about them when he undertook a routine flight. When his engine failed, under conditions which should have resulted in a successful forced landing, he was unable to cope with the situation and was killed.

Again, personal errors lost ball games. And again, one or more rules were violated.

We find similar causes in wire strike accidents. During the past seven years, wire strikes have resulted in 32 fatalities, 94 injuries, and losses in equipment valued at $7,000,000. Of 138 major wire strike accidents, 93 percent occurred below 100 feet. Violation of SOPs and regulations contributed heavily toward these mishaps. An example is the following accident brief:

". . . Aircraft struck ground, bounced, began to disintegrate, caught fire, and struck ground again in inverted position during low level training flight. Copilot's seat was thrown clear of wreckage during bounce. Pilot was killed and copilot sustained minor injuries. Aircraft was destroyed. Caused by pilot flying too low and striking ground. The unit SOP listed 200 feet as minimum altitude for low level training flights."

No coach would plan for a game with the idea of stretching the abilities of his team and equipment. Yet, we find pilots trying to do just that. One aircraft was ditched at sea after its fuel supply was exhausted. Three occupants sustained major injuries and the aircraft was destroyed at a cost of $647,973. The accident report contained this statement: "Both the pilot and copilot demonstrated a lack of professionalism in the planning and conduct of this flight by failing to insure that sufficient fuel was aboard, in accordance with AR 95-2."

A search through the accident files shows case

Play by the rules

after case in which accident cause factors could have been eliminated and mishaps avoided if all the teammates had done their jobs according to the rules.

The opponents we face in the aviation game are real and potentially lethal. Snow, rain, sleet, hail, ice, fog, cold, heat, density altitude, mountains, darkness, sand, and dust have all been around for eons. With the advent of man, these have been augmented by such concrete and abstract obstacles as powerlines, bridges, telephone poles, fences, laziness, fatigue, illness, inexperience, and many others.

Help is available. Your aircraft is equipped with flight instruments and you have been trained to use them. You are backed with meteorologists who provide current and projected weather information. Reports from other pilots supplement this. You have modern communication equipment. Radar is often available to guide you. Alternate fields are situated along your proposed route. If weather conditions are severe, you can call time out. At worst, it is better to be penalized for delaying the game than to lose it.

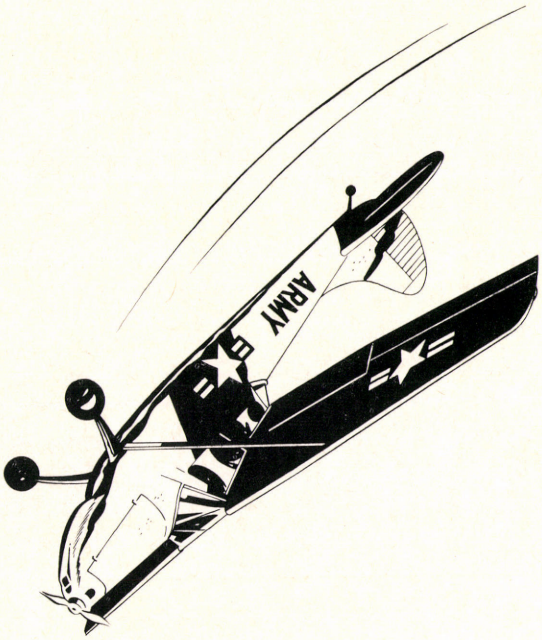
Proper clothing is another prime consideration. No football player would venture on the gridiron without helmet and padding. But far too many flight crews persist in wearing short sleeves, low quarter shoes, and synthetic fiber socks. They refuse to wear gloves or clothing treated to make it fire retardant. A few months ago, a pilot received third degree burns over his hands, arms, and portions of his body while escaping from his crashed aircraft. The copilot involved in this accident sustained only minor burns over a small portion of his body even though he was last to evacuate the flaming wreckage. He was properly outfitted for flight. The pilot was not.

Where practical, equipment aboard an aircraft is duplicated. If you lose your main inverter, you have a spare. If an engine driven fuel pump should fail, the electric boost pump can keep a reciprocating engine going. If your landing gear won't extend by normal means, you have an emergency system to fall back on.

You are provided with the best instructors, training aids, and equipment available. You have supervisors and inspectors every step of the way from the manufacturer to the mechanic.

It's a great game—this business of flying. To win, you must play it right—BY THE RULES AND BY THE BOOK.

After 59 years and thousands of contests, the most important "ball" games are still in progress all over the world. Whether you realize it or not, you are a participant.



THE NEED FOR SELF-DISCIPLINE

AN O-1A AVIATOR was on an RON proficiency flight during the Christmas holidays.

Farmer: "I returned home about 4:30 on the afternoon before the accident, entered my home, and was introduced to an Army aviator by my daughter. After supper, we talked until about 8:30 when my wife and I went to bed. My two daughters and the aviator went to town and returned about 1 A.M.

"The next morning, my son and the aviator went hunting, returned about 9 o'clock, and had breakfast. We sat in the living room until shortly after 1 o'clock, then my daughters drove the aviator back to the airport.

"About 1:30, the aviator returned in his plane to buzz the house. He flew two circles northwest of the house and returned south by the side of the road, met my daughters at the creek, and flew alongside the road as they drove to the house. My wife and daughters and I stood in the yard and saw the aviator make two other small circles, roll over, turn slowly north, and go straight to the ground."

Daughter: ". . . My sister and I took him to the airport, stopping on the way to pick up my brother and sister-in-law. He [the aviator] seemed to have had a pleasant visit and was in good spirits.

"When we arrived at the airport, he began to put his belongings in the plane. Then he began making preflight checks on the plane. He seemed very confident in what he was doing and explained the procedures as he made the checks. He drained gas from the tanks and carburetor to make sure water had not settled in them.

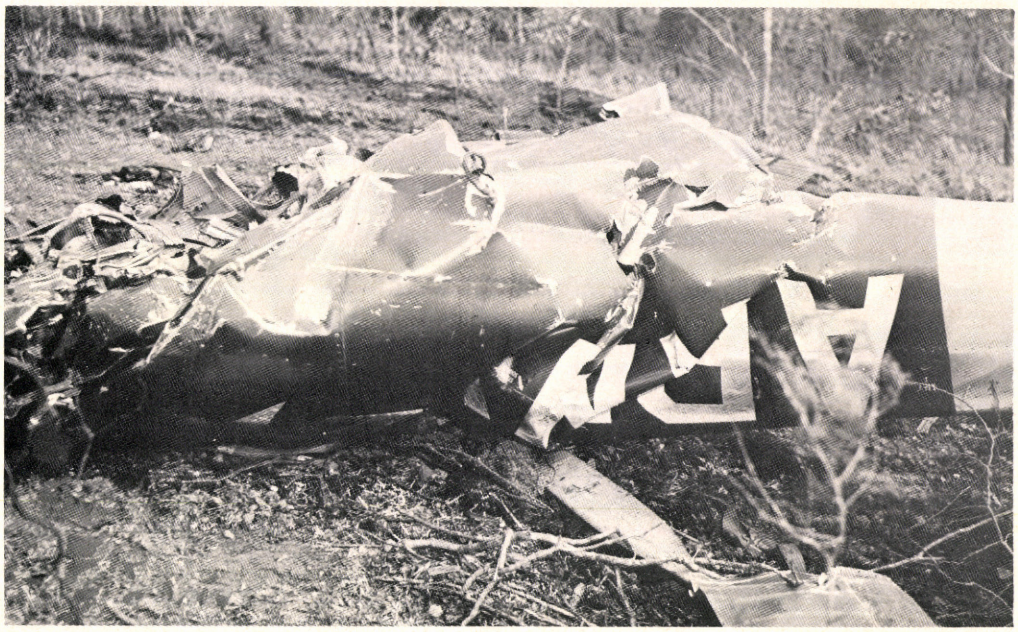
"He explained the controls in the cockpit and checked to see if the stick was working properly. After making several other checks, he took his log book from the plane and went to telephone and report his flight.

"When he returned, he said things were all set, put on his parachute, and climbed in the plane. . . . Before starting the engine, he put on his flight helmet and said, 'clear!'

"He slowly moved out to the runway and warmed up the engine. He first moved down to the right end of the runway, turned around, went the length of the runway, and was off.

"As my sister and I drove home, approximately seven miles, he flew along with us. He arrived at the house before we did. We pulled into the driveway and I had just gotten out of the car and was standing beside it. As I looked up, he was making a left turn. The plane turned over twice and went straight down. Shortly after the impact, the plane

All factors considered, none other than the actions of the pilot could be attributed to this accident . . .



The pilot of this O-1 failed to resist the temptation to show off and attempted what was described as a low altitude loop

burst into flames. As the plane was turning over, the engine seemed to falter and the controls appeared to be stuck."

Accident report: "The following information and statements were taken from individuals during the initial investigation at the crash site the day following the accident. . . .

"Subject number 1 saw aircraft just prior to impact. He heard no unusual noise, such as backfiring or other engine noises. He heard the crash and explosion and then saw smoke. The subject saw the aircraft perform what he described to the board as a loop, and stated the aircraft was going straight down immediately prior to his hearing the crash.

"Subject number 2 saw the aircraft just prior to impact. No unusual engine noises were noted. The subject stated he saw the aircraft perform what he described to the board as a loop. He said the aircraft looked level prior to impact.

"Subject number 3 also saw the aircraft just prior to impact. She saw the aircraft rocking its wings and then execute what she described as a loop.

"Subject number 4 stated the aircraft was doing aerobatic maneuvers just prior to the crash. She described diving maneuvers and a loop and stated the aircraft had just performed a loop and did not recover.

"Subject number 5 was with subject number 4. She described the same maneuvers and gave the same information.

"Subject number 6 stated that he was bird hunting on one of the farms in the area of the crash. He thought the pilot was a stunt man and said he performed a barrel roll or snap roll, then dove straight down, attempted a loop, and fell through. This subject stated that the power did not fail and the aircraft was headed north when he heard the crash explosion and saw the smoke."

Investigation: ". . . During the interview of witnesses, the board was seeking to establish the flight

path, type of maneuvers performed, altitude, unusual noises made by the aircraft, and the direction of flight.

"Witnesses were abundant, probably due to published accounts of the crash in two newspapers which were both distributed locally early the morning following the accident. Many who were not in the crash vicinity readily volunteered information. For this reason, efforts were concentrated toward those persons living in the immediate area. Credibility was given to most of these witnesses, except for the girl friend. She displayed considerable distress and grief and, although cooperative, seemed over-protective about the deceased's actions and her involvement in the circumstances.

"None of the witnesses interviewed had any aviation experience. Most of the inhabitants in the immediate vicinity were elderly people who had little experience even in observing aircraft. Many indicated concern and fear while watching this aircraft, due to its low altitude and flight maneuvers. Only one witness would estimate the altitude of the aircraft. The others spoke in terms of 'very low' and 'too low.' It could not be determined if any one witness observed the entire flight sequence. Therefore, it was difficult to determine for certain just how many turns, low passes, or other maneuvers were performed. . . .

"The board concluded that immediately prior to the crash the pilot had attempted a loop. How complete or perfect the maneuver was executed prior to his attempted recovery is unknown. Flight records of the pilot indicate considerable experience and assumed proficiency in this type aircraft.

"The board felt that the maneuver was attempted with insufficient altitude to assure safe recovery and definitely at an altitude which would not insure recovery by 1,500 feet, as required by AR 95-2. Elevation at the crash site was about the same or slightly higher than the departure airfield.

". . . Additionally, the pilot exhibited faulty decision by performing a prohibited maneuver, failing to anticipate the hazards of the maneuver while his attention was channeled to interests outside the cockpit, and possible overconfidence.

"Examination of the pilot's local orientation and command policies reflected that he had attended all monthly safety classes since his arrival at the installation. He had also been exposed to increased emphasis and policy regarding flight safety during the holiday season and the last minute completion of semi-annual minimums.

"Throughout the investigation, the board considered aircraft design, maintenance, inspections, materiel failure, training, supervision, and administration as factors which may have related to this accident. None were substantiated. The area of primary concern was the operation of the aircraft and pilot performance. All factors considered, none other than the actions of the pilot could be attributed to this accident."

The investigation board recommended that cause factors relating to this accident be widely disseminated through aviation publications as a means to emphasize the need for self-discipline among flight personnel.

PICTURE ANSWERS

1. *Helmet chin strap is unfastened.*
2. *Helmet nape strap is loose.*
3. *Sleeves are rolled up.*
4. *Aviator is not wearing gloves.*
5. *Shoulder harness is not in use.*
6. *Aviator is wearing low quarter shoes.*

NOTE: We can only hope he is not wearing synthetic fiber socks and underwear which will melt and fuse with his skin if exposed to flames.

Camp Number Two

Private Mary Jo Izsak

The author was inspired to write the following when she read "Mission Release" in the November 1966 DIGEST. The factual article concerned a group of American and South Vietnamese soldiers who set out to rescue five American advisors held prisoner by the Viet Cong. Private Izsak is assigned to the Information Office, Headquarters, Third U. S. Army, Fort McPherson, Ga.

I now, of course, know what to do.
The S-2 told us of "Plan Rescue."

I

The VC visited a nearby farm
unaware of creating any harm.
Five Americans were held by the VCs:
advisors in the hands of Vietnamese.
Three units were to move in by air.
In case of a trap Special Forces were there.
The routes of escape numbered three,
so we troops must move in on the QT.
In this plan I saw the flaw.
Before it was over my nerves would be raw.
We had to move into the area cold.
"Reconnaissance impossible," we were told.
At 0900 hours we moved out
all of us fearing the strange route.

II

The camps were numbered one and two.
The fifteen guards were none too few.
Our objective must be met some way.
I knew too well there could be no delay.
If we were detected the captives would die;
innocent men wondering why.
At least they were still alive.
Wait! The guards numbered just five.
The S-2 wondered what this could mean.
The informer said there would be fifteen.
Could we be falling into the VC's lap?
Is this another clever trap?
Too late to wonder why or how;
the signal given; the time is now.

III

Out from behind logs and trees
our troops rushed in to outflank the VCs.
In just a minute the job was done,
but into the woods one VC had run.
Being wounded he can't go far
'though I wonder how close his friends are.
Three surrendered; others were wounded or dead.
Camp Number One; we came out ahead.
In a nearby shack we found three of the five
laughing, babbling and glad to be alive.
Unharmed: they were safe and sound.
Still, the other two must be found.
I glanced around and of course I knew
that now we would go after the other two.

IV

I can't help but remember the escaped VC.
The hostility of his friends I can foresee.
I reluctantly wonder what lies ahead;
will I come back alive or dead?
We traipse and plod through this trail of mud
blazed in abundance with brave men's blood.
Will my blood also grace this trail?
Will we pursue our goal to no avail?
Dear God in heaven help us please.
The VC guards we must safely seize.
We must outplay them at their own game.
The American advisors we must claim.
No more of my thoughts do I have time to pursue,
for just ahead lies Camp Number Two.

Medic and Gunner — to the rescue

MOST OF THE unit was back at base camp. Six Hueys loaded with the last of Company B were taking off. A specialist named Joe, medic for the third platoon, thought his work was through for a while as he boarded a helicopter.

One of the birds didn't make it, though. It lost power and crashed into the jungle about 500 meters from their landing zone (LZ). The airborne choppers immediately returned to the LZ and unloaded the men for rescue operations.

The call went out for a medic. Joe stepped forward. The rescue plan was for him and a gunner from another Huey to rappel to the downed bird. At the same time the rest of the unit would work their way to them on the ground. Joe had never before rappelled but agreed without hesitation.

They hovered over the crash site but could not get down low enough for the two to get in. Nearby, however, was a clearing where the chopper could hover within 75 feet of the ground.

The clearing turned out be a briar patch with the thickest growth that Joe had ever seen. The two rescuers used machetes to hack their way 50 meters through the briars until they got back into the jungle where traveling was easier.

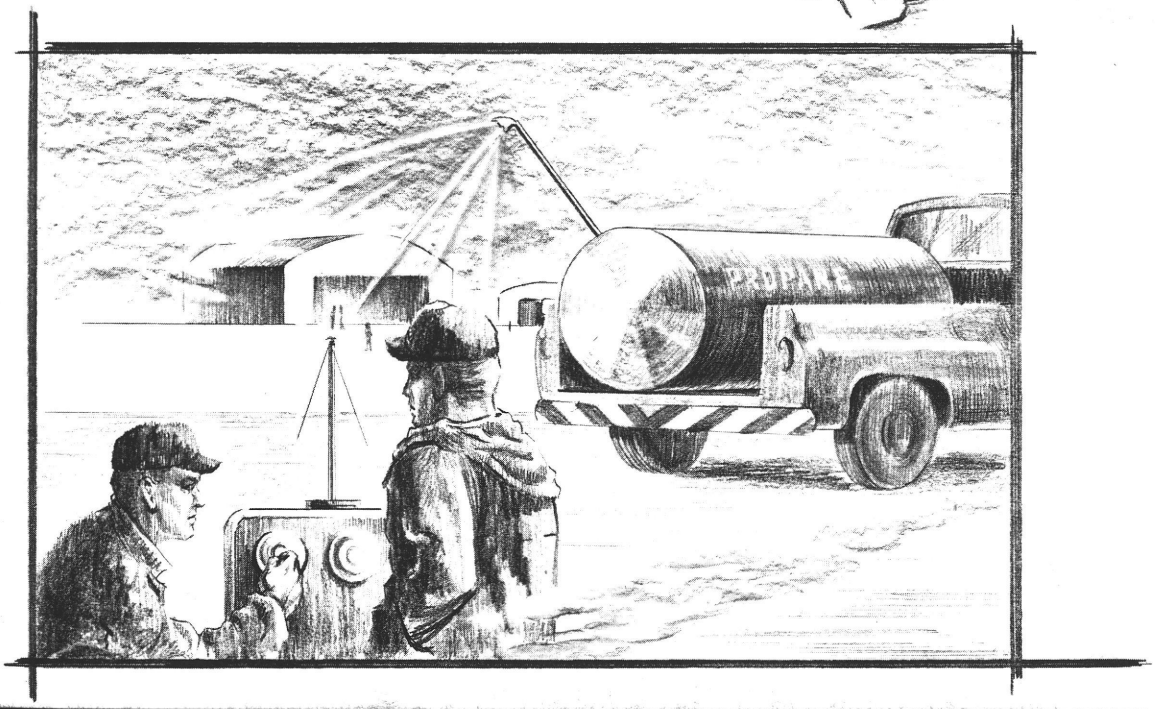
Several of the occupants of the Huey had either been thrown out or had crawled free before the aircraft burst into flames. Joe found the worst injured, and he set to work treating the pilot for shock and concussion. The gunner assisted while Joe bandaged wounds. The two men continued treating the wounded with no security until the men of third platoon worked their way from the LZ to the crash site.

Joe requested a medical evacuation by helicopter and continued to treat the injured. "They came pretty fast," Joe said. "It was only a few minutes from the time that I asked for help before a Chinook was lowering a basket down to us."

What makes men unhesitatingly volunteer to undertake dangerous tasks such as this? No one can say, other than it is a job which has to be done. Joe and the gunner reacted automatically and sought no credit for themselves. They are indeed a special sort of people, but their kind are not hard to find among American troops in Vietnam.

FOG DISPERSAL

A HELICOPTER eliminates a shallow, warm fog bank over Greenland by slowly skimming over the top of it. CRREL (Cold Regions Research and Emergency Laboratory) scientists have found that under certain conditions, the wind motion of the chopper's blade pushes the fog downward into warmer air —dispersing it—cutting a clear path 75 yards wide and a mile long in 15 minutes.

Below: CRREL scientists test ways to disperse freezing temperature fogs at airports. Propane gas in tank dispensers near runways is released, causing water droplets in the fog to turn to ice crystals, rise to cloud level, then fall as snow.

—Army News Features