JULY 1960

UNITED STATES ARMY AVIATION DIGEST

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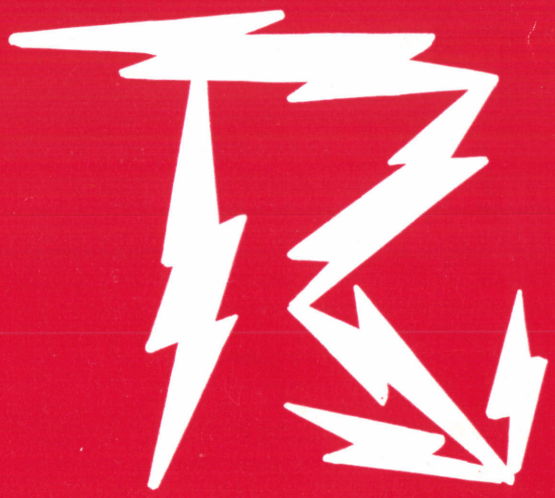

United States Army

AVIATION DIGEST

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JULY 1960
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BREAK-AWAY FUEL TANKS . . . . . INSIDE BACK COVER

We hope the angry red of our cover portrays a suggestion of the angry violence found within the summer season's familiar cloud formation, the thunderbumper.

Inadvertent flight into thunderstorm activity is always a possibility . . . but the basic rule of thunderstorm flying is DON'T!

If, despite careful scrutiny of current and forecast weather, you find yourself among the thunderbumpers BE READY. THE PROFESSIONAL knows Mr. Anvilhead's physiology and temperament.

As stated, the primary rule of thunderstorm flying is DON'T! Even under VFR conditions Old Anvilhead can hem you in and make a believer of you. Study your forecast thoroughly and watch for signs of his appearance throughout the summer months. He's a killer. Gusts, downdrafts, and hail are his weapons.

Don't push your luck. He who turns and flies away, lives to fly another day.

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The U. S. ARMY AVIATION DIGEST is an official publication of the Department of the Army published monthly under the supervision of the Commandant, U. S. Army Aviation School.

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.

Manuscripts, photographs, and other illustrations pertaining to the above subjects of interest to personnel concerned with Army Aviation are invited. Direct communication is authorized to: Editor-in-Chief U. S. ARMY AVIATION DIGEST, U. S. Army Aviation School, Fort Rucker, Alabama.

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FLIP-FLOP OVER THE TOP

Captain William J. Morris, Sig C

THE BALLOON had gone up. After weeks of trading ground for time, we were ready to take the offensive. Using our last river barrier in Western Europe to stave off the Aggressor, we were now free to use the 6th Armored Div in conjunction with our airmobile assault from the 20th Inf Div to launch a breakthrough.

The Aggressor 32d Rifle Division opposed the U. S. 20th Inf Div.

Air parity existed over the battle area. Nuclear weapons had previously been used in small numbers by both sides.

Major General Jumpoff, CG, U. S. 20th Inf Div closed his staff briefing on D-1 by stating emphatically:

"At the conclusion of tomorrow's airmobile operation we should be firmly established on the east side of the river, paving the way for the 6th Armored Division's link-up with the airmobile task force in our airhead objective area. The helicopter airmobile assault tomorrow will be the first large scale assault of its type we have conducted. Our planning follows doctrine evolved over the past five years of training in airmobility. I'm positive the crossing will be a success.

"We have been promised the close air support and armed helicopter escorts needed to make our airmobile attack a success.

"Our latest intelligence indicates normal employment of Aggressor force's light aircraft forward of the main battle area, with a slight increase of rotary wing activity during the past two nights. Probably these were resupply missions and troop movements to bolster Aggressor frontline elements.

"Alternate routes have been selected for each of the assault flights. They are integrated in the deception plan, involving a light helicopter flight supported by armed recon helicopters. The use of drone aircraft will also aid in deceiving enemy AA units as to our true intent. We may thus locate and destroy them prior to the main assault. (See Reduce the Kill, page 27)

"G-2 assures me that enemy AA presents no great problem. Aggressor forces have not ex-

---

Captain Morris is assigned to the Aerial Surveillance and Target Acquisition Platoon (Experimental), USAAVNS. He is rated with over 1,600 hours flying time.

tensively employed SAM against our low-flying manned and drone recon missions. These missiles have not been very effective against aircraft operating extremely close to the surface.

"Artillery will fire on known and suspected AA positions within range during movement of the airmobile force to the objective.

"Transport flights ABLE, BAKER and CHARLEY will be escorted by armed helicopter flights DOG, EASY, and FOX.

"In event a transport flight is hit by Aggressor en route, they will execute Plan ZULU and notify G-2 through the intelligence net of the size and disposition of the Aggressor forces.

"As the G-3 has indicated, Plan ZULU utilizes the next available terrain corridor for continuation of the mission to the objective. Transports will not engage Aggressor interceptors unless all other means fail. Escort choppers are provided for this purpose. In event you are trapped, use smoke, cover, and concealment to minimize losses. Escort aircraft will extricate you and provide flank or frontal screen for your deployment into the adjacent terrain corridor.

"Are there any questions?" Silence prevailed except for the folding of maps and crisp overlay paper.

"Gentlemen, I'll see you on Objective A."

IN THE ENSUING ACTION AGGRESSOR ARMED INTERCEPT HELICOPTERS DID MANAGE A WELL-PLANNED SURPRISE INTERCEPT OF THE HELIBORNE ASSAULT FORCE IN SPITE OF EXCELLENT PLANNING ON THE PART OF THE 20TH INF DIV.

A WILD, LOW-LEVEL MELEE OF ROCKET AND MACHINEGUN FIRE FORCED THE USE OF PLAN ZULU, BUT THE FAST MOVING AIRMOBILE FORCE REACHED ITS OBJECTIVE AS PLANNED. THE LINK-UP WITH THE 6TH ARMORED DIV WAS MADE ON SCHEDULE, AND THE NATO COUNTEROFFENSIVE ROLLED SWIFTLY FORWARD. OPERATION FLIP-FLOP WAS AN OUTSTANDING SUCCESS.

Let's reconstruct the action and see how the escort choppers of the U. S. Force played a vital role in the success of this operation.

As the airmobile force entered enemy territory, Sergeant Ruff shifted nervously in the canvas seat and readjusted his safety belt. Glancing out of the window of the transport chopper, he saw Hill A approaching rapidly. He mentally noted that they were about 14 minutes from the objective.

Suddenly, the cabin area exploded in front of him. He felt pain in his side as he lapsed into unconsciousness from the concussion.

Captain Speedy, Able flight commander, felt a sudden lurch and then a loss of cyclic control. The chopper descended the 100 feet to the ground in an abrupt, turning glide. Pulling pitch at the last minute, Speedy, with all the skill at his command, dropped the cut-up chopper into a clearing. As it ground to a metal-crunching halt the thought raced through his brain, "What hit us? There's no Aggressor reported here . . . ."

Lieutenant Wright, assistant flight commander, noting the crash, pressed the mike button and said, "Able Flight, this is Able Two — now Able leader. Execute Plan ZULU."

"Better notify Baker Transport Flight," he thought.

"Baker Flight, this is Able leader, over."

"This is Baker leader, over."

"Enemy choppers. They hit us at Hill A. Executing Plan ZULU. Use Corridor Two."

Baker leader turned his transport flight to Corridor Two, musing, "Hope Speedy got out of it OK. Sounded like Wright on the radio. Fox Flight's escort choppers ought to clobber those intercept choppers if he can flank them."

Background static ceased in Fox leader's radio as he heard, "Fox Flight, this is Able leader, over."

Scanning the swiftly moving terrain as his armed chopper whizzed along at treetop level, Fox leader pushed the transmit button, "This is Fox leader, over."

"Bogies on Hill A; executing ZULU: expedite, expedite . . . ."

Fox Flight leader, clipping along at 100 knots, treetopped his way to the west of Hill A. Behind him in a loose V were five heavily armed escort choppers, also skipping in and out of the terrain folds.

Able Flight, meanwhile, has veered left into the adjacent terrain corridor.

The new Able leader was passing on the full story of the enemy intercept to the G-2 via the intelligence net.

"That's right; they were on Hill A. I think there were more of them in the area, but I missed them when I executed Plan ZULU. Fox Flight ought to wipe them out with no trouble. I'm going to . . . ." The G-2 radio operator tried desperately to contact Able Flight, to no avail.

"They faded out," sir.

"I know, I know," said the G-2. "I just hope that the action on Hill A against Able Transport Flight wasn't a diversion. Aggressor may be set up to ambush the Baker Transport Flight in Corridor Two. The recon choppers couldn't pick up anything on their preliminary recon."

Approaching Hill A, Fox Flight leader caught a glimpse of turning rotor blades just to the west of the hillcrest, in defilade. As the aircraft came in line with his sight, he pressed the firing button, then saw it explode. He sped past and dropped down to a hover in a nearby clearing, barely large enough for his rotor blades. The remainder of the flight was also busy. Fox Two, while checking out a suspicious reflection from a copse of trees, was hit by a burst of machine-gun fire from an interceptor.

"Fox leader, . . . Fox Two . . . I'm setting down . . . hit . . . ."

"Roger, Fox Two. Be there in a minute."

Meanwhile, Fox Three spotted the Aggressor radar aircraft which had picked up the transports initially. He gave it a burst of mg and two rockets before it could escape down the valley. Decelerating and making a pedal turn, he noted its crash landing with satisfaction. Out of the corner of his eye he saw the pilot dashing madly for cover behind nearby rocks.

Pilot jumped behind rocks

Picking up Fox Two at his crashed chopper, Fox leader was rallying his flight when the static was broken by, "Fox Flight, this is Able leader. They've hit us again . . . we're boxed in . . . I'm having to scatter . . . we're in small clearings in the valley floor . . . interceptors on all the surrounding hills . . . have "Smoky Joe" screen us and we'll exit using Corridor Three."

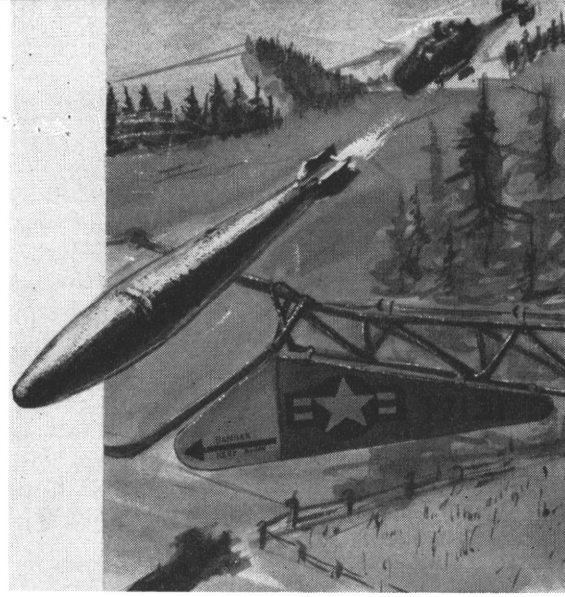
"Roger Able leader. Fox Flight on the way. Give us a Five Count for homing."

Able Flight was scattered. The transports had bottomed pitch after losing two aircraft and discovering that they were boxed in the corridor. Hovering below the treeline in small clearings, they awaited arrival of Fox Flight's armed recon choppers.

Escape without help was impossible. They were unable to leave the valley floor without unacceptable losses. Enemy interceptors controlled all possible exits. Several Aggressor interceptors attacked the flight under cover of those on the higher ground. Able Flight's actions were limited to passive measures.

As an intercept roared overhead attacking a transport in another clearing, Able leader rose to a hover and let fly a burst of 50 cal. A lucky hit on the Aggressor's gas tank caused him to explode in midair.

"Got one of them!" he shouted on intercom. Spirits picked up a bit in Able Flight as they heard this news on interflight frequency.



Met by interceptor rockets

"We can't hold out much longer. If Fox Flight doesn't get here soon . . . ." muttered Able leader on intercom to his copilot Jonesy.

The copilot, agreed, "You're right; if they pull those intercepts down off the high ground to join in on the attack, we're done for."

Fox Flight, having gone to a higher altitude, homed into Able Flight's trapped position cautiously, but was met by a burst of interceptor rockets. "They've had us on radar all the time," thought Fox leader. Pressing the mike button, he ordered, "Get that one in the trees on the pinnacle, Fox Two!"

"Roger," said Two. "Fox Four! There's one behind you in position to fire!"

"Roger, I'll . . . ."

Four's voice trailed off as he spun into the trees with a smashed rotor assembly.

Fox Five was engaging the intercept that Four should have hit. His sheaf of rockets missed, blossoming into a red fury in the trees behind it. The Aggressor intercept, now aware of his danger, fired and missed Fox Five. Pulling pitch, he darted downslope with Fox Five hot behind, trying to get him in his sights. The intercept,

making a simultaneous full flare and pedal turn, fired a second rocket, catching Five head-on. Five, hit but still flyable, autorotated and crash-landed on the slope.

Meanwhile, the smoke chopper zipped through the trees, laying down a smokescreen to cover Able Flight's withdrawal to an adjacent terrain corridor. As the smoke rose and thickened into a blanket effect, Able leader started sending his flight out behind the curtain to reform in an adjacent corridor.

Covered by the armed choppers of Fox Flight and the smoke screen, Able leader successfully regrouped his flight in the adjacent terrain corridor and continued on to the objective. Easy Flight, formerly rear guard for the airmobile forces, took over Fox Flight's mission of left flank security as well.

Fox Flight routed the remaining Aggressor intercepts and took over the rear guard mission. The remainder of the flight to the objective was uneventful.

Following link-up by 6th Armored Div the 20th Inf Div was placed in Corps reserve. Operation FLIP-FLOP was an undisputable success.

Discussing the operation over a cup of coffee several days later in operations, the flight leaders were quite surprised as General Jumpoff strode unannounced into the operations shack.

"At ease, gentlemen . . . just wanted to stop by on my way to the Corps briefing and compliment you on the fine way you handled the airmobile operation. The use of escort choppers is a matter of unquestionable doctrine now. Our success can be attributed greatly to the excellent job done by Fox Flight in extricating Able Transport Flight from the Aggressor's trap. I'm putting the flight in for a unit commendation.

"I've gone over the after action reports thoroughly, and you may be interested to know that Aggressor was set and ready to destroy our transports with their interceptors. With the superior firepower and maneuverability of the intercepts, the transports would have sustained heavy losses without the escort force.

"I've seen various doctrines, tactics and equipment come and go in my 26 years in service, and I had mental reservations about the armed helicopter concept, but the success of this operation has rid me of all doubts.

"You can be assured Aggressor is revamping his armed helicopter tactics at this moment. We weren't the sitting ducks he expected.

"It was an excellent operation, gentlemen. I want to congratulate you on the fine state of training your units exhibited.

"By the way, I'd like to drop in on your aerial gunnery practice on my return from the Corps briefing. Next trip we don't want to let any of those intercepts get away. I think we need to step up the gunnery practice. Where will Fox Flight be at that time?"

The flight commanders grinned and relaxed as the general left. "That's General Jumpoff for you," commented Fox leader. "Good show, **but** we'll just have to do better next time." They silently hoisted their cups for a last swallow before moving out for training.

Fox Five missed with his rockets . . .

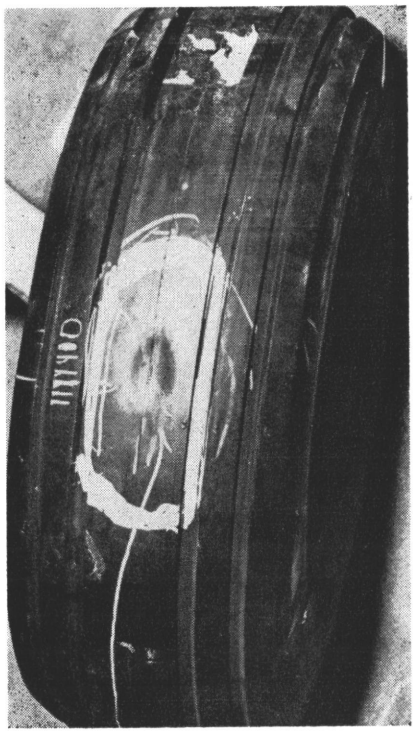
TIRES AND BRAKES

Richard K. Tierney

THE MEN AT the hangar watched the L-23 come in. "Look at that guy hit the brakes," one said. "That means a new set of discs and pucks sure."

"Yea," another answered, "and we're overloaded with work now. Those guys must think all we've got to do is work on brakes and tires. I'll bet it costs the Army plenty just for extra work on brakes and tires alone." He angrily slapped the palm of his hand with a wrench and blamed the heavy workload on "careless aviators."

The irritated mechanic was right. It does cost plenty, in both money and time, for needless repair work on brakes and tires. But the mechanic failed to realize that careless maintenance is just as big a factor as careless flying. For instance, he was working on a brake system that had gone spongy on an L-20. Another mechanic had not properly bled the hydraulic system, and the aircraft had to be grounded after the aviator's preflight.



Inspection is Safety First. This tire arrived from manufacturer with weak spot.

The aviator who had just landed the L-23 also was contributing to the waste of time and money. He had plenty of runway to let his plane run out, but he still jammed on his brakes so he could turn off on the **first** taxiway. That not only wore out the pucks and discs, but also damaged a set of tires. (Good examples of damage caused by excessive braking are shown in the head piece.)

There are many things we can do as aviators and maintenance men to minimize tire and brake failures.

It is highly important to guard against improper inflation, which shortens the life of a tire. Overinflation reduces resistance to bruising and produces excessive wear on the center of the tread. It also strains the tire beads and reduces traction and skid resistance. Underinflation increases deflection and tends to break down the sidewalls.

Proper inflation cannot be determined by just looking at the tire. A gauge must be used to measure pressure and ensure correct inflation. The air pressure should be checked when the tire is at ambient temperature. Hot tires build a slight overpressure, but this is not considered dangerous. The increase in pressure is allowed for in the design of the tire. Bleeding a hot tire to relieve pressure is not recommended.

A certain amount of leakage is common in all tires. However, the tires should not be removed unless the leakage is enough to require frequent reinflation. A new tire tends to expand slightly, giving the impression of leakage. This should be kept in mind when a new tire is inflated and checked later.

Valve caps stop some leakage and keep dirt and grit out of the valve. The cap should be tightened only with the fingers. A tool can damage the valve.

The life of a tire can be extended by rotating them as necessary. Periodic checks should be made to ensure that tires are rotated before they are too badly worn. At least one Army maintenance unit balances aircraft wheels as a safety factor and to ensure longer tire life. (See ARMY AVIATION DIGEST, January 1960, page 15.)

Tire inspectors should look for tread cuts, air blisters, loose or separated tread, wear, bead chafing, and flat spots. The inspection should be made when the tires are cool.

Tires should be replaced under the following conditions: when they will not hold air; when the cord is cut; when the cord is visible on any spot on the tire; and when blisters are detected. Blisters are danger signs that may indicate internal damage.

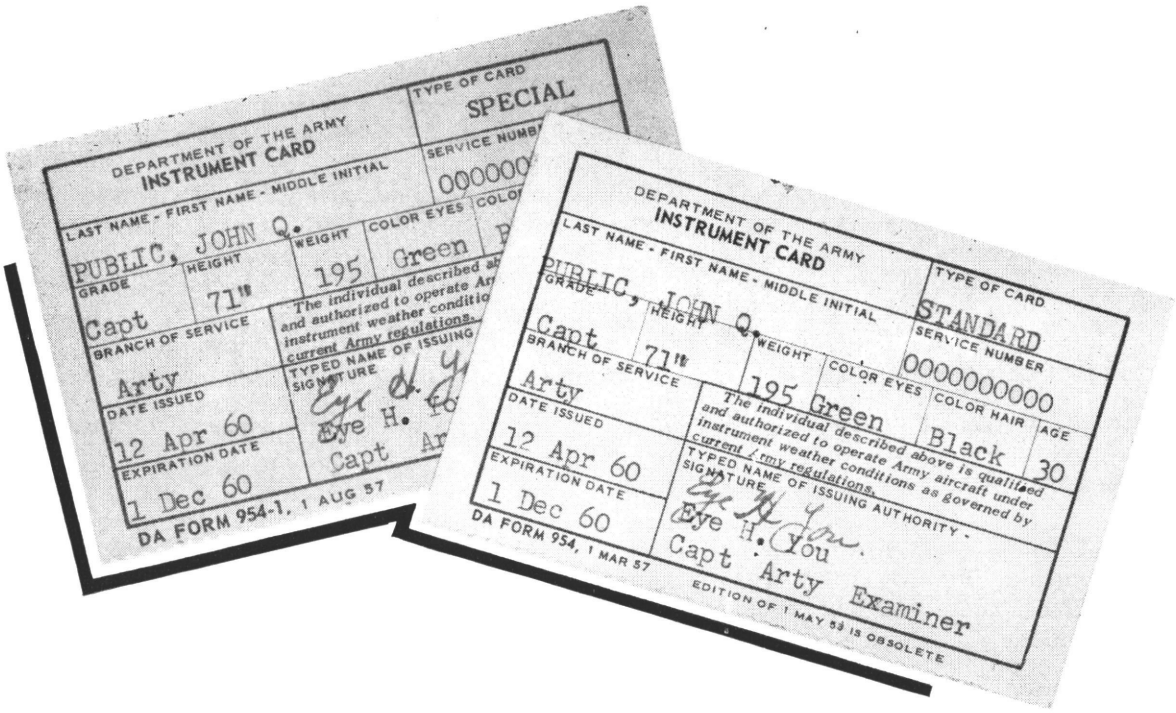
Brakes also present problems. The main concern is the use of brakes instead of the throttle to control taxi speed. Aviators often set their engines at a high rpm and then use the brakes as a primary control. This wears out the discs and pucks. Remember, the throttle comes first in taxi control.

Many times an aviator finds aircraft with weak batteries. That means he must maintain a high rpm on the ground to keep the generator operating the radio. The aviator must taxi as well as communicate with the tower. So, he figures it's best to set the rpm high and use his brakes to control the aircraft. The solution is simply that an aircraft should not be okayed for use if the battery is too weak to operate the radio.

Inspectors should look for incorrect installation and adjustment of brakes, and for bad torque and heat damage to brake and antiskid systems. A major overhaul job or accident could be averted if these conditions are caught in time.

Dragging brakes are a problem in themselves. They tend to overheat and deteriorate the brake systems and tires. The drag also causes a directional control problem.

Brakes and tires are responsible for less than one percent of Army Aviation accidents. But they could become a prime factor as Army Aviation grows and employs heavier and faster aircraft, often on unimproved fields. Let's show a little consideration for brakes and tires. Let's keep them from becoming a major cause of accidents or waste of maintenance time and money.



WHIRLYBIRD GAUGE TICKETS

NOW THAT AR 95-63 (18 February 1960) is effective, what does it mean to you —the rotary wing aviator, the rotary and fixed wing aviator, the rotary wing instrument examiner, the aviation commander? It means that the Army pioneered rotary wing instrument flight at Fort Rucker and now considers all-weather helicopter flying feasible. It does not mean that the flight surgeon has discovered some magic injection which will suddenly qualify you to drive your whirlybird into the nearest cloud. Neither does it mean your helicopter instrument ticket is going to be as easy to pick up as the tab at happy hour.

Proven ability to operate helicopters through instrument conditions is an exciting step forward for Army Aviation. The techniques developed at the Army Aviation School are sound; they will work. Aviators who master these techniques and maintain a high degree of proficiency will fly weather with assured confidence. They will be a credit to Army Aviation. These we don't worry about. We list them on the credit side of the ledger and send our accident investigators on extended leave. But what about the others?

First, there is the newly graduated type. Bright eyed and bushy tailed, he's gung ho to try any kind of new adventure. Vertigo? What's that? The accident recipe for this type is fairly simple: Take one VIP passenger, anxious to get from point A to point B to meet a commercial airline schedule; add one low-time, recently-graduated, eager-to-please aviator; stir in a 400-foot ceiling and 3-mile visibility. As this mixture comes to a boil, drop in lower and lower ceilings, less and less visibility. The final result is a broken Sioux and a very fortunate pilot and passenger. It is doubt-

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This article was prepared by the United States Army Board for Aviation Accident Research.

ful that this particular aviator will attempt a similar flight until he has received helicopter instrument training and qualified for his ticket. This is one way to learn the lesson, but Uncle can't afford enough new helicopters to teach us this way.

Then there are the dual qualified aviators who won their instrument spurs in fixed wing aircraft. Some, not many but some, will attempt to plow their helicopters into the overcast, using fixed wing instrument techniques. These gents are in for a rude awakening.

For instance, there was the acting company commander. An experienced pilot with a current fixed wing instrument card, he felt it imperative to return to his unit because of a pending inspection. Forecast weather was low ceilings, reduced visibility, and rain. He filed his flight plan and took off with a copilot and crew chief aboard. The Shawnee was seen one hour and 20 minutes later flying through misting rain at an altitude of approximately 150 feet. It made a descending 180° turn, passed over a farmer's house at about 50 feet and appeared to be approaching for a landing in an open field. For some unknown reason, the pilot aborted the approach and disappeared rapidly into the clouds. In a very few minutes, the Shawnee came diving out of the clouds and crashed inverted in a swampy area. The pilot was killed; copilot and crew chief suffered severe injuries.

Still another type is the I've-got-to-get-home, the-weather-might-get-better, I-can-set-it-down-anywhere aviator. These cover the full experience range from a few hundred to several thousand hours. There was the Mojave pilot who had completed his mission but decided he must get home. Despite the fact that he had encountered ceilings as low as 500 feet and fog during a portion of the outbound flight, despite a 2-point temperature spread, despite a closed control tower at his home field, he elected to depart at 0333 hours in darkness for the home-bound flight. He almost made it; the aircraft crashed and burned approximately 6 miles from his home field, killing all 5 aboard. Weather at the time of the crash was: ceiling, measured 400 feet, obscured and ragged; visibility, 2 miles. (For more on this accident, see CRASH SENSE, June issue.)

These typical weather accidents are not rehashed to frighten aviators at the thought of helicopter instrument flying. Far from it. They are reviewed here for one purpose only: to prove that no instrument training, a little instrument training, or fixed wing instrument training will not qualify you for flying helicopters in instrument weather. **On the brighter side, there is no report of any accident due to weather involving an instrument qualified helicopter aviator.**

To maintain this record COMMANDERS must designate only the most experienced and capable aviators as helicopter instrument instructors and examiners; ensure that aircraft and facilities are constantly available for training and proficiency flights.

INSTRUMENT INSTRUCTORS AND EXAMINERS must thoroughly indoctrinate and constantly evaluate trainees to instill and maintain a high degree of proficiency in those techniques developed by the Aviation School. Helicopter instrument examiners, in particular, must ask themselves these questions from AR 95-63:

Have I examined the pilot thoroughly?

Am I assured of his instrument proficiency?

Does he have a clear understanding of the rules of instrument flight?

Is his judgment sound enough to be trusted?

Am I sure his technique is adequate?

Is he experienced enough to hold the rating for which he applied?

Would I fly on instruments with him, relying solely upon his ability?

To those aviators who have not been trained for helicopter instrument flying or who, for any of several reasons, are unable to maintain proficiency, may we recommend this—

SPECIAL BLUE INSTRUMENT CARD

Aviator ..... No. .....

This card is for use by those aviators of the higher echelon who, as time goes by, are becoming more and more familiar with the mechanics of paper shuffling and less and less familiar with the mechanics of flying . . . .

1. Hold card up to sky
2. Look thru holes
3. If color of sky matches color of card, FILE FLIGHT PLAN

Date ..... Issued by .....

from the Falcon's Nest

Current items of interest from the U. S. Army Aviation School

DEPT OF MAINT

All basic mechanics attending the Airplane Maintenance Course (Entry) will get instruction on the gas-turbine engine. The addition of this course is significant of the complete reorganization and streamlining within the department.

Until now, instruction on the gas-turbine engine has been given to only those mechanics attending the Advanced Maintenance Course on the HU-1 (Iroquois).

The basic turbine course will be taught by the Primary Maintenance Division. It will consist of conference type instruction on the gas-turbine theory, construction, operation and nomenclature. The present course will use the T-53 engine as the training vehicle. As the turbine engine becomes more widely used, the course will be expanded to cover other turbines, such as the T-58. This expansion will also include practical work and troubleshooting on turbine engine test cells and/or turbine simulators.

DEPT OF P&NRI

AVAILABILITY OF USAAVNS INSTRUCTIONAL MATERIAL—Aviation School Master Lesson Plans are available on a gratuitous basis to both active and reserve aviation organizations. Each of these publications covers a block of resident instruction, and includes a lesson outline, full content manuscript, student handouts, and a photographic reproduction of each training aid used in the class. A listing of this material is contained in the USAAVNS Catalog of Instructional Material, which is supplemented by monthly changes on new and revised items printed recently.

NEW TECHNICAL MANUAL—Initial distribution has been made of TM 1-235, "Float, Ski, and Tandem Landing Gear Operations," dated February 1960. This manual provides basic guidance to units and aviators and is easy to read and carry.

NEW FIELD MANUAL—FM 1-(), "Army Aviation Organizational Aircraft Maintenance and Supply," has been submitted to USCONARC for approval and printing. It should be available by the end of the year. Watch for it.

REVISION TO COMMON SUBCOURSE 42, AIR NAVIGATION — Army Aviation common subcourses are prepared by the Army Aviation School but printed and administered by the Artillery and Missile School at Fort Sill, Okla. Subcourse 42 has been revised in toto. The revision should be printed and ready for extension course use within two or three months.

DEPT OF ADV F/W

In the past, aviation unit commanders in the field have been left in a quandary after examining a newly assigned aviator's "759" and discovering that he has 50 to 60 hours in the Beaver and is still not "checked out."

In the future things will be different. Starting with Class 60-1, students successfully completing the instrument phase of instruction in the Officers Fixed Wing Aviator Course will be checked out in the Beaver before leaving the Aviation School.

DEPT OF TACTICS

The Department of Tactics is currently preparing the instructional material on the tactical subjects included in the Program of Instruction for the (Caribou) AC-1 STOL Transition Course. These subjects cover organization and employment of an AC-1 company, aerial delivery of personnel to include parachuting, use of pathfinders, use of QM support

units in air movement of supplies, the AC-1 as an air ambulance, air movement planning, and loading and lashing loads on the AC-1. The scope of instruction is arranged to give the transitioning aviator the know-how to perform the many missions that will be required of the pilots assigned to an AC-1 company.

The Research and Projects Branch is currently working on these projects.

1. Vehicular loading plans for all TOE equipment for all Army Aviation units. 2nd Division Aviation Company at Fort Benning is assisting in this project.

2. An 18-hour POI covering tactical training for Caribou crews. This POI will cover loading, lashing, and duties of personnel.

3. The entire ASOC 60-3 Class participated in LOGEX 60, including numerous permanently assigned USAAVNS personnel.

Revisions to Technical Manuals: Minor errors have been found in TM 1-215, "Attitude Instrument Flying," TM 1-225, "Navigation for Army Aviation," and TM 1-300, "Meteorology for Army Aviation." Changes to these publications have been submitted to USCONARC for approval and printing.

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Dr. W. W. Prophet
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The Office, Chief Research and Development, the Office, Deputy Chief of Staff Operations, and the U. S. Army Aviation School are supporting Task INTACT, a primary flight training research project that will be conducted by the U. S. Army Aviation Human Research Unit.

The purpose of Task INTACT is to compare the effectiveness of integrated instrument/contact flight training with current training in the Army Aviation Primary Fixed Wing Flight Training Program. Integrated training differs from current training in two principal respects: (1) basic attitude instrument instruction begins on the first day of primary training; (2) instrument and contact cues are systematically related to one another.

Under current training procedure the student first learns to fly with visual reference to the ground and horizon (contact), and then learns to fly by sole reference to cockpit cues (instruments). As a consequence, the student pilot tends to view these as two distinct types of flying. However, if we examine the flying techniques of the **experienced** instrument pilot, we find that typically, whether flying instruments or contact, he utilizes all available attitude cues. In other words, he has "integrated" his contact and instrument flight techniques into a single technique. The integrated instrument/contact flight training concept seeks to teach this "single technique" to the student pilot rather than waiting for him to develop it on his own, if at all.

The teaching concept to be tested under Task INTACT is based upon research conducted by the University of Illinois and the University of West Virginia, and upon studies conducted by the Boeing School of Aeronautics, the U. S. Army Aviation School, and the U. S. Air Force.

In 1934-35 the Boeing School taught 16 students to fly by instruments before receiving **any** contact instruction. The manager of the school reported: "We are so completely sold that we believe all students taking our Airline Pilot Course (250 hours) should begin their flight instruction with instruments under the hood."

In 1953, two psychologists at the University of Illinois studied transfer of training from contact flying to instrument flying and from instrument flying to contact flying. In essence, transfer studies seek to determine whether prior learning facilitates or hinders subsequent learning. They estimated that there was a negative (hindering) 22 percent transfer from prior contact to subsequent instrument training and a positive (facilitating) 47 percent transfer from instrument to contact training.

These studies led to the first investigation of integrating contact and instrument training at the University of

Illinois in 1955. The aviation psychologists were concerned with a large number of fatal accidents which occurred when private pilots encountered unforecast weather. They conducted an experiment designed to train private pilots to make 180° turns on instruments within the standard training time, approximately 40 hours. In 1957 the University of West Virginia conducted a similar study with 10 students and obtained similar results.

In August 1956 the U. S. Army Aviation School conducted a limited study to determine the feasibility of the integrated concept for training Army Aviators.

It was determined that the integrated concept was feasible but that it should be subjected to a larger scale investigation before being implemented.

In December 1956 the USAF trained part of two primary classes at Graham Air Force Base, utilizing the integrated concept in tandem aircraft, T-34s and T-28s.

INTACT concepts will be taught at Fort Rucker by IPs of the primary training contractor, Hawthorne School of Aeronautics. The study will be directed by members of the U. S. Army Aviation Human Research Unit. INTACT will utilize students in two primary classes, Class 61-6, who begin training in January 1961, and Class 61-10, who finish primary training in September 1961.

The effectiveness of integrated and nonintegrated training methods will be compared in Cessna 180 aircraft being leased for the study. This aircraft will be utilized because of its side-by-side seating configuration and general similarity to the L-19. Review of prior research on integrated training and the forecast of the configuration for future Army aircraft have suggested the desirability of testing the integrated concept in a side - by - side aircraft.

In each of the two primary classes concerned, 18 students will receive integrated training in the Cessna 180, and 18 will receive present non - integrated training in the Cessna 180. The remainder of each class will receive present training in the L-19.

The progress and proficiency of these student groups will be continually checked by special objective daily grade forms and by special objective check flight forms developed by USAAVNHRU. These primary records and the records of the students in later training will be analyzed to compare the effectiveness of the different types of training.

If INTACT results measure up to the expectations of those who are supporting the project, it could cause great changes in traditional Army primary training procedures.

AO-1 Mohawk Makes First Trip To Rucker

"The Mohawk is a great aircraft. It was designed to improve and expand our surveillance means and I am confident that it will perform its mission with distinction. We look forward to the addition of this responsive airplane within our inventory." — Maj Gen Ernest F. Easterbrook, USA

According to Col Jack L. Marinelli, President of the United States Army Aviation Board, the Mohawk was brought here for orientation of Board and United States Army Aviation School personnel in preparation for the pilot training program to be held at Grumman Aircraft Corp. later this year. After pilot training, service tests of the Mohawk will be conducted by the Aviation Board at Fort Rucker.

THE HELICOPTER VERSUS LAND MINES

CWO-2 B. J. Vanderkolk, TC

THE VERY NATURE of a land mine, whether of the antitank or antipersonnel type, makes it one of the most feared and effective defensive weapons. It presents a problem of both tactical and psychological nature to the advancing commander and his troops. Many times a successful advance has been halted by an unprotected known minefield or even a suspected one, the delay giving the enemy valuable time to reinforce or regroup.

The fear of the unknown and unseen has since the beginning of mankind been a frailty of human nature. Perhaps one of the most demoralizing weapons of modern warfare is the hidden land mine. No foot soldier or tank commander can advance over newly taken terrain without the apprehension of possible minefields or road mines. In World War II Germany alone used over one billion land mines, inflicting innumerable casualties upon allied personnel.

Many countermeasures have been employed against land mines, such as aerial strafing, mortar and artillery fire, and driven livestock. The most practical method was developed by the allies as they advanced through France and Germany. A most difficult and dangerous method, it called for the troops to line up and creep across fields on hands and knees, probing for mines with bayonets. This is an extremely hazardous and slow method, to say the least.

A faster, safer method of mine detection and demolition is not only desired but an absolute necessity. These questions now arise: **how?** and **what with?** Undoubtedly an electronic device can be developed which will not only detect but also detonate the land mine. What more suitable method could be used to expeditiously and safely transport such a detector than the helicopter?

The flight characteristics of the helicopter, especially its ability to hover, would make it an ideal carrier for present electronic detection equipment. With very little modification, and then only to provide proper mounting for the detector gear, either of the light helicopters currently in use by the Army would be suitable for the operation. The detector device could be mounted on or suspended from a rigging similar to that used by commercial operators for chemical spraying. Such a rigging would provide a sweep approximately 20 feet wide, which would be sufficient for road clearing operations.

The second phase of the operation would begin after the discovered mines were properly marked by the sweeper helicopter. Using conventional methods of disposition, trained demolition teams would disarm the mines—or they could be disposed of by countermining.

Because future mine construction and design might not be detectable by present means, a radical new approach to the problem must be contemplated. Here again the helicopter would play a major role.

The old axiom of "getting there firstest with the mostest" is probably more important in modern warfare than it was in the past. The smaller combat teams must be highly mobile to remain effective. Mined roads or approaches to an objective would greatly deter the success of these ground forces. How could the helicopter safely and expeditiously clear unprotected minefields, or at least safe routes through them?

The solution to this problem, as the writer sees it, is relatively simple, safe, and expedi-

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Mr. Vanderkolk is assigned to the Department of Rotary Wing Training. He has approximately 3,600 flying hours.

tious. By using a dragline attached to one of our larger cargo type helicopters, a heavy sweep or boom could be towed along roads or through minefields with comparative ease. The sweep itself could be jerry-built of railroad iron, etc., at least 10 feet in width and of sufficient weight to discharge the mine. The tow cable would probably have to be about 100 yards in length to minimize the possibility of damage to the helicopter from mine blast. The cable would be attached to the sweep with a quick release device, controllable from the tow aircraft. Tests under field conditions would determine the design of the sweep, but it would have to be flexible to fit the contour of the terrain.

By using this towed sweep method to detonate mines, many miles of roads and approaches which heretofore posed a serious problem for the field commander, could be cleared in a matter of minutes.

Since the advent of helicopter use by the Armed Forces in Korea, this versatile aircraft has radically changed the concept of modern warfare. If this proposed method of mine sweeping proved successful, it could very well make the nemesis of the infantryman, the land mine, less effective.

Studies are being conducted by the U. S. Army Engineer School on installing and detecting minefields with rotary wing aircraft. The following information was taken from "Report of Utilization of Army Rotary Wing Aircraft in Support of Engineer Activities." At the present time no definite conclusions have been reached.

DEMOLITION SNAKES

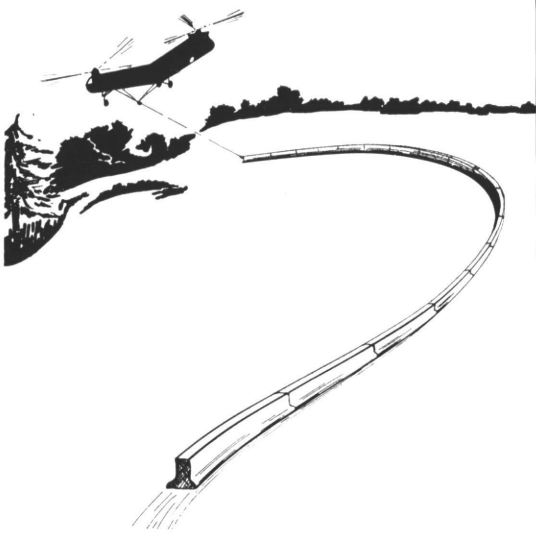
The helicopter was used to tow the "Diamond Lil" and "Mountain Lion" into an anti-tank minefield across a clearing a distance of 400 yards. When the demolition snakes were in position the pilot released the tow hook and flew out of the area. The test site was a clearing completely surrounded by trees with dry gravelly-clay soil devoid of vegetation. The helicopter, when flying close to the ground, created a very heavy dust cloud which on several occasions obscured the ground from the pilot's view. The possibility of dust cloud in an area should be taken into consideration, both from the flying hazard and the tactical aspect, before using the helicopter to tow a demolition snake into a minefield.

DIAMOND LIL

A metal, sectional, demolition snake, 400 feet long, weighing 7,800 lbs, was towed three times in straight and circular paths. The average cable tension for the three trials was 6,000 lbs. On each trial it was towed into a minefield area without difficulty. The pilot was able to release the tow and fly out of the area each time without difficulty.

MOUNTAIN LION

Three demolition line charges contained in a skid-mounted metal box; the complete assembly weighs 14,000 pounds. Each line charge made of manila rope with demolition blocks attached is 375 ft long and weighs 7 lbs per foot (total for three line charges 7,875 lbs). The helicopter was able to tow, with extreme difficulty, the complete "Mountain Lion" assembly a distance of 200 feet. (Cable tension of 8,800 lbs was recorded.) After the completed assembly had been moved into position in front of the minefield the helicopter was able to tow the line charges into the minefield without any difficulty. Maximum cable tension 2,750 lbs was recorded.

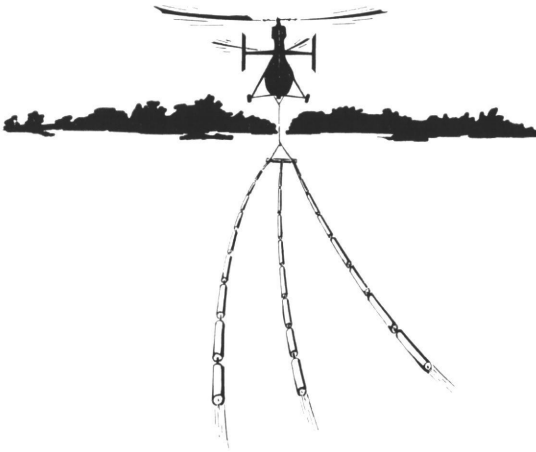


"Diamond Lil"

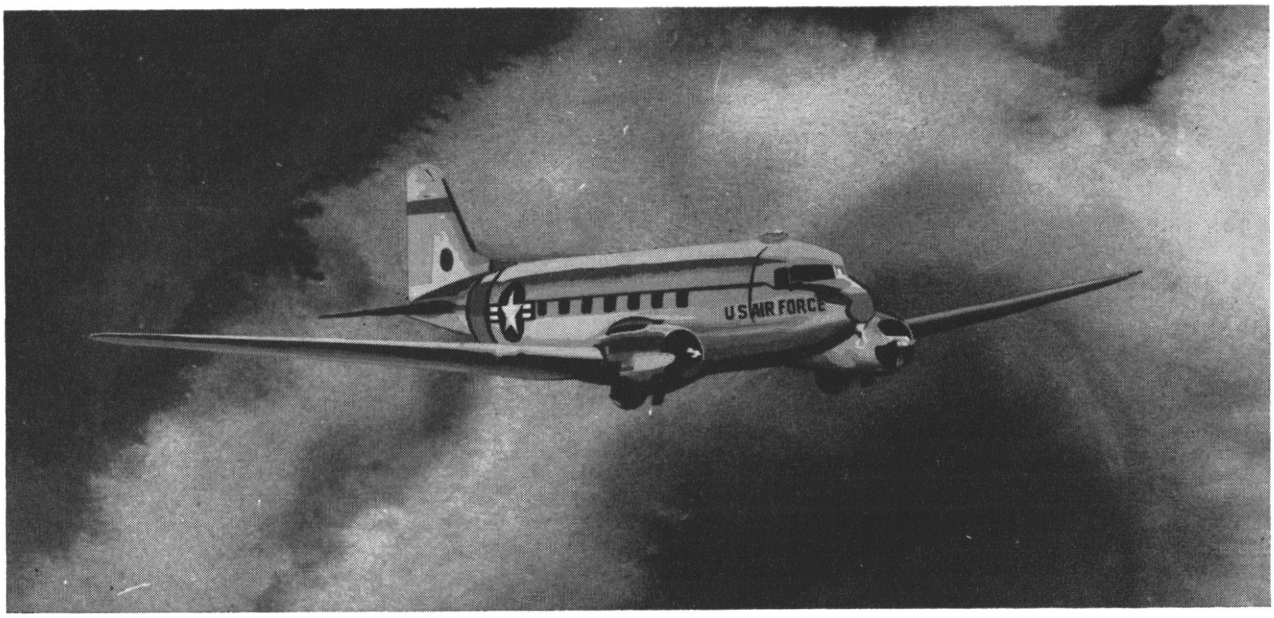
TOWING EXPEDIENT DRAG IN AP MINEFIELD

An expedient roller was fabricated using four 55-gallon drums connected with chains. This roller was towed three times through the minefield and made ineffective about 60% of the mines in its path. The chain connection between the drums allowed a great deal of lateral and vertical movement of the drums which caused the roller to miss several mines in the path. This type roller with more rigid connecting links appears to have good prospects as an AP minefield breaching device. Other possible expedients not tested were the sheeps foot rollers and disc type harrows.

"Mountain Lion"



WEATHER



IS MY BUSINESS

Major Jack A. Bell, USAF

FAILURE TO take advantage of standard weather services available to all pilots could turn a routine trip into a bad dream.

This had been one of those days when everything seemed to pile up. The summer months were upon us—and this meant thunderstorm activity in many areas of ZI. We had been receiving and disseminating severe weather advisories throughout the day. The heavy workload during my shift left me dog-tired when finally relieved from duty. Before going home I decided to stop a moment in the pilot's lounge for a Coke. A few minutes relaxation would ease the tension built up by the hectic day. I settled down in a comfortable chair. . . .

The time was just after lunch. I asked the copilot if he was ready to go, and we walked out of operations to the waiting C-47.

There were 26 passengers on the manifest, the copilot, navigator, crew chief and myself; 30 in all, with baggage and a full load of fuel for a flight from Maxwell, AFB, Ala. to Brooks, AFB, Texas.

The crew chief told me everything was fine as we made a walk-around inspection. It was. The preflight completed, I signaled for the passengers to load. As they came out, the copilot and I boarded the aircraft.

When the last passenger boarded and the passenger briefing had been completed, we fired up, made our cockpit check, and taxied out to the active. Runup was normal. We copied our clearance: "Climb on course to 6,000, cruise at 6,000 feet."

Takeoff was normal, and shortly after takeoff we entered the clouds. We reached cruise altitude in time and settled down to a routine IFR flight. Stratus clouds gave us smooth flying. The passengers looked contented.

I completed my paperwork and sipped coffee. Our checkpoints came up right on the button. We were over New Orleans range at ETA and continued outbound on the west leg. New Orleans radio acknowledged our position report

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Major Bell is Commander, Detachment 9, 16th Weather Squadron at Cairns AAF. He is single and multiengine F/W qualified, and has logged approximately 4,000 flight hours.

and said they had a message from Military Flight Service. I told them to go ahead.

"Military Flight Service reports severe thunderstorm activity between New Orleans and the San Antonio area. They advise you to land at New Orleans. What are your intentions?"

Back at Maxwell we had been briefed that scattered thunderstorms would build up along the route, but chose to go anyway. Now we had to make another decision.

Before I could decide on a course of action, it suddenly became very dark. I immediately turned on the Fasten Seat Belts sign. It was lucky I did because we were then entering either towering cumulus or cumulonimbus activity. Requesting a clearance for return and letdown, I started a procedure turn, heading back to New Orleans.

Before the turn was completed, we ran into severe turbulence. The old gooney bird was bouncing around like a frisky colt, difficult to control and getting worse by the second. The New Orleans Center cleared us to 3,000 feet inbound. I started descending immediately and went bumping and bouncing down toward the lower level, hoping to get out of the clouds. As we reached 3,500 feet, a severe updraft tossed us back to 5,000. I knew then we were in a thunderstorm. Buffeting was so severe that I was afraid of structural damage to the aircraft.

Again I attempted to descend to 3,000 feet. Nose down, we were tossed back to 5,000 with the rate of climb needle quivering on the peg. The C-47 was uncontrollable at times. I asked the crew chief to reassure the passengers, but it was impossible to do more than yell a few words to them. I needed reassurance myself when I heard a commercial airliner in the vicinity report that hail had knocked out his windshield. I kept hoping we wouldn't run into the hail. I had a feeling that the dependable old gooney bird just wouldn't take much more. From the tense look on my copilot's face, I knew he had the same misgiving.

We tried to descend and again the C-47 was tossed back by the mighty, invisible hand of weather. Advising New Orleans Radio of our difficulty, we were given clearance to enter a holding pattern and continue attempts to descend. We began a pattern, still trying to descend, with all the instruments fluctuating wildly. We broke out of the clouds just long enough to sight a clear area to the northeast. Breathing a sigh of relief, I turned the C-47 in that direction and in a short time was clear of the clouds. I made a letdown to 1,500 and cancelled IFR. Bases of the clouds were about 2,000 feet. The C-47 continued to bounce around like a cork on rough water.

I turned toward the airport and asked for landing instructions.

"There's a thunderstorm directly over the field," the tower answered. "Winds are gusting to 100 mph." The tower also informed me that alternate landing fields were available in the immediate area but none of these had control facilities available.

The copilot and I decided our best course was to try to get through to Keesler AFB, Miss. However, VFR appeared impossible in that direction so I tried to get an IFR clearance.

Radio chatter was almost continuous. There was considerable static. I was unable to re-establish radio contact to get another clearance.

Our only out was to attempt to maintain VFR. A line of storms appeared to be along the entire coast and spreading seaward. In attempting to remain VFR we were being forced farther and farther out over the gulf. We had no survival equipment and this posed another problem.

We cut in at 90° to the line of the storms and descended to 500 feet. We bumped along at this butterfly-producing altitude until we sighted Gulfport, then proceeded along the coastline toward Keesler.

All during this time, we kept trying to establish radio contact. Our first contact was with an aircraft just landing at Keesler. He answered our call and said, "If you're coming here, you'd better hurry!"

We couldn't hurry any faster, but it was comforting to get through to somebody. We landed in heavy rain showers. Those 26 passengers were radiantly happy to get their feet on solid ground again, a feeling shared by their flight crew.

The jangling telephone abruptly ended the nightmarish flight. I was in a cold sweat, even though I had gotten back on the ground. This dream pointed out even more vividly to me that it is possible for a pilot to blunder into a thunderstorm by failure to adhere to proper weather procedures and flight planning. I reaffirmed a resolution to check and double check all weather advisories, radar reports, and pirep's before taking off during critical summer months.

Now fully awake I answered the phone, "Major Bell, Sir. Yes, this is the Air Force weather officer. . . .

BEAVERS AND BUMPS

What are your chances of survival in a Beaver when encountering severe turbulence? Is there a safety factor?

Captain Alvin L. Brooks, Arty

EVERY DAY some 44,000 thunderstorms spatter their violent contents over the world's surface. At least 1,800 of these churn the earth's atmosphere every hour, discharging 100 flashes of lightning each minute. This lightning alone represents a continuous transfer of energy equaling 268,000,000 horsepower.

A thunderstorm is composed of several cells that vary in diameter from 1 to 5 miles, depending upon the stage of development. The life cycle runs between 1 and 2 hours. As old cells die, new ones build up. A full grown cell has been measured as high as 67,000 feet, making it impossible for present-day Army aircraft to fly over the top. These cells are impossible to see and avoid when imbedded in other clouds.

A thunderstorm can never be regarded lightly and should be a major consideration in flight planning. Flights under instrument conditions should **never** be made along routes where thunderstorm activity is forecast or has been reported unless radar advisory service is available for circumnavigation purposes, or the existing and forecast cloud conditions are such that thunderstorms can be circumnavigated under visual flight conditions. This precaution **should** keep you out of thunderstorms. Unfortunately, due to rapidly changing weather conditions and errors in forecasting, you may still inadvertently tangle with one.

Hazards of flight associated with a thunderstorm are turbulence, lightning, hail, and icing. Hail and ice are dangerous properties of a thunderstorm. Either one is capable of taking a Beaver out of the hands of the pilot and putting it in the hands of God. Unfortunately, the Beaver has no defense against these elements. So if they are encountered, all that can be done is maintain control as long as possible and if it is lost, bail out and start praying to the new pilot.

Lightning will have an effect of varying degrees on your radio. Again we have no defense against this danger. The only thing we can do to combat this element is to turn up all the lights inside the aircraft to avoid the blinding effects of its flashes.

Turbulence is generally regarded as an extremely dangerous hazard because of its effect on the aircraft and the pilot.

(NOTE: The main purpose of this article is to point out the effects of turbulence on a Beaver and how to keep these effects within safety limits. This discussion is pointed mostly to thunderstorms but the technique applies to turbulence under both VFR and IFR conditions.)

Turbulence can best be dis-

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cussed by breaking it down into two components: drafts and gusts. Drafts are the huge columns of rapidly rising or descending air which comprise an integral part of the thunderstorm's structure. Draft velocities up to 100 fps may be encountered, resulting in altitude changes from a loss of 2,000 feet to a gain of 6,000 feet. Draft velocities exceed by a wide margin those of gusts, but since the time interval required to reach the maximum is much greater with the drafts, the acceleration force is far less. Consequently, drafts are not as severe as gusts.

Although the effects of drafts are quite spectacular from a pilot's viewpoint, they are not important with regard to stress loads imposed upon the aircraft as long as the pilot does not attempt to maintain a constant altitude. Attempting to maintain altitude could be the pilot's first step to serious trouble. It could lead to fighting the aircraft, resulting in a dangerous increase in stress loads.

When an aircraft goes abruptly from calm air to a vertical current, the condition is a sharp edge gust. The sharp gust, with its steep gradient, delivers that solid jolt so familiar to anyone who has flown in rough air. Because of their steep gradient, these gusts are capable of imposing great stresses upon aircraft. This stress increases with the velocity of the gust and the speed of the airplane. When encountering a sharp edge gust, aircraft control is normally no serious problem as far as attitude is concerned, but a rapid change of altitude can result.

Other gusts of **no less importance** will have to be considered. They can be best described as whirling masses of air, varying in size from only a few inches to several hundred feet in diameter and moving in either a horizontal or vertical plane. The characteristic response of an airplane intercepting a series of these gusts is a series of sharp accelerations or "bumps." These accelerations may be accompanied by pitch, yaw, or roll movement. They may even cause the aircraft to stall.

The disturbed angular motions of an airplane in turbulent air, even with fixed stability and proper piloting technique, are dependent not only upon the maximum intensity of a single gust, but also upon the sequence, spacing and intensity of all gusts encountered. During an experiment, a pilot flew into a thunderstorm and experienced a gust sequence imposing acceleration on the airplane measured in g's of +1.49, —1.16, +1.99 and —1.45.

The sequence lasted 5 seconds and corresponded to effective gust velocities of +35, —24, +43, and —29 fps respectively. The pilot later said, "The jolt was so severe that I thought I had collided with another plane. I was unable to keep my hands on the controls, they banged around so much." It is believed that the element of surprise and the sequence of four large, alternately positive and negative, gusts were the main factors contributing to the temporary loss of control of the airplane.

The areas of heaviest turbulence are found in the area containing the highest water concentration within the thunderstorm. Of course, the pilot of a Beaver without radar has no way of determining this except that those areas may appear darker. In flights below the cloud base, the heaviest turbulence will be found where the darkest rain columns are seen. Extreme conditions of turbulence may not always be encountered when flying through thunderstorms; nevertheless, at some time and place within the storm, conditions may be severe. Hence, the practical approach is to prepare for the worst.

During a test consisting of 1,600 thunderstorm penetrations, the most severe recorded sharp edge gust measured 43 fps. (This was encountered at 15,000 feet and is accurate to within a plus or minus 4 fps.) What is the average aviator's probability of encountering a 43 fps gust? Based on the above tests, the National Advisory Committee of Aeronautics estimates that a 43 fps gust might be experienced once in every 1,000 traverses, 40 fps gusts once in 500 to 700, 35 fps once in 125 to 300, 30 fps once in 35 to 100.

Breaking it down still further, to exceed the highest recorded gust, 43 fps, it would probably take some ten million flight miles. Assuming a cruising speed of 125 mph, the limit could be reached, on the average, once in every 80,000 hours of flight.

Now that we have determined that you may inadvertently tangle with a thunderstorm at one time or another, and that thunderstorms can toss you around quite a bit, let's take a look at the Beaver and see what we can do to increase our chances of getting through without losing our wings.

The **design** cruising speed of the Beaver is 120 knots. The manufacturer tells us that the normal operating limit should not exceed design cruising

speed. The range between normal operating speed and the never exceed speed (red-line, 173 knots) is to provide for inadvertent speed increases. Even though the Army's recommended power settings do not give us an airspeed of 120 knots, the aircraft is designed and stressed for this speed.

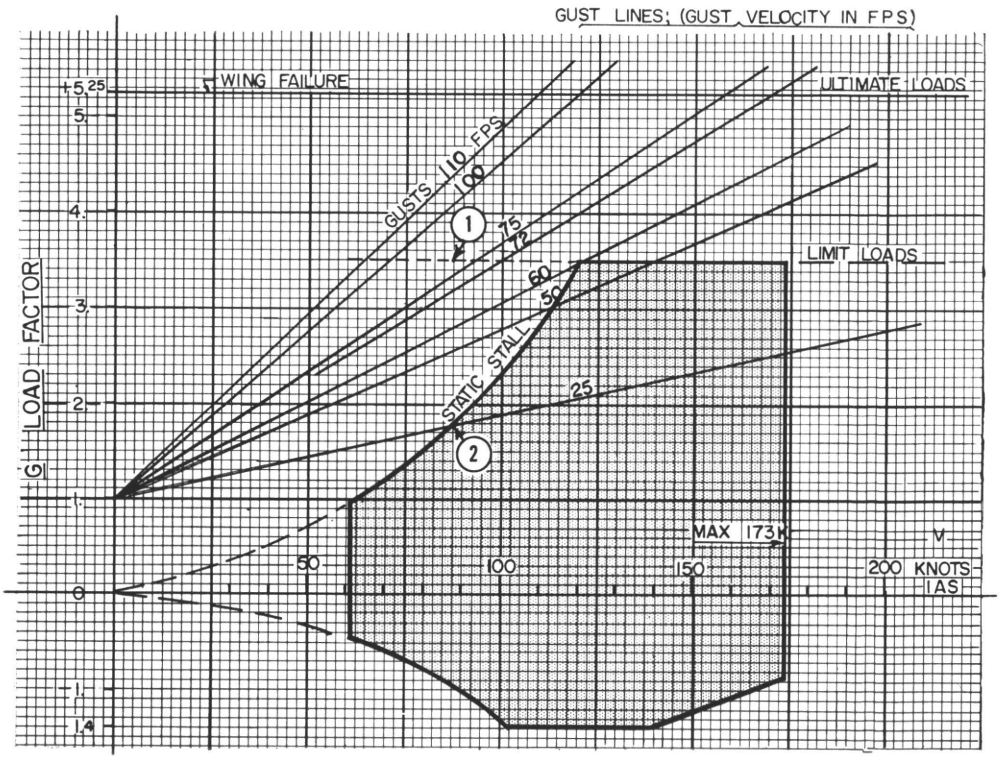
The manufacturer further tells us that the Beaver is stressed for 3.5 g load at 5,100 pounds gross, plus a safety factor which increases this to 5.25 g before the ultimate load is reached and wing failure results. It is important to note that this safety factor required by FAA Regulations, is only good for a one-time shot. If a **new** Beaver is exposed to a 5.25 g load, no structural damage will result. But the second time it is exposed to a force in excess of 3.5 g, no matter if it is 2 minutes or 2 years later, wing failure will probably occur. This means that after we exceed the 3.5 g load limit **once,** the safety factor is no longer reliable. Note that this applies to a **new** Beaver. As the aircraft is used for a time and subjected to varying degrees of stress, it's metallic structural supports are weakened and the safety factor becomes smaller. Therefore, we will use the 3.5 g factor when considering load limits.

Structural failure is not the only hazard connected with gusts. A gust can also cause an aircraft to stall. Airspeed is of prime importance in considering these hazards. The higher the airspeed, the more stress is put on the aircraft; the lower the airspeed, the more vulnerable you are to a stall. The maximum speed is the design cruising speed of 120 knots; the minimum is the stalling speed of approximately 62 knots. The most desirable or safest airspeed will lie between these two figures—but where?

Let's consider the stall speed first. In referring to the Vn diagram, we see that a gust of 25 fps will stall an aircraft indicating 88 knots, a gust of 50 fps produces a stall at 113 knots, and a gust of 60 fps causes a stall at 120 knots. We know that the possibility of encountering gusts in excess of 43 fps is very remote, so our best speed for avoiding a stall lies between 88 and 113 knots.

Keeping this in mind, let's again refer to our Vn diagram and consider the effect of gusts on the structure of the aircraft. Gusts below 50 fps will not damage the aircraft if the airspeed is below 140 knots; gusts

L-20-Vn diagram based on gross weight of 5,100 Lbs.



To determine effects of various gust velocities at different indicated airspeeds, move vertically along the indicated airspeed line to the point where it intersects the gust line of interest. If this intersection falls below the 3.5 g line, the aircraft is within structural load limits. The area between the 3.5 and 5.25 g load represents the safety factor. Points on or above the 5.25 g line represent ultimate loads that will result in wing failure.

If the intersection falls in the area to the left of the static stall line, that gust airspeed combination will result in a stall. The area within the heptagon is safe from both stall and structural failure.

of 60 fps will cause the wing to fail at 120 knots. Design cruising speed being 120 knots, this now becomes the top end of our bracket. We know now that at 120 knots we are safe in gusts below 60 fps, both from the stall and wing failure viewpoint. At the other end of our bracket we see that 88 knots is safe in gusts below 80 fps, as far as structural failure is concerned (see 1 on diagram) but at this airspeed gusts of 25 fps will stall us out (see 2 on diagram). We have to raise the airspeed from 88 knots so we can encounter gusts in excess of 25 fps without stalling. We have to lower the airspeed from 120 knots so we can encounter gusts in excess of 60 fps without suffering wing damage. The average is 104 knots, which would produce a stall in gusts of approximately 43 fps and wing failure at approximately 69 fps.

This gives us a good margin of safety, but it is more important to prevent structural failure than it is to prevent a stall. So, let's give ourselves a little more of a safety factor on that side of the bracket. We will select an airspeed of 100 knots, which will increase our structural failure factor to gusts of 72 fps and reduce our stall factor to gusts of 38 fps. (NOTE: All gusts and g forces mentioned are positive. Negative forces have been considered but not included, due to the fact that maximum negative gusts are not as strong as positive gusts. All aforementioned facts should fall in a safe zone in regard to negative forces.)

It is possible to fly through severe turbulence with no damage to the aircraft or pilot. I use the word **possible** because we have only determined that the Beaver is stressed to take almost any turbulence you might expect to encounter. We have not yet considered that the pilot is a significant factor in severe turbulence as to the total loads on the airplane. In continuous rough air the amplification of load due to control movement can be appreciable and might mean the difference between getting through or falling out of control.

What technique can we use to overcome the possibility of inducing structural failure ourselves?

Attitude flying with as little elevator control action as possible is of prime importance. This will keep you from setting up a pitch oscillation which could ultimately lead to excessive control movement and possible structural failure. Take corrective action only after major or dangerous displacements of the aircraft appear to be taking place. Use the attitude indicator to keep the wings level and your nose in a level flight condition. Banking the aircraft will result in heavier loads being placed on the aircraft. Disregard altitude and maintain heading only to the extent that you will be flying a reasonably straight course to get out of the area as soon as possible. Don't rely excessively on airspeed indications; they will fluctuate and give inaccurate readings. If you have your power set properly and maintain a level attitude, your airspeed will take care of itself.

Another primary factor which has led to structural failure is loss of control resulting from a stall, followed by a high speed recovery. This danger can be minimized by merely holding the attitude, leaving the power alone and letting the aircraft fly out of the stall on its own.

Rely on your gyro instruments! During 1,600 thunderstorm penetrations not one flight gyro failure was reported. Your barometric instruments give false readings due to rapid changes of pressure and cannot be considered too reliable.

When flying in an area where there is the possibility of hitting a thunderstorm or severe turbulence, prepare yourself and your aircraft ahead of time. Fly as though you knew you were going to hit a thunderbumper in the next two seconds; and if you do it won't come as a surprise. The danger of being unprepared is that you accidentally fly into one and everything happens at once.

To prepare for a possible penetration, turn all cockpit lights full bright, check instruments, pitot and carburetor heat, mixture, safety belts and loose objects in the cabin. If you are at an altitude over 6,000 feet above the ground, request a lower one to put you in the area of minimum turbulence. (This applies to thunderstorm technique only as it has been determined that the area between 4,000 and 6,000 feet above the ground offers the smoothest ride. Usually under VFR conditions a higher altitude is smoother.) Set up your power to give an indicated airspeed of 100 knots. Reset your gyros and you're ready to go.

On entry, don't panic; keep your nose on the horizon, wings level and power constant. When you come out the other side give a sigh of relief; then pick up your DD Form 781-2 and write "aircraft subjected to severe turbulence." Let the next guy to fly the aircraft know that you have already used up his one-time safety factor.

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ACCIDENT RESEARCH

TWX exce

H-19C LOST ROTOR RPM during takeoff from soft mud. Main rotor blades struck tree. Incident damage to main rotor blades. No injuries.

L-20 DRIFTED OFF RUNWAY. Left landing gear struck runway light during simulated instrument takeoff. Incident damage. No injuries.

H-34 LOST ROTOR RPM during attempted sling load mission and settled on jeep. Fuselage bottom ripped and buckled. No injuries.

U-1A BALLOONED and stalled during attempted full flap landing in gusty wind. Left wing dropped and scraped runway for 80 feet. Aileron, flap, aileron hinge and wingtip damaged.

H-13G SETTLED IN RIVER due to power loss after takeoff. Main rotor blades destroyed; aircraft submerged in water. No injuries. Cause of power loss undetermined pending investigation.

U-1A NOSED OVER to near vertical position and fell back following brake application for short field roll out. Fuselage buckled; engine cowl air scoop crushed; propeller damaged; sudden stoppage to engine. No injuries.

L-19E WHEEL ASSEMBLY CRACKED and tire was punctured by jagged edge, causing aircraft to nose over and come to rest inverted. Major damage to wings, vertical stabilizer, engine cowling and propeller. No injuries.

H-23B MAIN ROTOR BLADES FLEXED into tail boom during practice touchdown autorotation. Major damage to main rotor blades, tail boom assembly and tail rotor assembly. No injuries.

H-13H ROTOR WASH pulled oil drip pan into main rotor blades, causing dents and nicks in one main rotor blade.

H-21 ROCKED OVER and slid sideways during slope landing. Aircraft rolled on right side. Copilot suffered lacerations and contusions. All rotor blades destroyed; right horizontal and vertical stabilizers torn off; structural damage aft of engine compartment.

H-13E TAIL ROTOR struck bubble and main rotor blade of parked aircraft during hovering flight. Damage to tail rotor blades of hovering aircraft, bubble and leading edge of main rotor blade of parked aircraft. No injuries.

H-21C ENGINE BACKFIRED and caught fire during landing touchdown. Fire extinguished and no further damage to aircraft. Cause undetermined pending engine analysis. No injuries.

HU-1A LEFT DOOR FELL OFF during flight and hit house. No further damage to aircraft. Bolt came off lower portion of door; roller at top of door broken. Suspect materiel failure.

H-21C AFT ROTOR BLADES struck concealed wire on hillside. Incident damage to 2 blades. No injuries.

H-21C AFT ROTOR BLADES struck tree snag during landing approach. Major damage to aft blades, aft transmission, aft rotor head; sheet metal damage to dorsal deck and tail cone; hole in forward blade. No injuries.

H-19D AUTOROTATED to safe landing with no damage, following engine failure at 900 feet. No significant engine indications. Suspect fuel line air pocket.

HU-1A MAIN ROTOR BLADE partially severed tail boom during tail-low practice touchdown autorotation. Major damage. No injuries.

pts from may and june

H-19D ENTERED GROUND RESONANCE after becoming inadvertently airborne while taxiing over rough terrain. Aircraft rolled to left side. Major damage to all main rotor blades, tail rotor, left main gear, left nose gear, fuselage and tail boom. No injuries.

H-19D CRASHED AND BURNED during service flight. Pilot, copilot and crew chief suffered second and third degree burns. Aircraft destroyed. Cause undetermined pending investigation.

H-21C NOSE CAME UP and sudden vibrations began at altitude of 400-500 feet. Aircraft rolled to left, spun to right, struck ground and rolled on left side. Aircraft destroyed. No injuries. Suspect blade failure of aft rotor blade.

L-20A DAMAGED IN FLIGHT when trooper, moving in aircraft, popped reserve parachute accidentally and was pulled from aircraft. Trooper's weapon hit side of aircraft door and ripped one-foot square hole in aircraft side. No further damage. Trooper hospitalized with spine injury.

H-23D STUDENT PILOT attempted to slow moving rotors after shutdown by wrapping his arm around 5-inch drive tube while holding main rotor tie-down block. Strings from tie-down block twined around 5-inch tube and block struck student's face and chest causing lacerations and abrasions. Incident damage to aircraft.

HU-1A STRUCK TREETOP after partial power failure on landing approach. Aircraft fell into gully and was destroyed. Pilot, crew chief, and two passengers suffered minor abrasions and bruises. Suspect fuel pump system failure.

L-19E PROPELLER STRUCK TREE branches while pilot was attempting to dislodge faulty smoke grenade from wing bomb shackle. Incident damage. No injuries.

H-19D MAIN ROTOR BLADES struck building during confined area approach. Major damage to all main rotor blades; fuselage buckled. No injuries.

H-13H TOOK OFF and climbed out with magneto switch on RIGHT magneto. Pilot then turned magneto switch to OFF position, attempted autorotation and made hard landing. Skids spread and cross tubes bent. No injuries.

HU-1A TAIL ROTOR BLADES and 90° tail rotor gear box separated in flight, shearing 90° tail rotor attachment bolts. Aircraft autorotated into swampy area. Further damage undetermined pending removal. No injuries.

L-23D LEFT ENGINE developed hot spot in No. 5 cylinder, caused failure of exhaust pushrod and backfire through induction system. Aircraft landed with no further damage.

H-13H CRASHED during final approach to helipad adjacent to field CP. Aircraft destroyed. Pilot hospitalized. Degree of injury unknown. Cause undetermined pending investigation.

H-23D STRUCK TELEPHONE WIRES during descending turn. Major damage to all components. No injuries.

H-21C RIGHT TOP TIP vertical fin came off during night flight. No loss of control experienced and damage undetected until completion of flight. Cause undetermined.

TEAM FOR FIELD WORK

Lieutenant Robert A. Burbank, Arty

TO PARAPHRASE a famous quotation: if the organizational officer will not come to the Army Aviation School, the school will go to the officer. This decision was reached after the recent elimination of the Organizational Maintenance Officer's Course (1-A-F13) from the school curriculum due to undersubscription.

It is admittedly difficult to release organizational maintenance personnel for school attendance. Yet, additional instruction is needed for supervisory maintenance personnel, both officer and enlisted.

Several methods of providing this additional instruction were evaluated, such as: mandatory quotas to a course of instruction at the Aviation School, the lengthening of flight courses to include a greater emphasis on maintenance subjects, publication of a correspondence course, and the possibility of forming a mobile instructional team. The last two methods were found worthy of further effort, resulting in the initial stages of development of a correspondence course and the formation of the United States Army Aviation School Organizational Aircraft Maintenance Supervisor Mobile Instructional Team.

This team is scheduled to leave Fort Rucker the first of FY 61 for presentation of a 40-hour course of instruction at major posts in each of the continental Army areas. It will be under the direction of the Department of Maintenance, which also has the responsibility for the training of enlisted organizational aircraft mechanics and the presentation of maintenance subjects to officers enrolled in various courses at the school.

Many are already familiar with the mobile instructional teams originating through TMC, which consist of manufacturer's technical representatives engaged in the instruc-

Figure 1

Itinerary of USAAVNS maintenance instructional team

Team One—From 5 July 1960 through 23 September 1960

THIRD ARMY—
Fort Benning, Ga. 5 Jul 60 - 16 Jul 60
Fort Bragg, N. C. 19 Jul 60 - 30 Jul 60
Fort Campbell, Ky. 1 Aug 60 - 12 Aug 60

FOURTH ARMY—
Fort Hood, Tex. 16 Aug 60 - 27 Aug 60
Fort Sill, Okla. 29 Aug 60 - 10 Sep 60
Fort Bliss, Tex. 12 Sep 60 - 23 Sep 60

Team Two—From 20 September 1960 through 24 November 1960

FIRST ARMY—
Fort Devens, Mass. 20 Sep 60 - 1 Oct 60
Fort Jay, N. Y. 3 Oct 60 - 14 Oct 60

SECOND ARMY—
Fort George G. Meade, Md. 15 Oct 60 - 28 Oct 60
Fort Belvoir, Va. 29 Oct 60 - 10 Nov 60
Fort Knox, Ky. 11 Nov 60 - 24 Nov 60

Team Three—From 9 January 1961 through 30 March 1961

FIFTH ARMY—
Fort Leonard Wood, Mo. 9 Jan 61 - 20 Jan 61
Fort Riley, Kan. 21 Jan 61 - 2 Feb 61
Fort Carson, Colo. 3 Feb 61 - 16 Feb 61

SIXTH ARMY—
Fort Lewis, Wash. 18 Feb 61 - 3 Mar 61
Presidio of San Francisco, Calif. 6 Mar 61 - 17 Mar 61
Fort Ord, Calif. 18 Mar 61 - 30 Mar 61

Lieutenant Burbank is a duty instructor in the Special Subjects Branch of the Department of Maintenance. He is fixed wing qualified, instrument rated, and has approximately 1,000 flying hours.

tion of maintenance procedures or technical assistance with the manufacturer's product. It must be explained that the team from the Aviation School is made up of military personnel who are currently serving as instructors with the Department of Maintenance.

The 40 hours of instruction will consist of several broad areas, broken down as follows:

Thirteen hours of organizational maintenance supervision and supply subjects.

Ten hours on the use of the various technical publications required in the support of maintenance functions at the organizational maintenance level.

Twelve hours of instruction on the purpose, use and preparation of various forms kept as different types of records for Army aircraft, or submitted as reports.

Finally, five hours covering such general subjects as test flights, weight and balance, adverse weather conditions, and safety precautions. These general areas of instruction are planned for presentation at this time; however, minor changes may occur before the team reaches your organization.

Let us take a deeper look into the material to be covered in these broad areas of instruction.

ORGANIZATIONAL MAINTENANCE SUPERVISION AND SUPPLY

Fundamentals of Management and Supervision: principles of organization; personnel relations; and functions of management.

Duties and Responsibilities of Maintenance and Supply Personnel: discussion of the aviation maintenance MOS structure, the specific duties of organizational maintenance personnel in Army Aviation units; methods of training to include service school, unit schools, on-the-job-training, and conferences; and a type maintenance training program.

The Maintenance System: principles of Army aircraft maintenance, definition, objectives and levels of maintenance; categories of maintenance, and inspection system.

Organizational Aircraft Maintenance: organizing to perform maintenance; technical inspections and faulty maintenance; charts and boards.

Maintenance Scheduling, Methods and Factors: methods of performing maintenance; maintenance scheduling and programmings; preparation and use of DA Form 811; factors affecting the performance of maintenance.

The Supply System: discussion of Army Aviation technical supply; classification of air items; channels of supply in CONUS and overseas; the modern Army Supply System (MASS); Army Field Stock Control System (AFSCS).

Supply Procedures: preparation and use of DA Form 1546, unit single line requisitioning, turn-in procedures; special supply procedures; replenishment of stocks and stock levels, requisitioning and storage procedures.

TECHNICAL PUBLICATIONS

Technical Publications System: introduction to technical publication system and its application to Army aircraft maintenance and supply; discussion of the technical publication numbering system.

Time Compliance Technical Manuals and Publications Changes: discussion of distribution, purpose and use of Time Compliance Technical Manuals and changes to publications.

Handbooks of Instruction: contents, purpose, and use of the Handbooks of Instruction on aircraft, engines, and equipment.

Technical Publications Indexing and Filing.

Parts Identification: aircraft and equipment illustrated parts breakdown.

Supply Manuals: introduction to Transportation Corps supply catalogs.

Five Part Technical Manual: explanation of the Five-Part Technical Manuals.

Utilization of Technical Publications: practical application in the use of technical publications.

FORMS AND RECORDS

DD Form 780 Series: purpose, preparation, use and maintenance of Aircraft Inventory Record.

DD Form 781 Series: procedure employed in preparation and use of all parts of the DD Form 781.

DD Form 829 Series: purpose, preparation, use and maintenance of Historical Record for Aeronautical Equipment.

UER and UR: purpose, use and importance, preparation and routing of Unsatisfactory Equipment Report, DA Form 468, and Unsatisfactory Equipment Report, DD Form 1275.

Utilization of Maintenance Forms and Records: practical application in use of forms and records.

DA Form 1352: responsibility, preparation, use and routing of Army Aircraft Inventory, Status and Flying Time Report.

DA Form 1890: responsibility, preparation, use and routing of Installed and Spare Air-

MASTER SCHEDULING SHEET

	First Day	Second Day	Third Day	Fourth Day	Fifth Day	Sixth Day	Seventh Day	Eighth Day
TNG DAY								
SEC I 1 0700	Fundamentals of Management and Supervision	Handbooks of Instruction	The Maintenance System	Organizational Aircraft Maintenance	DD Form 781 Series	The Supply System	DD Form 780 Series	Five Part Technical Manua
2	ditto	ditto	ditto	ditto	ditto	Supply Procedures	DA Form 1352	DA Form 468
3	Safety Precautions	Technical Publications, Indexing and Filing	Adverse Conditions	Test Flights	ditto	ditto	DA Form 1890	Utilization of Forms and Records
4	Technical Publications System	Duties and Responsibilities of Maintenance and and Supply Pers.	Parts Identification	Time Compliance Technical Manuals & Publication Changes	Maintenance Scheduling, Methods, and Marginal Factors	DD Form 829 Series	Weight and Balance	ditto
5	ditto	ditto	Supply Manuals	Utilization of Technical Publications	ditto	ditto	ditto	ditto

The schedule of instruction is repeated in the afternoon sessions

craft Engines Report.

GENERAL SUBJECTS

Test Flights: general requirements for DA aircraft test flights and maintenance operational checks.

Weight and Balance: importance of maintaining proper distributions of weight and balance; discussion and comprehensive study on its principles.

Adverse Weather Conditions: the effects of heat, cold, dust, and moisture on the operation and maintenance of Army aircraft.

Safety Precautions: safety practices and precautionary measures for flight and maintenance personnel and material in organizational maintenance.

This instructional material will be presented to the attending personnel as shown in master schedule, with the student body broken down into two sections, so that one section may be able to accomplish the unit mission while the other section is receiving instruction. Each section will receive 5 hours of instruction a day for an 8-day period, for a total of 40 hours.

The present plan calls for the presentation of this course to be made by three teams, on the schedule shown in figure 1.

The team will not try to teach your personnel how to perform maintenance. Rather the team will teach the principles involved in the different subject areas and present one solution to your questions, as taught at the Army Aviation School. The instructing personnel will be glad to help with any specific questions or problem areas which you may have, asking only your cooperation.

Hand-in-hand with its instructional mission, this team will provide liaison between existing aviation units and the U. S. Army Aviation School to assist in quality control of the maintenance courses taught at the school.

COMMANDING OFFICERS . . .

Did you know that it's **your** responsibility to see that Army Aviators assigned to your command remain branch proficient? Par. 9, AR 95-5 states that, "Commissioned officers who have qualified as Army Aviators are basically officers of their respective branches. They are qualified to operate Army aircraft as one of their various normal duties. Unit commanders will insure that such personnel under their command maintain a high standard of proficiency in their basic branch."

Oops!

We Got Disoriented . . .

Figure 2 in "Magnetic Bearing With ADF," page 32 of the June ARMY AVIATION DIGEST, was incorrect. The illustration should have shown the ADF card with the zero reading on the nose of the aircraft, and the needle indicating a relative bearing of 310° to station "B". The correct Figure 2 is shown at the right.

We suggest you clip out this figure and paste it over Figure 2 in the June issue.

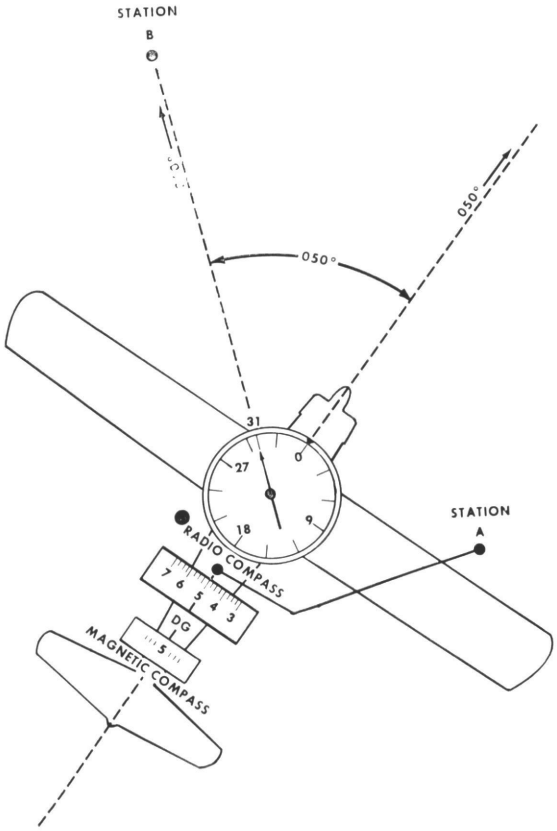


Figure 2

Is Army Aviation Effective For A Battle Group Commander In The Field?

These words from a BG commander speak for themselves: "We took our annual training test two weeks ago. An aviation flight of fair size was made available to support our 2½ day operation . . . my chopper alone flew 22 hours during the exercise.

"Even in near marginal weather, low scud in the mountains, we managed to keep thoroughly busy: 2 H-13s for low reconnaissance and liaison; 1 H-19 for COPL and FEBA delivery of mines, wire, food and ammo; 1 L-19 for radio relay day and night; 1 L-19 for Artillery FO; and 1 L-20 for photo reconnaissance, with prints available 1½ hours after request.

"On the last day the H-13s laid 5 miles of wire in a few minutes, and the H-19, L-19, and L-20 dropped 3,500 pounds of ammo for resupply on 15 minutes notice. I have never seen Army Aviation, whatever its handicaps in old model equipment, prove itself in more ways at once. Without it, the mission would have been 3-4 times as difficult, if not impossible . . . ."

Of Birds . . . Bees . . . Man

Nature's winged critters spend most of their lives in flight. See and be seen is their minute to minute business. Yet, there is no case on record where bees, flies or birds have collided in mid-air. Just doesn't happen! They live to fly, and fly to live.

Man spends the majority of his life on the ground, even if he is sometimes an aviator. Scanning the sky is not environmental to him. There are **many** cases on record of mid-air collisions—and near misses. Let's fly to live . . . and live to fly!

EIGHTEENTH ANNIVERSARY OF ARMY AVIATION

The eighteenth anniversary of Army Aviation affords me a welcome opportunity to extend congratulations and best wishes to the officers and enlisted men of all the branches of the Army participating in this important activity.

Only a comparatively few years have passed since modern Army Aviation was established. Nevertheless, during that time, this function has come to embrace many phases of Army activities, and to include among the individuals performing this type of duty members of virtually all the Army's arms and services. Their record of achievements, in war and peace and in the face of frequently difficult and hazardous conditions, has been impressive. These achievements, which have played an important part in the Army's success, are a tribute to the skill, courage, and devotion to duty which you and your predecessors have consistently displayed.

Equally impressive has been the remarkable expansion of functions through which Army Aviation contributes to the Army's effectiveness. This expansion clearly reflects the foresight, imagination, and initiative of Army Aviation personnel. Your constant search for improved means of performing assigned tasks and for new applications of available potentials has led to the extension of Army Aviation activities into a host of important fields. The result has been a material increase in the mobility, flexibility, and capabilities of the Army and in the welfare of its individual members.

For all your fellow soldiers, I express our appreciation for your many past accomplishments and our confidence in your continued success.

L. L. LEMNITZER
General, United States Army
Chief of Staff

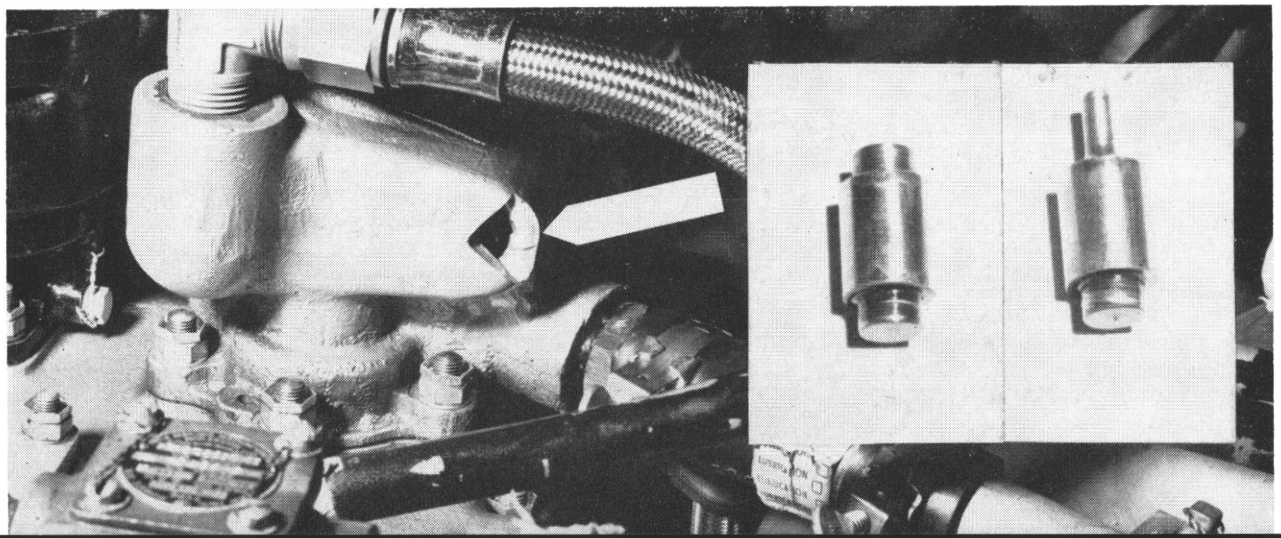
WARNING

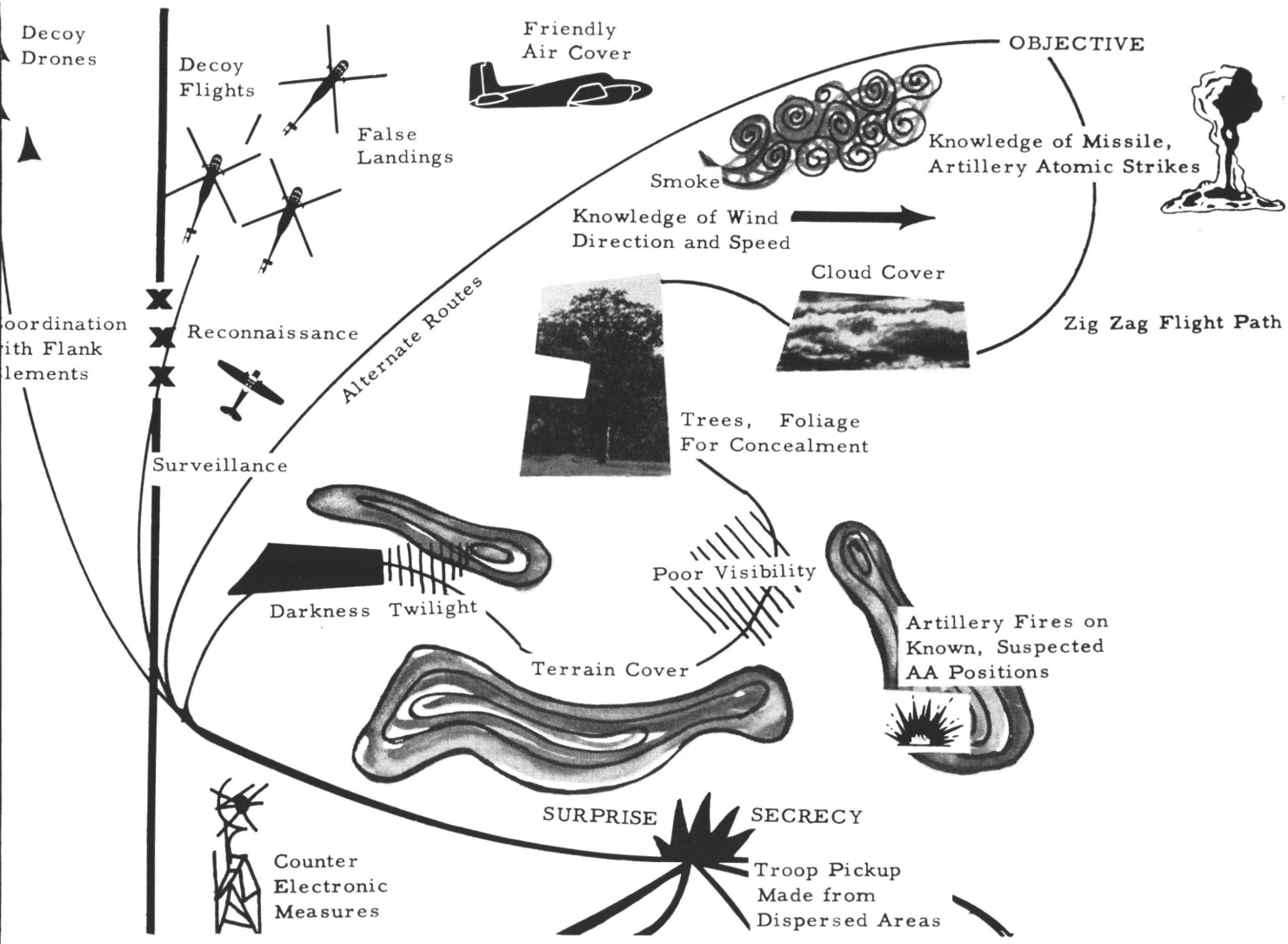
ARMY AVIATORS and maintenance personnel are warned that overhauled L-19 A and E model engines (0-470-11) at their installations may contain the wrong type plunger oil relief valves. This situation is serious since at least one oil pump has had a hole knocked in it by the plunger.

The defect came to light recently at Fort Rucker, Ala., when an Army Aviator reported loss of engine oil pressure during a flight. Investigation disclosed that a hole (arrow) had been knocked in the housing of the oil pump (P/N 532502-A1) by the pointed end of the wrong type plunger (P/N 625173) (pictured at the right in inset). The hole allowed the oil from the engine to escape through the housing. The engine had 225 hours since overhaul.

An inspection conducted on 48 0-470-11 engines at Fort Rucker disclosed that 28 had the wrong type plungers installed. Of the 48 engines inspected, 30 had less than 200 hours since overhaul; 23 of these had the wrong type plungers.

Inset shows at the left the proper plunger (P/N 533103) for 0-470-11 engines on L-19 A and E models. At right is the wrong type plunger mistakenly installed in these engines during major overhaul. This plunger (right) is for the 0-470-15 engine of TL-19D aircraft.





Reduce the Kill

Lieutenant Colonel Horst K. Joost, Inf

THE CONDUCT OF tactical operations employing Army aircraft to traverse enemy territory necessitates a reappraisal of the adequacy of present tactical planning considerations. The ultilization of the vertical dimension incorporated into a ground type operation, and conducted by nonairborne specialists, adds planning and execution complexities to the ground arms commander. These complexities are mainly attributed to the problem of the high degree of vulnerability of Army aircraft to enemy destruction.

As measures must be taken to reduce the vulnerability of the tank and the infantryman to enemy destruction, a commander employing Army aircraft in tactical operations has at his disposal certain measures that he must utilize which will reduce the aircraft kill.

Aircraft vulnerability is a most critical planning factor in the employment of airmobile forces in modern warfare. Unless every plan for such an operation is viewed through the light of aircraft vulnerability, the mission may fail, although perfectly planned in all other

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respects.

Vulnerability cannot be computed in slide rule fashion for airmobile operations. Vulnerability can be calculated only by considering the factors influencing it and the measures that can be used to minimize it.

First, let's look at the vulnerability of the equipment itself. Every hit on an aircraft will by no means destroy it. Data from operations over enemy lines in Algeria substantiate this claim. French Army experience in Algeria indicates that four helicopters were lost during 10,000 combat flying hours. During this period, over 70,000 combat troops were transported. The most gratifying aspect of this fact to the French Army was the ability of their helicopters to take a surprising amount of punishment from rebel small arms fire without being knocked down.

Although this data is obtained from an action against rebel forces without AAA capability, present day and future product improvements can cope with the problems foreseen on the modern day battlefield.

A number of aircraft product improvements can be made which will result in reduced aircraft vulnerability. It is not my intent to discuss the cost nor the technical aspects of these improvements but to consider them from the viewpoint of the aviator and ground commander.

AIRCRAFT PRODUCT IMPROVEMENTS

An improved VTOL/STOL capability with increased cruising speed is needed.

Requirements exist for engine and rotor noise dampers, exhaust flare dampers, rupture and flame-resistant fuel tanks.

Passenger firing ports are needed. External camouflage needs improvement.

Critical aircraft components need to be armor protected with no appreciable weight increase.

We need an improved aircraft configuration, with smaller silhouette and increased allowable cargo load.

In armament improvement we need to include tank-destroying weapons.

An all-weather navigation capability is also required.

Parameters should be established for each type aircraft by scientifically analyzing vulnerability factors. Weaknesses thus revealed can be corrected.

With these and other product improvements forthcoming, Army aircraft airmobile operations have an excellent chance of success if proper vulnerability planning is carried out.

Ground commanders and staffs, in conjunction with their aviation staff officers, can reduce vulnerability in many ways. Failure to consider all aspects can result in an unacceptable loss rate.

Let's assume you are the CO of a BG and are tentatively planning an Army airmobile operation. Our mission is to move the BG to key terrain and hold it until the arrival of the division. We must consider five vulnerability factors in respect to our mission.

FIVE VULNERABILITY FACTORS

1. Airmobile forces should not be employed if a ground action will accomplish the mission as well.

2. Airmobile operations, such as the vertical envelopment or an airborne raid, are conducted in mass with the use of surprise, and should be completed in the shortest possible time.

3. Airmobile operations must be carefully planned and cannot be hurriedly conceived and executed. Prior planning, detailed coordination, and reconnaissance are elements of a successful mission.

4. Detailed information of the enemy, the weather, and terrain are prerequisites for a successful operation.

5. Full use of the available staff must be made to advise the commander regarding the tactical situation and how the vulnerability of the aircraft will be effected.

With sufficient time for careful planning, detailed coordination, and reconnaissance, we stand a good chance of success. Our study of enemy information, weather, and terrain will further ensure that the majority of our force will be available at the objective to accomplish our mission.

In our planning, we will rely heavily on our aviation staff officer, combat support flight leader, aviation unit commanders, and pathfinder personnel, as well as our own staff, to give us the best possible plan of action which makes us least vulnerable.

What are some of the factors we will need to know in our vulnerability planning?

The degree of secrecy to be employed is a vital factor. This factor decides such important items as total number of aircraft, routes, formations, exact time of the operation, and use of air and supporting fires. Secrecy may also influence whether the aircraft will remain in the objective area, whether additional personnel will be needed for safeguarding them, and the need for a camouflage plan.

Secrecy affects the time of the operation, and whether or not to infiltrate, shuttle, or make a mass flight. Return of

the aircraft or use of a shuttle subjects the aircraft to additional exposure to detection and subsequent enemy fire.

The characteristics of the aircraft play an important part in the secrecy of the operation. Such factors as type aircraft, speed, relative maneuverability, noise levels of engines and rotors, exhaust flames, proficiency of the aviation units, proficiency of the ground troops in loading and unloading are definite factors to be considered.

Intelligence factors play a major role in vulnerability planning. The availability, completeness, timeliness and reliability of information on weather, terrain, enemy situation, disposition strength, and capabilities are vital to a successful mission.

We must use each bit of this information to its maximum to decrease our vulnerability.

What about the enemy situation and disposition? By knowing how he is disposed on the battlefield, the strength of his forces, whether he is defending, delaying or attacking, and his capabilities, we can make a tentative plan for our operation in respect to aircraft vulnerability.

Another prime consideration is the degree of aerial superiority held by the enemy or friendly forces.

What about the terrain? Here the ground commander's desired information normally is in respect to observation, fields of fire, flotation, road and stream nets, etc. From the aircraft vulnerability standpoint we are interested in our main aerial avenues of approach and the degree of control the enemy exercises over them by observation and fire. We must make our terrain study from the standpoint of an aerial platform.

How much cover and concealment will be afforded by our avenues of approach? What observation and fields of fire are open to the enemy? What landing zones are available in the objective area? How will our choice be affected by employment of nuclear weapons? Measuring these factors and weighing them against our tentative plan, we continue to evaluate it by considering the plan in relation to weather.

Weather can make or break our operation. A favorable weather forecast can weight the factors heavily in our favor. If we have some leeway timewise, we may decide to wait for the conditions we desire.

We must have minimums (until science catches up and we have an all-weather capability). These minimums are arbitrarily based on several considerations. Depending on the type aircraft, navigational aids available, skill of the pilots involved, time of the operation. the terrain and the urgency of the mission, a minimum weather standard will be set up on a GO or NO GO basis.

Minimums established, we must predicate our plan accordingly. Our best weather for the operation may be just barely above these minimum standards. Such weather will permit our operation, yet hinder to the greatest degree the enemy's ability to detect and fire upon us. If our operation is conducted at night, the moon phases may either hinder or help us. Combined use of the available weather and of dusk or dawn conditions may give us the edge we need.

Other atmospheric phenomena must be considered. Aircraft have difficulties in icing conditions. Snow can be a hindrance as well as a blessing. Though it may mask observation on the enemy's part, it may complicate navigation and cause landing difficulties. Blowing snow and deep drifts can be hazardous.

Wind direction and speed can affect our vulnerability. Engine and rotor noises may either be masked or carried to the enemy. High gusty winds can affect our maneuverability and susceptibility to enemy fire. Wind can change our direction of approach into the landing area, possibly exposing us to observation and fire. It can aid or hinder our efforts to conceal our flights by the use of smoke.

The effects of weather must be considered in relation to our vulnerability to nuclear attack also.

Time of the operation, based on the predicted and desired weather, is perhaps the most critical decision the commander must make in respect to vulnerability.

Another consideration which will reduce equipment vulnerability is the use of evasive measures. Flight altitudes and flight paths must be varied to reduce hits from ground fire weapons. Shallow turns and small changes in altitude and speed, coupled with more abrupt altitude, attitude and speed changes, will reduce the effectiveness of enemy gunnery. (See "Flip-Flop Over the Top," page 1).

Evasive measures against enemy high-performance aircraft will consist mainly of getting to minimum altitude as soon as possible and placing terrain features between the aircraft and the enemy aircraft's firing passes. Friendly high performance air escort during the operation can aid immeasurably.

A combination of friendly air

strikes, artillery and missile fires along the approach route will help neutralize known and suspected enemy antiaircraft positions. Use of these means to lay smoke can also aid in covering our movement or for deception. Artillery can also aid by firing colored smoke at given points and times along the route for use as check points.

Coordination with fire support elements during the flight will also preclude the possibility of damage to aircraft or blinding of pilots from friendly atomic strikes.

Deceptive measures can aid us greatly in our vulnerability problem. By deceiving the enemy as to the intent, size of forces, direction of flight, and objective, we obtain a better probability of success.

We can cause the enemy to commit his antiairborne forces in areas other than our objective area.

Drone aircraft can be employed over false routes and areas, causing the enemy to commit his fires and ground enforcements in other areas. Enemy antiaircraft positions can be thus detected and planned for.

Decoy landings, dropping of dummy parachutists, and false landings en route are other possible aids. Counterelectronic measures may also be employed.

The integration of this deception plan with that of other friendly forces will make maximum use of the enemy's confusion as to our real plan.

The skillful use of the factors affecting aircraft vulnerability can be crucial to the success or failure of any airmobile operation.

Failure to consider all of the factors or to discount any of them in formulation of the basic plan can be disastrous.

Every commander and staff officer should be well-versed in all aspects of aircraft vulnerability and be constantly on the alert for new developments and techniques which can enhance the ability of Army aircraft to traverse enemy held territory to accomplish such an airmobile operation successfully.

ARMY AIRCRAFT VULNERABILITY CHECKLIST

1. **Type Aviation Mission**
   - a. Degree of secrecy required
     - (1) Operation dependent on secrecy
       - (a) Reconnaissance patrols
       - (b) Air delivered observers
       - (c) Raid
     - (2) Secrecy not paramount
       - (a) Vertical envelopment with rapid ground linkup
       - (b) Vertical withdrawal
   - b. Disposition of aircraft
     - (1) Aircraft remain in objective area
     - (2) Aircraft return after delivering force
   - c. Number of aircraft involved
   - d. Distance to traverse enemy territory
2. **Aircraft Characteristics**
   - a. Range
   - b. Landing requirements
   - c. Allowable cargo load
   - d. Engine or rotor noise
   - e. Camouflage ability
   - f. Exhaust flame
   - g. Configuration (size, shape)
3. **Proficiency of aviation unit and supported unit**
4. **Intelligence Factors**
   - a. Enemy situation
     - (1) Disposition
     - (2) Strength
     - (3) Composition
     - (4) Recent and present significant activities
     - (5) Peculiarities and weaknesses
   - b. Enemy capabilities of engaging Army aircraft
     - (1) Detectability
       - (a) Visual perception
       - (b) Sound perception
       - (c) Sensatory devices
     - (2) Ability to react for attack
       - (a) Immediate
       - (b) Verbal command
       - (c) Electronically directed
     - (3) Means of engaging aircraft
       - (a) Ground fire
         - 1. Small arms
           - (a) Individually fired
           - (b) Crew served weapons
         - 2. Light antiaircraft (4-5,000 yd range manually operated
         - 3. Medium and heavy antiaircraft (effective to 30,000 yards)
           - (a) Visually controlled
           - (b) Electronically controlled
       - (b) Aircraft — degree of air superiority available
         - 1. High performance
         - 2. Low Performance
       - (c) Atomic
         - 1. Blast
         - 2. Heat
         - 3. Flash
   - c. Estimation of enemy capabilities from the above factors
   - d. Effects of Weather
     - (1) Temperature—air density
     - (2) Visibility
       - (a) Precipitation
       - (b) Fog

(c) Cloud cover
(d) Light data
(e) Snow
(3) Wind direction and velocity
(4) Effects on communications
(5) Effects on nuclear detonations manually operated
e. Terrain
(1) Cover and concealment
(2) Critical terrain features
(3) Obstacles
(4) Avenues of approach
(5) Observation and fields of fire
(6) Affect of terrain on nuclear detonations

5. **Measures to minimize aircraft vulnerability**
a. Selection of suitable flight routes
b. Contour flying and evasive measures
c. Inclement weather and reduced visibility operation
d. Suppressive fire: preparatory and on-call
(1) Artillery
(2) Antiaircraft
(3) High performance aircraft
(4) Army aircraft
(5) Nuclear
e. Use of smoke
f. Deceptive measures
(1) Drone aircraft
(2) Dummy parachutists
(3) Evasive flight techniques
(4) Utilizing other ground actions as decoy
g. Electonic countermeasures
h. Crew and passenger armor protection
i. Timing of the operation
j. Flight formation
k. Camouflage

6. **Commanders' evaluation of probability of success of the airmobile operations based on the above factors**

Straight and Level

To Editor-in-Chief:

Enclosed is a recent communication pertaining to a common and potentially dangerous flying problem and a very acceptable temporary solution until a redesign is accomplished. I hope that this may serve useful in our effort to achieve greater flying comfort and safety for our aviators.

DONALD A. RITCHIE
Captain MC
Aviation Medical Officer

Lt Col Jack J. Tinnin
Army Aviation Officer
Fifth United States Army
1660 East Hyde Park Blvd
Chicago 15, Ill.

Dear Colonel Tinnin:

I, like many other aviators who are forced to wear bifocals for close reading, have found the AN/ARC-55 installation in the L-20 to be a most frustrating problem. The problem lies in the fact that the channel selector is so close to my eyes that I cannot read the numerals clearly, especially at night. I know, from talking to a number of aviators around the world, that the problem is not uncommon. I thought I would pass along my solution for the benefit of similarly afflicted aviators in your command.

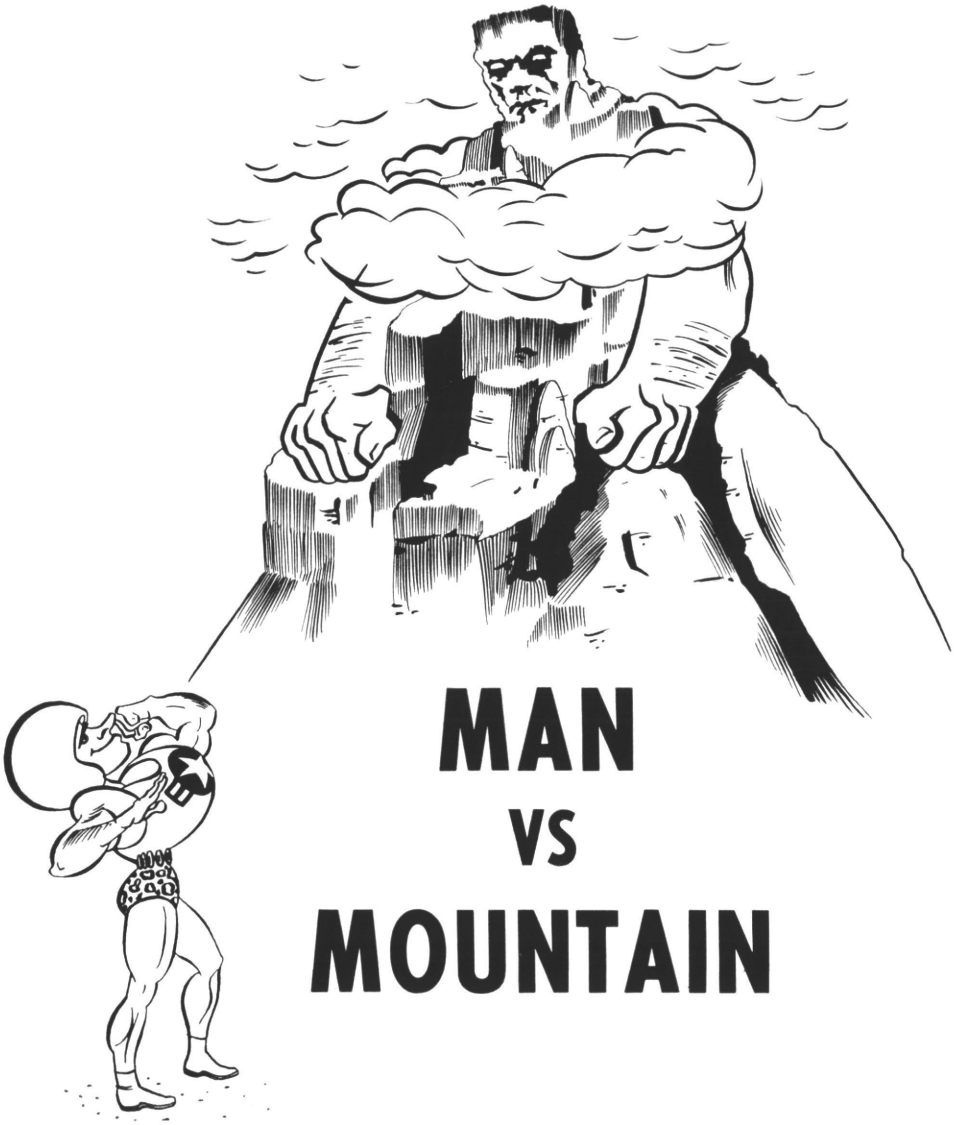
I took the problem to the eye doctor here with a view to getting trifocals, i.e., a lense at the top of the eye piece with the same correction as the bottom of the bifocals. He advised me that the Army will not issue trifocals except to meet a specific need. He made up a DD Form 771 in the usual manner for bifocals to be sent to the Base Optical Shop, St. Louis, Mo. He also included, under "Details," the following statement:

"Request double segment bifocals. The top segment to be decentered to the near PD and to end 6mm below the top of the frame. Patient's job requires him to operate a radio which is above him. He cannot see with conventional style bifocals."

The glasses arrived in about three weeks and were most satisfactory. I don't have to strain any more than a man with good eyesight, now, in selecting channels for the ARC-55 and the ARC-44 in the L-20. I feel that the new glasses might eliminate cases of vertigo, particularly at night or under IFR conditions.

With warm personal good wishes, I remain,

Sincerely yours,
CHARLES R. MURRAY
Colonel
Chief, Army Avn Sec



MAN VS MOUNTAIN

THE ATHLETE striving to win a race, the circus performer walking a tightrope, the artist trying to produce his best work, the aviator airlifting a near gross load into a narrow mountain pad — all are under strain. The difference is that the aviator is under more than mere stress. Life and death, possible loss of valuable equipment, are at stake. The artist, the athlete, the circus performer are tops in their fields. The aviator must top them all when he pits his skill and machine against mountains.

A Shawnee (H-21C) crew prepared to make a personnel and resupply lift to assist fire-fighting crews. They had completed two previous landings at the destination helipad, located on a mountainside at a 1,500 foot elevation. The pad was at the edge of the fire zone.

The aircraft was loaded to normal gross with 2 drums of diesel fuel, four 5-gallon cans of gasoline-oil solution, five 5-gallon cans of water, C-rations, survival kit, rucksack, and 3 passengers. In addition to the pilot and copilot, two enlisted crew members were aboard. Extra fuel was carried in external tanks.

After preflight, the engine was fired up and the aircraft was brought to a hover. This required 40 inches hg and 2700 rpm.

Takeoff was normal and the flight proceeded directly to the helipad. A high and low reconnaissance was made and the approach started upwind of a smouldering pile of logs, brush, and debris which had been bulldozed from the helipad. As the Shawnee came abreast of this smouldering pile, the forward rotor sucked ashes, smoke, sparks, and small debris all around the forward section. An aircraft length from the helipad, 25 feet above the ground and in normal attitude, the forward rotor lost lift and fell abruptly toward the ground.

Lift was regained momentarily as the pilot applied corrective action just a few feet above the ground. Realizing he could not make the helipad, the pilot maneuvered the Shawnee to a more suitable area, and it fell through again. The forward rotor blades struck a tree and the aircraft settled to the ground. All personnel aboard left the aircraft and used water from internal stores to extinguish small woods fires in the vicinity. There were no injuries.

The accident investigation board was unable to fix the cause of the accident. They theorized that the loss of lift on the forward rotor system was caused by unusual currents on the mountain slope and uneven heating of the air by forest fire.

This pilot had made two previous flights into the helipad the same day with approxi-

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This article was prepared by the United States Army Board for Aviation Accident Research.

Unusual atmospheric conditions are the rule in mountains

mately the same load, so it seems safe to assume that this accident was caused by unusual atmospheric conditions.

Unusual atmospheric conditions are the rule rather than the exception in mountain terrain.

High altitude helicopter operations take a skill apart from pattern and cross-country flying — skill that takes time and practice to acquire. If you find this hard to believe, listen to an experienced mountain-wise pilot. Better yet, go flying with him and then listen. Let's look in on a mountain-wise pilot starting his day!

Early in the morning of a blue sky day he scans the 0600 winds aloft report. The wind from 240° at 50 knots at the 20,000-foot level shouldn't concern helicopter operations in the mountains. But it does. From experience this pilot knows the wind will come down during the day. Maybe it won't be 50 knots by midafternoon, but that mountain pass will be an accident trap for the unwary.

The aviator without that know-how blithely files his flight plan and flies his well-loaded helicopter out toward his destination through that mountain pass. He encounters turbulence, downdrafts, updrafts, dangerous eddy winds, and finally starts to settle in spite of all he can do. He tells the accident board that he had forward speed and a reserve of power but that it just wasn't enough. Actually the deficiency was his apprenticeship in mountain flying.

This is but a small part of mountain flying. Mission accomplishment in high altitude operation depends upon perfected basic skills and knowledge. This can be applied to mission accomplishment anywhere in the world.

The helicopter pilot operating in mountainous terrain must know the capabilities and limitations of the model helicopter he is flying. He must have acquired precision handling of the controls, and mastered the basic techniques of helicopter flying to the extent that they are instinctive with him. At high altitude, there is often little or no margin for error.

The most important of all the weather variables is wind. More helicopters have been damaged as a result of some fluctuation of the wind than from any other cause in mountain operations. To assure a high level of mission accomplishment, the pilot must understand how to determine directions and veering of wind. He must know gust limits. He should know the value of crosswind approaches and when to use them; downdrafts and updrafts, how to use, when to avoid. He must be aware of the danger of upslope takeoff. He recognizes the real hazard of ignoring slight downwind conditions on takeoff and landing.

The mountain-wise helicopter pilot learns all the tricks of the trade, like taking off on a gust of wind. He is skeptical but knows that on occasion a downwind approach is desirable. Most of all, he is familiar with the limitations of the helicopter he is flying. Only by having this knowledge can he correlate wind with available power. He anticipates slow flight maneuvers because he knows anticipation is a major factor in this flight regime.

One helicopter pilot didn't know this. He was assigned a photographic mission in a Chickasaw (H-19D). Wind was from the west, blowing across the mountains. The photographer, riding in the copilot's seat, called for low, slow passes over the area. The pilot circled to check for hazardous conditions and made a power check at a high hover (300 feet), headed into the wind. He found the power satisfactory and proceeded with the mission. A downdraft was encountered at an altitude of 150 feet on a slow pass to the east. This resulted in a rapid rate of descent. Rotor rpm was lost as the pilot tried to stop the sinking. He was unable to prevent a hard touchdown on an incline. The helicopter rolled to its left side and was destroyed.

Slow flight on lee side

Anticipation could have prevented this accident, which was caused by slowly flying downwind on the lee side of a mountain in high density altitude. A severe downdraft, coupled with this unstable flight condition, overcame the operational capabilities of the aircraft.

To **assume** wind direction can be fatal. The pilot must **know** what the wind will be. A general wind direction is not necessarily the direction that will be encountered when approaching the ground or in the lee of obstacles. Winds that are gusting from 5 to 15 knots can lead to trouble in marginal approaches and takeoffs. This is where anticipation in huge chunks pays off a like amount of dividends in mission accomplishment.

These two accidents give a bird's-eye view of some of the problems of getting familiar with flying the mountains. There are many others.

Altitude affects performance. Control and mixture requirements change. Height and rugged terrain have a psychological effect. An aviator who is not relaxed in the mountains is apt to overcontrol. The newcomer may be quite tense. While some measure of fear may act as a safety factor by keeping the pilot alert, too much may cause rough handling of controls. A heavy hand on the controls in the thin, sensitive air of mountain terrain is not conducive to mission accomplishment.

We all know that the whirlybird is ultrasensitive to temperature. On a clear cold day you can lift the hangar. That afternoon you have trouble getting airborne with a full fuel load. This makes it mandatory that you know your density altitude. Only by having this knowledge at your fingertips can you know what performance to expect.

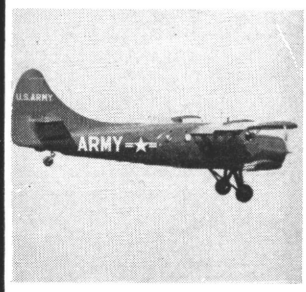
Because helicopter performance is affected by varying altitude, temperature and wind, the load that may be carried must vary with them, both in individual variations and in combinations. The mountain-wise pilot must understand safe c.g. loading; aerodynamics of various-shaped loads; positive internal or external storage; length limit of cargo; necessity to reduce speed when certain flatplate exposed areas exist; necessity of flawless operation of shackles and releases.

Even your vision can fool you in the mountains. Obstacles will always appear larger on landing than from the air. The mountain-wise aviator must know how to deal with this problem.

Mountain operation accident experience indicates a definite need for specialized training. In many of the accidents of this nature, unit training was being conducted at the time. In others, short duty tours, coupled with mission requirements, prevented an effective unit training program. The number of like accidents are increasing. This is a logical trend in view of expanding capabilities and mission requirements of cargo helicopters.

Individual aviators can concentrate on attaining perfection under other aviators who are qualified to impart the fine points of mountain flying. Attaining the sort of proficiency needed to cope with the mountains doesn't come without effort. It means hard work, study, and more hard work.

When you're working the mountains, dividends will come your way — if you have the know-how — dividends in the form of mission accomplishment.



CRASH SENSE

PREPARED BY THE UNITED STATES ARMY BOARD FOR AVIATION ACCIDENT RESEARCH

MISSING OTTER

THE AVIATOR was young, ambitious and newly assigned. He frequently expressed a desire to become instrument qualified. During two previous flights, the instructor pilot had to restrain him from making overwater shortcuts. One of these flights terminated in a forced landing when oil pressure was lost. The IP took pains to point out their fate if they had been over water.

One pilot in a flight of three Otters transporting personnel, the young aviator was seen to take off and turn to a course that would carry him over water for a considerable distance. There were nine passengers aboard. The remaining two aircraft took off and proceeded along the coast. These two encountered a line of thunderstorms and were forced to descend below 1,200 feet to maintain VFR. Their pilots reported that the thunderstorms appeared more severe over the sea.

The two Otters flying the coastal route reached destination and landed. The other aircraft was declared missing and an intensive search was begun. A few small parts of the aircraft and some personal belongings were found in the surf the following day. The accident investigation board could only conclude that the aircraft had flown into a violent thunderstorm and crashed at sea.

There are many aids to prevent inadvertent thunderstorm flying: flight route and destination forecasts, en route weather advisories, pilot reports, radar, and others. These are **aids.** The only person who can prevent your flying into a thunderstorm is YOU.

WEATHER NOT A FACTOR?

"... Sioux pilot executing normal approach. Rate of descent was normal and power was applied at 40 feet. Aircraft struck ground tail-first in hard landing. Weather not a factor."

"... aircraft landed hard from power approach, causing the landing gear to spread. Propeller and underside of fuselage struck ground. Weather not a factor."

"... Shawnee pilot found his autorotative approach normal. He flared the aircraft and applied collective pitch. Rate of descent was not stopped and the aircraft landed hard, tearing off the left gear. Weather not a factor."

"... Chickasaw touched down tail-low from autorotation. Aircraft bounced, rolled on side. Weather not a factor."

"... Otter landed hard from power approach. Weather not a factor."

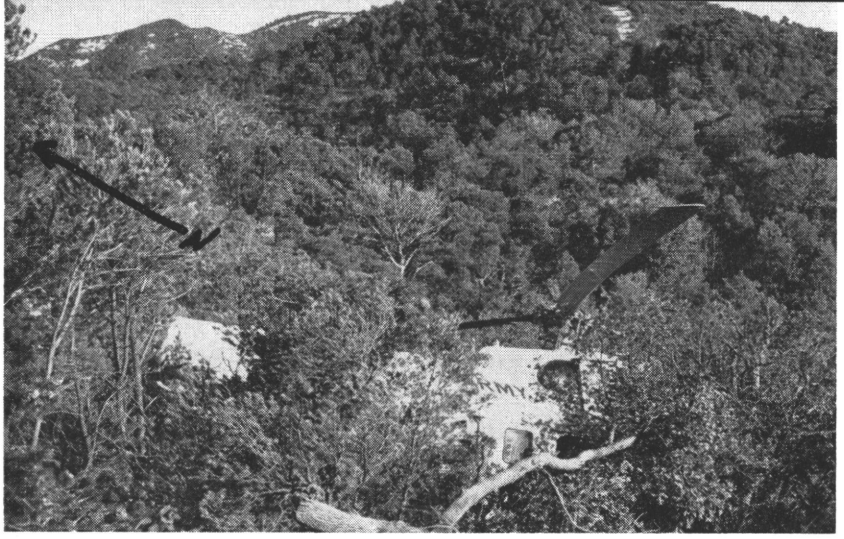
The amazing fact about these and 22 other accidents during the period studied is that weather definitely **was** a factor. Density altitude was the culprit. We all know what density altitude is. Remember your ground school days? "Therefore, density altitude is a theoretical altitude of any place or point in the air, determined by the altitude at which its air density would place it in stan-

A few small parts

Weather not a factor?

dard atmosphere."

Some of the time, density altitude is of little concern. At other times it's more critical than the political situation in Upper Slobbovia. July is well known as the month of the blazing sun — a much better time to chew the pencil and spin the howgozit than to explain to the accident board how the bottom dropped out, or who shortened the runway. Weather not a factor?



No time for handbooks

IN THE GREEN

The pilot picked the Shawnee up to a hover, noted power settings of 41½ inches and 2700 rpm. He estimated 3½ to 4 remaining inches above hovering power for takeoff. This appeared ample to climb over trees and ridges surrounding the area and he began the climb into the wind.

The Shawnee climbed to approximately 50 feet, then began to settle. The pilot noted extremely tall trees ahead and turned left to avoid them. As the aircraft settled into a growth of 20-foot trees, the rotor blades were torn away. Fortunately, there were no injuries.

The pilot, a veteran of some 2,000 flying hours, was a qualified instructor pilot. He and the copilot agreed that everything was "in the green." The aircraft should have flown.

Why **did** the Shawnee settle into the trees? The answer may be in the statement of a forest ranger, the only witness to the accident: "I am no judge of helicopter maneuverability, but it appeared to me that the crew and machine operated very well. Certainly, a nice takeoff was executed by the crew. However, **the air currents that boil up and down side slopes and valleys in this rugged terrain are strong and very changeable at and near ground levels."**

Though loaded within -1 green limits (12,600 pounds), this appears to be a case where two trips would have succeeded where one failed. "Pessimism," Mark Twain said many years ago, "is only the name that weak men give to wisdom." The successful mountain flier is a healthy pessimist, especially in his respect for air currents.

In the green

THE HANDBOOK SAYS . . .

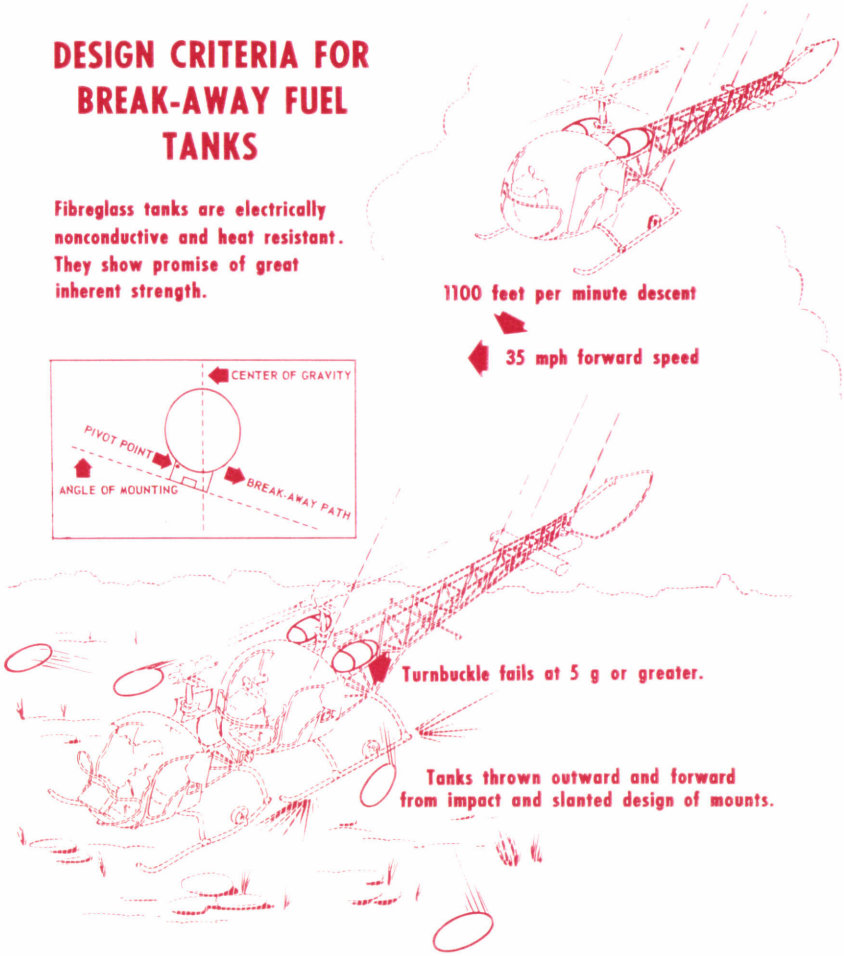
The Chickasaw Flight Handbook (TO 1H-19B-1) specifies maximum performance takeoffs from restricted or mountainous areas, critical altitudes, and over obstacles. A copilot faced all of these in his takeoff from a remote mountain helipad, located in a saddle surrounded by trees at an elevation of 7,350 feet. He brought the aircraft to a hover and began a normal takeoff. The Chickasaw reached treetop level and began to settle. The pilot quickly got on the controls, but neither he nor the copilot could stop the descent. The aircraft went through the trees, hit the ground with brakes locked and came to a stop against a barbed wire fence.

Knowledge is of two kinds. We know a subject or we know where to look to find out about it. The time to start looking up source material in the -1 is before pulling pitch and rolling in throttle.

Break-Away Fuel Tanks Designed to Prevent Aircraft Fires

DESIGN CRITERIA FOR BREAK-AWAY FUEL TANKS

Fibreglass tanks are electrically nonconductive and heat resistant. They show promise of great inherent strength.



A POSSIBLE major step forward in the prevention of aircraft accident injuries was made recently when an H-13G Sioux helicopter, equipped with break-away fuel tanks, was hovered around the taxiways of Cairns Army Airfield. Designed to break away at the impact forces normally present during aircraft accidents, these tanks will safely remove the aircraft fuel supply from such igniting sources as hot exhausts, electrical wiring, and sparks from grinding metal.

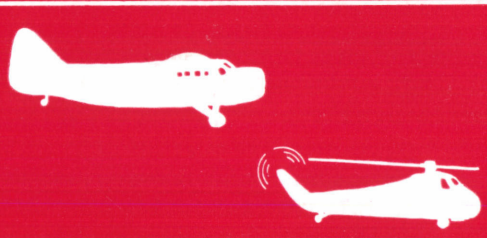
Research of past accident experience has proved that some aircrewmen survive the impact forces of aircraft accidents only to be fatally injured by fire after impact. Fuel from ruptured, rigidly mounted fuel tanks is the greatest cause of such fires.

Asked to fabricate a crashworthy tank, an aircraft manufacturing company made two fibreglas tanks, using the standard H-13 tank as a model. Fibreglas is electrically nonconductive, heat resistant, and possesses a high degree of inherent strength.

After the crashworthy tanks were made, there still remained the problem of securing the tanks to the aircraft in a manner that would permit them to break away during crash impact forces, yet remain firmly in place during all normal operations. To solve this problem, a design criteria of 5 g, such as might result from a 1,100 fpm descent, 35 mph forward speed impact in level flight attitude, was adopted. The tanks were mounted in angular frames which place the center of gravity of the tanks outside the mounts.

Each tank was secured with two straps fastened by a single turnbuckle designed to fail under impact stress of 5 g, or greater. As the turnbuckle fails, the straps release the tank and it falls downward and outward away from the aircraft. Quick disconnect fittings will stop fuel flow in the lines to the engine as the tanks fall away. The oval shape of the tanks will permit them to roll along the ground under the inertial force of impact and any forward speed at the time of the crash. In this manner the fuel supply is removed from the immediate area of the accident and the probability of fire is greatly reduced.

The installation of these tanks on the H-13G was the result of a cooperative effort at Fort Rucker. It was made to illustrate the feasibility of break-away tanks. Unfortunately, this is not the final answer; more engineering effort will be required. However, our aircraft can be made safe from fire in those accidents where forces are such that the occupants would survive if no fire occurs.

This article was prepared by the United States Army Board for Aviation Accident Research.

DON'T!