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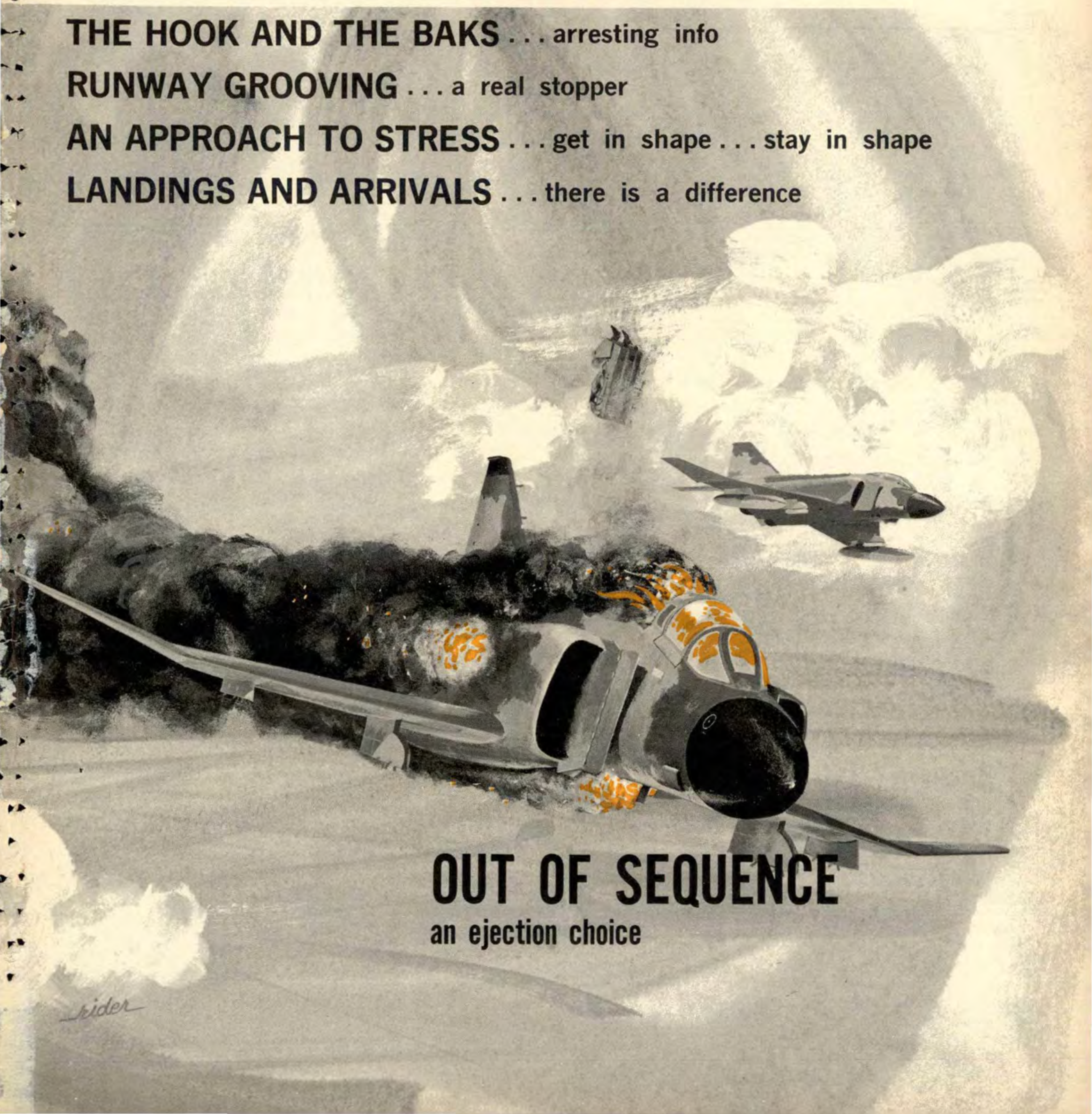
Aerospace SAFETY

THE MAGAZINE DEVOTED TO YOUR INTERESTS IN FLIGHT



OUT OF SEQUENCE

an ejection choice

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November 1968 AFRP 62-1 Volume 24 Number 11

SPECIAL FEATURES

REGULAR FEATURES

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PREFLIGHT

Instructor pilots have one of the most demanding jobs in the Air Force, whether they are involved in upgrading rated pilots or teaching fledglings how to fly. Lt Col Victor Ferrari discusses the role of the IP in terms of a student Capability - Judgment gap, page 5. Dr Ferrari, a flight surgeon, worked out the charts used in the article to illustrate this crucial period in a student's development. The article is recommended for commanders, IPs and students.

Options are great and are designed into systems in order to give the operator a choice of two or more ways of doing something. But when you offer a choice you also present the problem of selection of the best alternative. This is the situation the A/C of a tandem seat aircraft may find himself in, if an ejection becomes necessary. Some thoughts on this subject are presented by Major Raymond Krasovich, F-4 project officer in the Directorate of Aerospace Safety, in "Out of Sequence," page 2.

As the result of several requests *Aerospace Safety* is reprinting updated BAK 9 and 12 charts showing maximum engagement speeds for most of our hook equipped aircraft. See page 18. And on page 11 is a report on runway grooving, its contributions to preventing hydroplaning, and its effect on runway life.

There are several other items of interest to aircrew members—"An Approach to Stress," page 15, and "Chain of Events," page 8, both covering human factors. And on page 4, the Chief of the Flight Safety Division, Directorate of Aerospace Safety, Col James Fussell, takes on the delicate subject of senior officers in the cockpit.

Who gets the fame & Who takes the blame?

Have you noticed that the best way to tell when you have something good going for you is to count the number of people taking credit for it? If it's a success, lots of people are busily engaged in documenting and asserting their proprietary claim. If it's a BIG success, not only is the number of claimants large, but the elevation of their positions is awe-inspiring.

In such a setting, the true originator may find that there isn't any room for him on the bandwagon.

Now, let the project run into difficulty, let scathing derision or censure be involved. Then look for the crowd. They are about as obvious as a graduate level escape and evasion class taking a final field test.

When a pilot valiantly tries to save his bird, but, because of some minor, often commonly practiced deviation, fails to do so, who takes the blame? On the other hand, when the score is tallied at the end of the year and the results show that pilots and airmen collectively have performed outstandingly well, who gets the fame? Is it the man at the bottom, or the one at the top?

If you are the one at the top, it's always a temptation to bask in the sunshine of approval and to either blatantly or implicitly accept full credit for all that's gone well. Now that's wrong—and I can say so from close to the top. For four years, I have been the Number 2 Man in the Directorate of Aerospace Safety, USAF. I've seen a good record get better and better. I'm certainly human enough to want to feel that I had a part in this improvement. However, I have learned enough to know who really did it and who will continue to do it. The major commanders and the dedicated field Safety specialists certainly deserve much of the credit, as do all those people who fly and those who directly support aircraft operations. They are close to the problems and are in a position to see and feel directly the results of their efforts.

But there are others whose great contributions to the success of our endeavors are often overlooked. They are the engineers, scientists and specialists in many fields in Systems Command and Logistics Command, and their counterparts in industry. They carry tremendous responsibilities but seldom receive public acknowledgment of their deeds. We in Safety, as well as the users of Air Force equipment, owe them much and that is why I am singling them out here for the credit due them. However, in considering the Air Force as a whole, our enviable safety record is the product of each individual who accepts his responsibility and does his job well.

When you pick up your local paper and see that the Air Force has received the President's commendation or a National Safety Council award, or many of the other commendations that come along, you remember someone accepted the award, BUT, he accepted it for you. YOU—each airman, civilian, officer, or commander—are the ones who made it possible, and it in reality belongs directly to you. ★

Edward W. Szaniawski

Edward W. Szaniawski, Colonel, USAF
Deputy Director of Aerospace Safety

There are times when you can improve your odds by going . . .

Out of Sequence

Maj Raymond L. Krasovich, Directorate of Aerospace Safety

"This is Snapper Two. I've been hit."

"Rog, Two, I've got you in sight. You're trailing smoke. Get rid of the garbage and head for the water. I'll get on your wing."

"OK, Lead, I've jettisoned everything. I have a fire warning light on the right engine and am getting some smoke in the cockpit."

"Rog, Two, you've got fire coming from the right side of your fuselage. Stay on your present heading and you'll be home free in about ten miles."

"This is Two. I've got the right engine shut down but we're still on fire. The smoke in the cockpit is bad and it's getting hot in here. I've got the beach in sight and think we'll make it."

"OK, Two, you're almost over the beach now; give it a few more seconds and you've got it made."

"Rog, Lead, I'll give it a few more seconds and then get out. Joe is going first and when he is clear, I'll go. See ya!"

"OK, Dave, good luck."

The crippled F-4 flew for a few more miles, and Dave, the aircraft commander, and Joe, the rear seater, quickly reviewed the ejection procedures. Joe was to launch on Dave's command. It was getting hotter in the cockpit; aircraft control was deteriorating, and they were about four miles out to sea.

Dave gave the word GO. Joe pulled the ring up, heard the canopy go, felt the rush of air and along with it a blast of heat, then he was ejected up the rails and out of the cockpit to an eventual recovery. As Dave gave the word to go, he positioned himself in the seat, kept the aircraft level and waited for Joe to eject. He heard the bang of the canopy going and then the seat. Almost immediately and certainly before he could react, he felt the rush of air accompanied by searing heat and flames. Dave didn't eject. He didn't have a chance. The stricken F-4 lazily rolled over into a dive and, trailing heavy black smoke, crashed into the Gulf of Tonkin.

Although the above incident is fictitious, it is reasonably close to what actually has happened to aircraft experiencing fire or cockpit fires. Several reports, both Navy and Air Force, have indicated that, either as a result of combat damage or an electrical fire in the cockpit, smoke became so dense that the pilot was forced to jettison the canopy. Then, the cockpit was immediately engulfed in flames of such intensity that the pilot was incapacitated, precluding any possibility of saving himself.

Could the pilot have been saved if he ejected instead of blowing the canopy? I don't know—but he'd have a chance whereas previously he had none. Now, don't get the idea that I am advocating ejection because of smoke in the cockpit—certainly not! Aircraft flight manuals call for jettisoning the canopy or opening a window (for many motor drivers) to eliminate smoke from the cockpit. In some situations, this has done the trick and the aircraft has been safely landed.

However, in other cases, and admittedly a minority, blowing the canopy or opening a window created a draft which fanned the smoldering fire into one of disastrous proportions.

That's the problem. Now, what can we do about it? Well, as it states in the flight manual, rely on your best judgment and assessment of the situation, and, of course, carry out the prescribed emergency procedures. These procedures will get you out of the spot under most conditions. However, in combat, where the aircraft has been hit or is on fire and is going to be lost anyway, all efforts should be directed toward saving the crew. Under these conditions, I would recommend leaving the canopies on until ejection is initiated. On those airplanes equipped for sequenced ejection, *set up for a sequenced ejection!* For the uninitiated, sequenced ejection is a system wherein one or either occupant in a tandem seat aircraft initiates the ejection for both crewmembers. The rear seat crewmember is ejected first to protect him from rocket blast burns from the front cockpit. For instance, the F-4 when modified by TO 1F-4-663 incorporates sequenced rocket ejection seats. With this mod these are the ejection options:

• Any time the aircraft commander initiates the ejection, both crewmembers go;

• The pilot may eject individually, or,

• By the positioning of a selector valve the pilot may initiate the sequenced ejection for both crewmembers.

Once initiated, the canopy/canopies are jettisoned and both crewmembers are ejected with a minimum time delay and no further action on their part is required to complete the sequence. Unless the system has been damaged, sequenced ejection offers the best probability of getting the crew out of the aircraft. The system was installed for your use and this is the time to use it.

Survival is not guaranteed under an emergency such as this, but using the sequenced system, both crewmembers have a chance. If you are flying an aircraft equipped with a sequenced ejection system, think about it! After all, the life you save just may be your own! ★

(The sequenced system discussed here was used in a shoot-down. The airplane was on fire, both crewmembers ejected with no problem, and landed about a hundred yards apart. This eased the rescue problem. Ed.)

A SENIOR PROBLEM

Col James G. Fussell, Directorate of Aerospace Safety

One of the most common complaints registered with members of the Flight Safety Division, whether it be during a survey or a telephone conversation with a wing safety officer is, "How do we cope with the problem of senior officers arriving at the aircraft five minutes before takeoff, jumping in the left or front seat, with little or no briefing, and roaring off into the blue?"

We all know this is an age-old problem. We know precisely, and can quote verbatim from AFR 60-16, the responsibility of the aircraft commander or the Instructor Pilot, but the reaction of a young Captain or Major IP when confronted by a senior officer announcing he will fly the "first leg" is a different subject completely. The IP immediately reacts to this proposition with a "so what? I instruct the right or rear seat most of the time; therefore, I can compensate for any procedural error or take over in case of an emergency." This approach is not necessarily true and has proven to be disastrous.

Let's consider a hypothetical but realistic situation. A senior officer arrives at the aircraft just before daylight, cold and probably not too wide awake. He straps in, takes a quick look at the SID, runs the checklist and starts to taxi. In the meantime, the IP is copying the clearance so the pilots have their attention concentrated in different directions. Inevitably "some little problem" goes unobserved, whether it is a slightly high EGT or a heading indicator ten degrees off or one of a dozen other things that could fail to energize the warning light or attract either pilot's attention.

The IP has just called rotation speed and you are committed to take off. Now, in a matter of seconds, the little problem becomes a big problem. Put yourself mentally in this situation. You may or may not get by with a heading deviation or a sick engine while you quickly evaluate the situation, but if you are so fortunate, the odds are that you are going to have to return and land or, even worse, go into a nearby alternate with which you are not acquainted. Your brain is clicking with such questions as, what is minimum altitude, heading, speed, etc? The whole nine yards sit squarely on your shoulder for a minute or so, and the IP is busy as the proverbial cat trying to tune TACAN, VOR or advise departure control of the problem. Or if he doesn't follow this procedure and immediately attempts to "take over", the time factor becomes critical and he may not be capable of coping with the emergency in time to prevent an accident.

There is a solution to this problem—one that will satisfy all concerned and result in a much safer operation at the same time. Senior Officers, as a general rule, do not make the first takeoff unless you have personally participated in the mission planning to include filling out the Form 70, receiving the weather briefing from the weather officer and personally reviewing the NOTAMs. Further, if weather at T.O., and/or at destination is low, say 200 and ½, and you're not as proficient as you should or could be, let the IP do it. He and the rest of the crew—let alone the passengers—will be grateful, as certainly the IP is more current and proficient than you are. Also, it will certainly be to your advantage to conduct the walk-around inspection of the aircraft and check part two of the Form 781.

We realize that senior officers do not always have the time to participate in the complete flight planning process, but are otherwise well qualified to fly the bird. So—we offer this alternative. Let the aircraft commander make the first takeoff of the day, climb to altitude and level off. Then take over if you like, fly the route and make the landing. If you are proceeding beyond the first point of landing, you then make the second takeoff and let the aircraft commander make the second landing. In this way we all get our minimums and accomplish the mission one heck of a lot more safely. ★

Those pursuits which require the development of manual skills generally indicate a need for the development of good judgment—or else great skill without good judgment might result in trouble for the individual. This is particularly true in flying and is a factor that must be taken into account in any training program for the development of piloting skill.

What we have just said, and what is about to be presented, is not new. In fact, we assume that nearly all pilots who read this recognize the concept as something learned in a practical way in youth and documented in some textbook at a later day. What *is* new is the chart upon which we have plotted curves representing certain factors indigenous to the kind of training program described. The chart presents graphically an abstraction that, while known, is not always recognized nor acted upon—a desert-like area of the chart we call the *capability-judgment gap*.

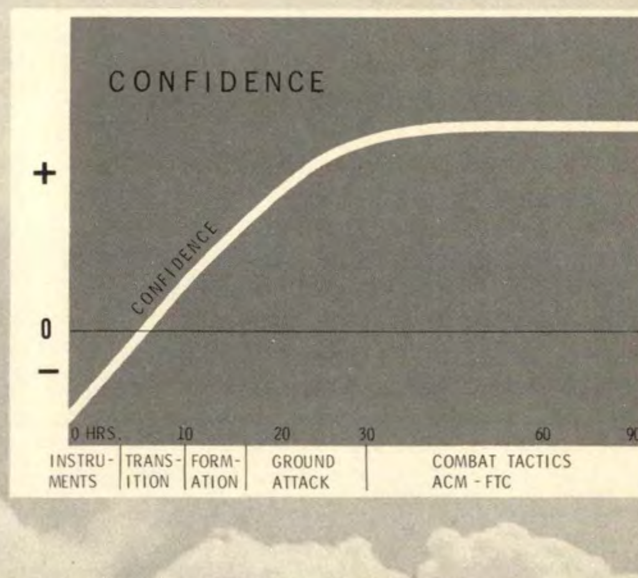
The chart came about as the result of a study of an F-105 Replacement Training Unit. The aim of the study was to identify all factors which have accident potential.

The method used was an analysis of the psychological and physiological stresses of the training program and student capability and limitations. Techniques

THE CAPABILITY-JUDGMENT GAP

Lt Col Victor J. Ferrari, Jr., USAF, MC
Directorate of Aerospace Safety

The graph at right depicts the buildup of student confidence throughout the training program. Student interviews indicate that they enter the F-105 program with a "healthy" apprehension as depicted by the portion of the curve below the base line. Confidence builds rapidly, with most students stating they "get ahead of the aircraft" by the second or third transition ride. Confidence continues to rise to the high confidence level of the typical fighter pilot. IP interviews verify this rise in confidence.



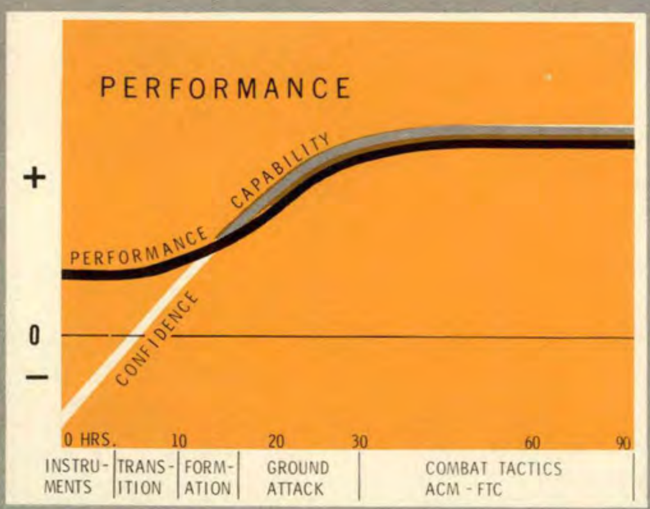
The capability

included interviews with students who had recently graduated from undergraduate pilot training (UPT), squadron commanders and IPs, medical evaluation of the training program (inflight and ground) and a review of accident experience. We should point out certain factors:

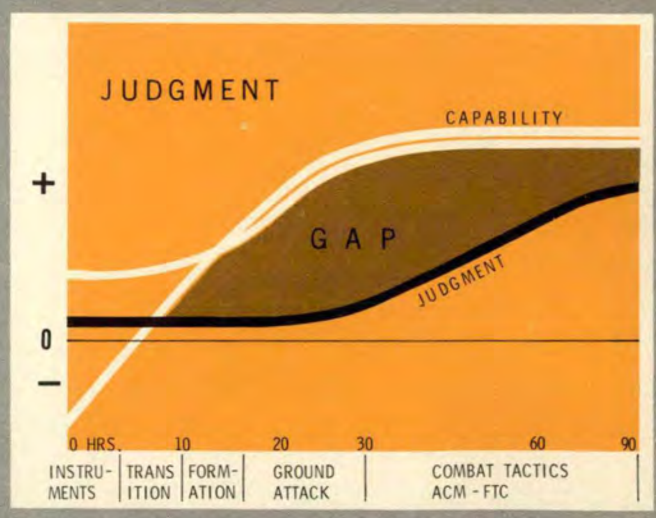
- The majority of students involved in accidents was evaluated as above average in the course.
- Some students were direct from undergraduate pilot training, while others were experienced pilots but new to tactical fighters (only one had any significant tactical fighter experience).
- The accident experience covered in this study was too limited to be applied with statistical significance to the concepts discussed here.
- The Capability-Judgment gap is validated by correlation of accident rates and age groups in general aviation and automobile accident experience.
- The curves on the charts represent judgment factors and are not intended to imply mathematical values or relationships. Their shapes are based on student and IP interviews, review of training folders, and general aviation and automobile accident experience. The curves should be expected to vary in shape and magnitude with specific training programs and personnel. However, the concepts are valid for any flight training program.

As the charts show, there exists a gap between a student's capability and his judgment development. This gap occurs early in a training program and would be predictably greater in the more aggressive student.

One thing we were especially interested in was the role competition plays in this type of training program. The UPT students who are assigned to F-105s are selected for their competitive background, and well so, for the tactical fighter mission demands an aggressive, competitive personality. Student and IP interviews, both formal and informal, reveal that this competition is not very apparent during



The black line depicts student stick and rudder performance. The student enters the program with moderate capability in this skill. Instructor pilots testify that this ability rapidly rises and closely parallels the confidence level. This is to be expected because confidence and performance reinforce each other. For the purpose of this discussion, we equate confidence and performance to capability.



This curve represents the development of judgment, or is comparable to the student's capability to correctly estimate the effect of all human and environmental factors on his "real life" capability. This starts to rise toward the middle of the ground attack phase, after he has had enough experience to convince himself he can and will make mistakes. As mentioned previously, this capability-judgment gap is validated by automobile and general aviation accident experience. This curve flattens out below the "capability" curve and may never merge with it.

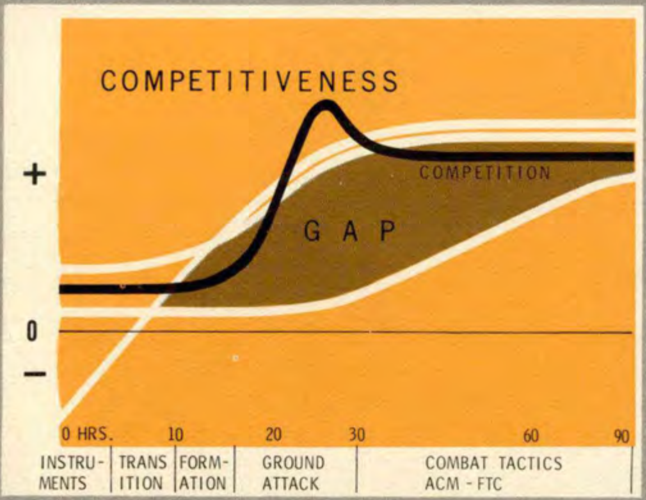
the orientation/transition phase of the program. However, as soon as the students "get their feet on the ground" it rises rapidly. Formation and ground attack naturally stimulate the competitive spirit of the students with a positive correlation with the students' aggressiveness.

Rarely does this competitive spirit result in an accident. More often it results in a "near miss," which only the student knows about and never talks about. This experience has great learning value because it produces "judgment." Note the time correlation of the two curves, with the judgment curve starting to rise just after this peak.

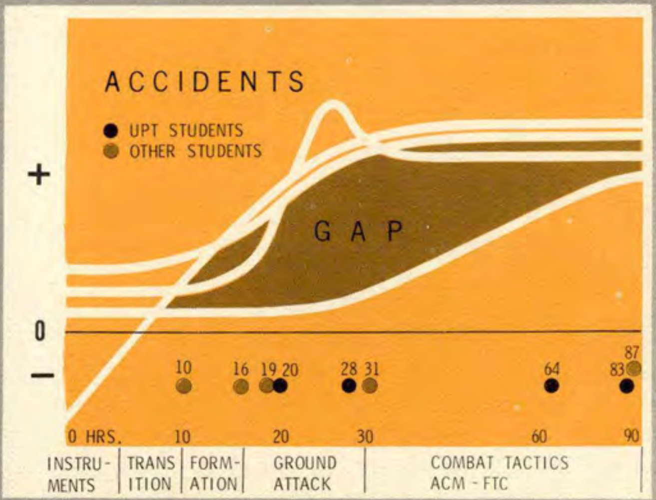
Even if an accident rarely results, the accident potential during this phase is great. It must be recognized and controlled in order to optimize the learning process without compromising safety!

So where does all this lead? It leads to the conclusion that the instructor pilot must fill the capability-judgment gap. This means that instructors must exercise mature judgment in their supervision of students. Inexperienced or immature instructors may misinterpret the observable self-confidence and performance of students as an indication of good judgment and, consequently, set up a potential accident. Therefore, instructor pilot upgrade programs must emphasize a sound student-IP relationship with special attention to the capability-judgment gap. Finally, supervisors must closely monitor inexperienced IPs in order to develop in them an awareness of the need for a close student-IP relationship and the vital role the IP plays in the development of student pilots.

While this article was based on a study of a pilot training situation, the principles discussed apply to many training situations. For example, supervisors of automotive and special vehicle driver training would do well to ponder the charts presented here, and then look at their instructor force to determine how well they are filling their students' capability-judgment gap. ★



The element of competition is shown here. The graph depicts the competition curve rising rapidly while the judgment curve is still flat. The peak of the curve suggests that this factor may exceed the "capability" curve. This becomes more likely when a very capable and aggressive student is matched with an inexperienced IP. Actually competition may exceed capability at several points in the program, for example, the air combat maneuvering phase.



On this chart are plotted nine accidents involving pilot factor. As previously mentioned, these accidents are too few to have statistical significance. Black dots represent students fresh from UPT; gray dots are experienced pilot students. The most significant thing about this chart is that two of the accidents involving recent UPT graduates and four of those involving experienced student pilots occurred between the 10th and 31st course hour—in the wide portion of the capability-judgment gap.

CHAIN OF EVENTS

Lt Col Robert H. Bonner, USAF, MC
Directorate of Aerospace Safety

Charlie X, a senior pilot, sat in his T-33A at Pfoggbound AFB waiting for his IFR clearance. The weather was cold, rainy, and foggy.

"Why in H——don't they come through with that clearance? I told Maggie I'd be home for supper. The whole center's probably on coffee break." Charlie was an angry man and reacted angrily to many minor frustrations.

"Boy, what a great TDY! Fine party, good booze, and $100 winner in that poker game . . . little headache though, stomach upset . . . glad I didn't eat breakfast, my coffee and cigarette didn't even taste good. Whew! I'm getting too old for these late night poker games. Ah, there's the clearance . . ."

Charlie X departed Pfoggbound AFB IFR at 0800 hours and was last heard from at 1015 hours trying to make a VOR instrument penetration and final approach at Snakes Naval Air Station.

The names and places are fictional; the situation actually happened.

Anyone who reads the above account can remember times when he has gotten angry or flown when hung over and tired and nothing happened.

So what's the problem?

The problem is this: Although any of the above factors (anger, fatigue, hangover, or inadequate diet) *singly* might not be an important factor in accident causation, they can cause performance degradation which may be critical in emergencies. When an emergency occurs we have to be as alert as possible. Fatigue, anger, hunger, and hangovers are certainly not conducive to alert, decisive thinking or actions and they have all been incriminated as primary or contributing causes of aircraft accidents. *Together* the above mentioned factors can create a chain of events that makes an aircraft accident inevitable!

How many times have we acted impulsively because of anger? Each of us can remember instances when we over-reacted because of temper. Can we really afford impulsive acts while flying?

We all know that alcohol is a depressant and that the hangover is the body's reaction to large amounts of alcohol which contains small amounts of metabolic poisons. Even alcohol itself is a metabolic poison in that it actively competes with the cells of the body for oxygen. The body reacts by generally slowing down. Unfortunately, the brain is the most susceptible to this slowing process. Can we afford this in a high performance aircraft?

All of us know that fatigue also slows us down. Discriminate tasks become difficult if not impossible. Repetitive tasks show rapid performance deterioration. Judgment can be impaired. We also should know that improper diet or lack of food can add to the effects of fatigue.

What hasn't been apparent to us is that all the above factors are additive! Each makes the other a little worse. It is this additive component that particularly makes the difference in one's ability to cope with an inflight emergency successfully.

When we are tired or hung over, we are more edgy than normal. We are more easily angered. If angered, our attention is usually focused on the cause of our anger, which can lead to preoccupation. This preoccupation can cause us to forget items which may be life saving in an emergency situation. For example, consider the frustrations of poor communications with a GCA controller. Add to this the fatigue resulting from inadequate sleep with the anger generated by a late start and lousy weather. It would be very easy not to hear the GCA controller give a direction or altitude change or to so intently listen for transmission that airspeed and altitude gages are forgotten. In fact, this has actually happened and resulted in a major aircraft accident.

Next time you are TDY, remember Charlie X. Get a good night's sleep, eat a good breakfast, arrive back home safely, and avoid becoming a statistic. ★

the I.P.I.S. approach

By the USAF Instrument Pilot Instructor School, (ATC)) Randolph AFB, Texas

STANDARD INSTRUMENT DEPARTURES

The minimum climb rates published on Standard Instrument Departures (SIDs) have been a major contribution to flying safety. However, the protection provided by the minimum climb rates is occasionally misunderstood.

SID areas are divided into two segments: The initial climb segment and the maneuvering segment.

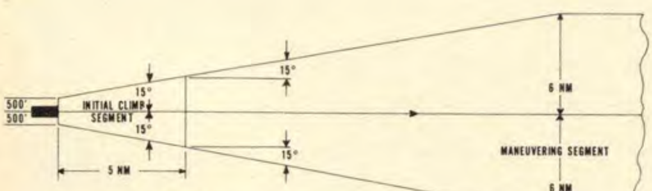
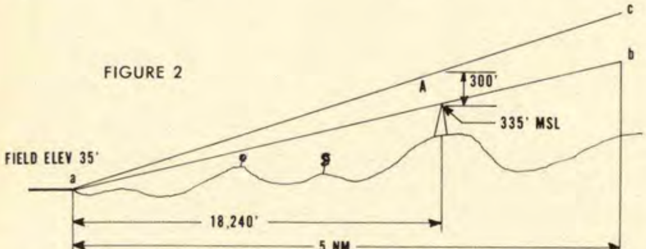


FIGURE 1

In the initial climb segment, a minimum climb rate will provide 100 feet obstruction clearance for each nautical mile a controlling obstruction is located from the end of the runway. (For example, a controlling obstruction located three miles from the end of the runway requires 300 feet obstruction clearance.) At least 500 feet obstruction clearance will be provided throughout the maneuvering segment and normal en-route clearance from then on.

A minimum climb rate is based on the height of a controlling (highest) obstruction and its location. Line a-c, Figure 2, depicts an example minimum climb rate. The minimum climb rate line is started at the departure end of the runway. Any altitude gained before the departure end of the runway is in the pilot's favor.

FIGURE 2



The preceding information is of a simplified and general nature. Our primary interest, as pilots, is the operational use of a SID. However, a better understanding of the obstruction clearance criteria may make the following questions and answers clearer.

Q Why do some SIDs still not list minimum climb rates?

A When a minimum climb rate is not published, the climb requirement is less than 150 feet per mile. A pilot should still climb at least 150 feet per mile to clear possible obstructions.

Q Are all obstructions depicted on a SID?

A Not necessarily. The controlling obstruction will always be depicted; however, to prevent clutter smaller obstructions may not be shown. For this reason, pilots must understand that required climb rates are not averages *but minimums throughout the climb to a specific altitude*. In other words, it may not be acceptable to takeoff, level off (to accelerate or retract flaps), and then climb rapidly to make up for the level-off. Also, minimum climb rates are frequently required beyond the controlling obstruction.

Q If an aircraft is not capable of meeting a required climb rate, what alternatives does the pilot have?

A The pilot can select another SID with an acceptable gradient. He can reduce aircraft weight or request a VFR climb if possible. Requesting a radar vector in lieu of a SID is not recommended for solving climb gradient problems. Obstruction clearance criteria has not been established for radar departures, as controllers do not know each individual aircraft's climb capability.

SID minimum climb rates have proved adequate for the majority of pilots. Usually a pilot, through aircraft familiarity alone, knows if he can maintain a required climb rate. However, aircraft load and performance capabilities vary. When the performance is marginal and the pilot is attempting to ascertain the maximum load he can carry, an appreciable computation problem exists. The same problem exists on any departure (SID, VFR climb, radar vectors). Significantly, only a

SID provides the minimum rate of climb needed. Accordingly, SIDs are still the safest means of departure in weather conditions. This statement is particularly true when departing over adverse terrain in marginal performance aircraft. IPIS has recommended the pertinent climb reference point (altitude and distance) be published on every SID to simplify computations.

Q In event of approach lighting component failure, are USAF pilots required to compute new approach minimums in accordance with FAR 91?

A FAR 91, par 91.117, and the approach lighting table do not apply to USAF pilots. Minimums for any approach are as published unless raised by NOTAM. Military base operations have the responsibility for revision, if necessary, of approach minimums with lighting component failures. However, pilots, when informed of approach lighting failure, should carefully consider the effects of the failure prior to commencing the approach. ★

WHY did common sense and good judgment desert this pilot at such a crucial time?

Maj Larry T. Cooper, Directorate of Aerospace Safety

The circumstances surrounding a recent fatal Voodoo accident are almost unbelievable. Apparently nothing, short of a double engine flameout, could have prevented this pilot from taking off regardless of the condition of the airplane. His desire to press on obscured all other considerations, including common sense and safety.

The trouble started when the aircraft landed at a transient base with all sorts of electrical problems including boost pump failure, generator failure, and popping circuit breakers. Transient maintenance was unable to fix the bird, and the home base was unable to provide immediate assistance, due to the distance involved.

Since the pilot was anxious to continue the mission, he played it real cool and didn't write up the aircraft, nor did transient alert ever look at the AFTO 781. Therefore, the aircraft was never grounded. All the maintenance trouble shooting and attempts to repair the aircraft were conducted on a verbal basis. Home base supervisory personnel were not made aware of the pilot's impending decision to fly the airplane in its present condition.

After determining that the trouble could not be corrected, the pilot told transient maintenance to button up the airplane and that he was going to depart. He taxied past the last chance inspectors, refusing this service, and proceeded directly to the runway. Witnesses noticed fluid running out of the bottom of the aircraft but did not advise anyone.

On takeoff, the left AB failed to light, and a fire started in the left engine area just prior to or after brake release. The tower and RSU both advised the pilot that he was on fire. He acknowledged the calls, shut down the left engine, and asked for a vector to a clear area for bailout. Ground observers then advised the pilot that the fire appeared to be out. He replied that his instruments indicated no further evidence of fire and that he would land the aircraft from a straight-in approach lowering the gear on short final.

After the F-101 had turned final, an airborne helicopter advised the pilot that the aircraft was indeed still burning in the left wing root and wheel well area. On final approach, the RSU advised that the left main gear was not down. This was due to the fire burning through the hydraulic lines and preventing left main gear extension. The pilot then attempted to go around; however, by this time the fire had probably burned through other hydraulic lines causing total hydraulic failure. The aircraft went out of control, rolled left, and crashed inverted, killing the pilot. Another statistic was added to the long list.

The events leading up to this completely avoidable accident are so replete with human error, human omission, neglect, complacency, and overconfidence that it staggers the imagination.

The moral of this story is the same old rule we have heard over and over. When the bird is not functioning properly, write it up and get it fixed. If the desire to press on is tempered with sound judgment and common sense, we can live with the decisions that follow and not die because of them. ★

RUNWAY GROOVING

Maj David L. Elliott,
Directorate of Aerospace Safety

Mr Walter Horne and Mr Thomas Yager, of the NASA Langley Test Facility, study the touchdown point of Convair 990 in recently completed test on grooved runway at Wallops Island.

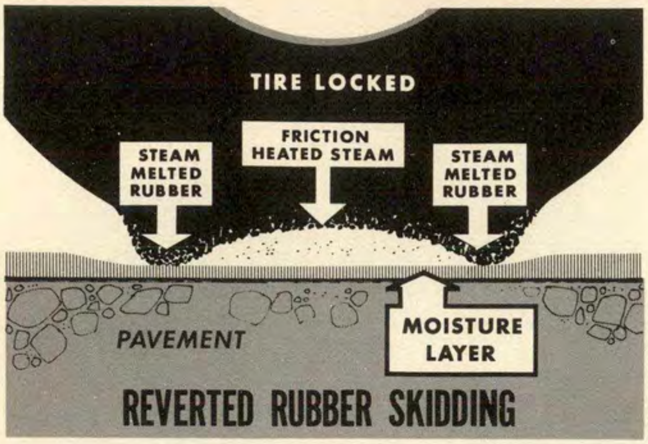
Volumes of test data being analyzed by NASA may prove that grooving runways is the one attainable solution to the problem of loss of aircraft tire traction on wet runway surfaces.

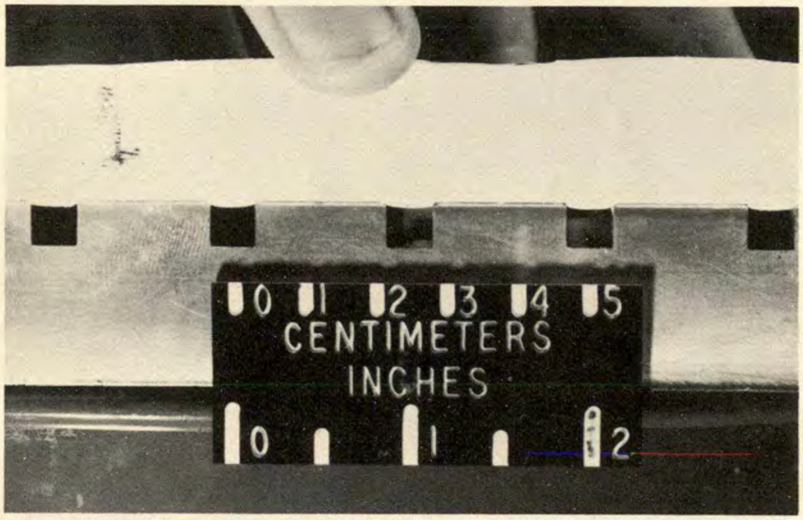
Major Nelson Allen, in the June 1968 issue of *Aerospace Safety*, discussed the causes of hydroplaning and what it can do to a computed landing roll. Major Allen's article was addressed to *dynamic hydroplaning* which applies to the most horrendous type of loss of tire traction. Mr. Walter B. Horne, Assistant Chief of the Landing and Impact Branch of NASA Langley Research Center, states that in some cases the coefficient of friction in a dynamic hydroplaning situation is less than the free rolling friction of an unbraked wheel. That equals a stopping distance of about infinity.

Two other general categories of traction loss that are not so "dynamic" are *viscous skidding* (sometimes referred to as viscous hydroplaning) and *reverted rubber*. Viscous skidding is simply a result of lubricating the runway surface with a little water. It makes the runway slick, and will result in skidding when braking exceeds the friction value of the lubricated runway surface. Rubber reversion can develop from this skid.

Reverted rubber skidding is the most insidious form of hydroplaning since it may continue until the airplane almost stops. Due to friction, the surface moisture underneath the skidding tire turns to steam which in turn melts the rubber surrounding the footprint. This molten rubber traps the steam under the tire. The trapped steam builds up pressure and effectively keeps the tire separated from the runway.

Major John Lowery, Hq, Tactical Air Command, in his October article in *Aerospace Safety*, "Slippery Runways and Crosswinds," points out that the combined effects of crosswinds and slippery runway can result in shorter stopping distances—alas, not oriented with runway headings.





The plaster applied to the set of test grooves represents the amount of penetration of an F-4 tire on a grooved runway. This penetration results in a mechanical interlock between the tire and the runway.

Grooved pavement on California freeway. Grooves run parallel to roadway, whereas runway grooves are transverse for best effect.

Both of the above authors made statements about grooved runways but they did not elaborate. It seems as though anything this simple which purports to be this good, is either a myth or should have been discovered years ago. Test data indicate that it's no myth; in fact, it seems to be in accord with the laws of physics and interestingly enough, the grooved runway has been very effective in decreasing wet runway skidding problems for the RAF since 1956.

Mr. R. F. A. Judge, of the Ministry of Public Works and Building, was instrumental in having several runways grooved for the RAF. The first runway was grooved 12 years ago. It was an asphalt runway and the grooves were cut transversely (across the runway) ⅛-inch deep by ⅛-inch wide and spaced one inch apart. After 12 years, this runway is still in operation.

Research began in 1962 by NASA and the State of California on highway pavement grooves. Starting in 1965, the California highway department placed grooves longitudinally on several road curves which had a history of skidding accidents when wet. Data indicate that this technique has been most effective in reducing skidding accidents. For instance, on one stretch of highway, there were 52 accidents in the year preceding the grooving. The year following, only eight accidents occurred.

As was indicated by Major Allen's article, longitudinal grooves had a detrimental effect on runways, especially when associated with standing water; however, the longitudinal grooves on highway sections having sharp turns have had the effect of guiding the automobile tires around the turn.

The transverse grooves determined as best for runways improve tire-ground traction in several ways:

First, the pavement groove offers a low pressure escape channel for fluid or water trapped under the tire. The water is guided approximately 90 degrees to the direction of tire movement. This acts against dynamic hydroplaning. Second, the sharp edges of the grooves tend to break up the viscous film that creates viscous hydroplaning. Third, if skidding should occur and it were possible to build up enough steam, which is remote because there is also an escape channel for the steam, the sharp edges of the grooves would skim the reverted rubber from the tire footprint and restore normal tire traction.

Probably most important for all types of slick pavement, the weight of the airplane on the tire forces the rubber to penetrate pavement grooves 1/64 to 1/32-inches. This causes a mechanical interlock of rubber and groove and increases tire traction force under conditions conducive to sliding.

NASA, FAA, USAF and some foreign governments are participating in separate and joint runway grooving experiments aimed at finding both good and bad effects of runway grooving on aircraft, aircraft tires and runways. Preliminary data indicate that the advantages outweigh the disadvantages. Some of the findings to date include the following:

Some 18 different groove patterns were tested by NASA at the Langley Test Facility under damp and flooded conditions over a speed range up to 100 knots. Several different size tires were tested on these groove patterns. These tires were tested in both yawed rolling and braking runs. The greatest traction resulted using grooves ¼-inch wide by ¼-inch deep on a one-inch pitch, i.e., centers of the grooves, one inch apart. Any significant deviation from this pattern results in a decrease in the coefficient of friction.

The grooves on concrete runways to date have not caused any runway damage. However, test grooves on some asphalt taxiways where ambient air temperatures are in excess of 90°F have resulted in deterioration due to plastic flow of the asphalt. This does not mean that asphalt runways cannot be grooved; in fact, the first runway grooved in England in 1956 was asphalt and is still in operation.

There was concern for possible damage to runway structure as a result of water freezing in the grooves. NASA investigated this by running 22 freeze-thaw cycles on the optimum groove pattern (¼ x ¼″ on 1″ pitch) and making braking tests on the frozen section. After the test was completed there was no decrease in friction from the original values nor was there any deterioration in the grooved runway.

It was determined that certain grooving procedures had to be followed to prevent damage to the concrete runways. For instance, if the groove was placed too close to an expansion joint, the concrete could break off. Therefore, grooves should not be cut within a certain distance to expansion joints (approximately two inches).

Tests indicated that stopping completely and turning tightly on asphalt runways can result in damaging the grooves especially in warmer weather; however, you who have asphalt runways realize your runway can be damaged by that, even if you don't have grooves.

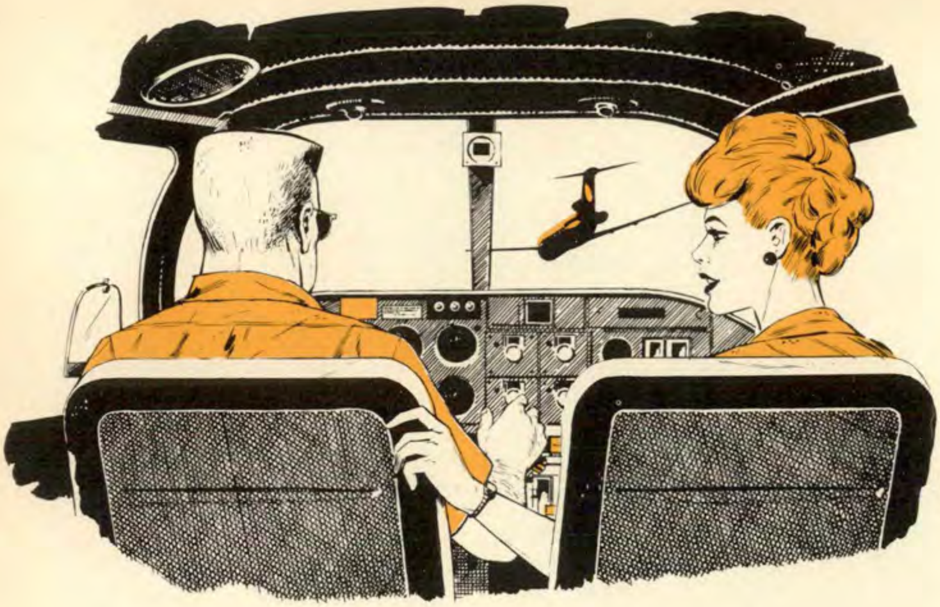
One detail that has not been completely worked out is keeping the runway clean. In areas where rocks are prevalent they can wedge between the grooves and become a cleaning problem. This has been reported at bases where the larger grooves are used (¼″ to ⅜″). However, this has not proved to be a monumental headache and will probably not be too difficult to rectify.

Another voiced concern was rubber buildup on grooved runways. In the past, large amounts of rubber buildup have resulted in very slick touchdown areas and have consistently required attention. On the grooved runway rubber buildup still occurs, but only on the lands. At Kennedy Airport after a year of operation, the grooves are clear of rubber; however, the lands between the grooves are coated with rubber deposits from dry touchdowns.

In these times of austere thinking the cost of grooving a runway is of prime consideration. The cost of grooving varies from eight cents a square foot for the asphalt runway at Washington National Airport to as high as 16 cents a square foot for concrete runways. The most recent cost figure is for Chicago's Midway Airport where two 6000-foot concrete runways have been contracted for 14 cents per square foot. Using this figure, it would cost $210,000 to groove a 10,000-foot by 150-foot-wide concrete runway. That's a little bit less than the average cost of purchasing and installing a set of U.S. Standard A approach lights.

Most important of all, grooved runways work. According to Mr. Horne, with the optimum size groove, the coefficient of friction of a flooded grooved runway is equal to that of a dry nongrooved runway. This simply says that properly grooved runways will prevent all forms of hydroplaning.

There's more to be done though. There's enough data now to warrant grooving certain runways in certain areas. More data is coming in every day, more tests will be conducted, and undoubtedly more information will become available. When all the figures are in, it appears logical that quite a few runways are gonna be . . . like groovy, man! ★



REX RILEY'S CROSS COUNTRY NOTES

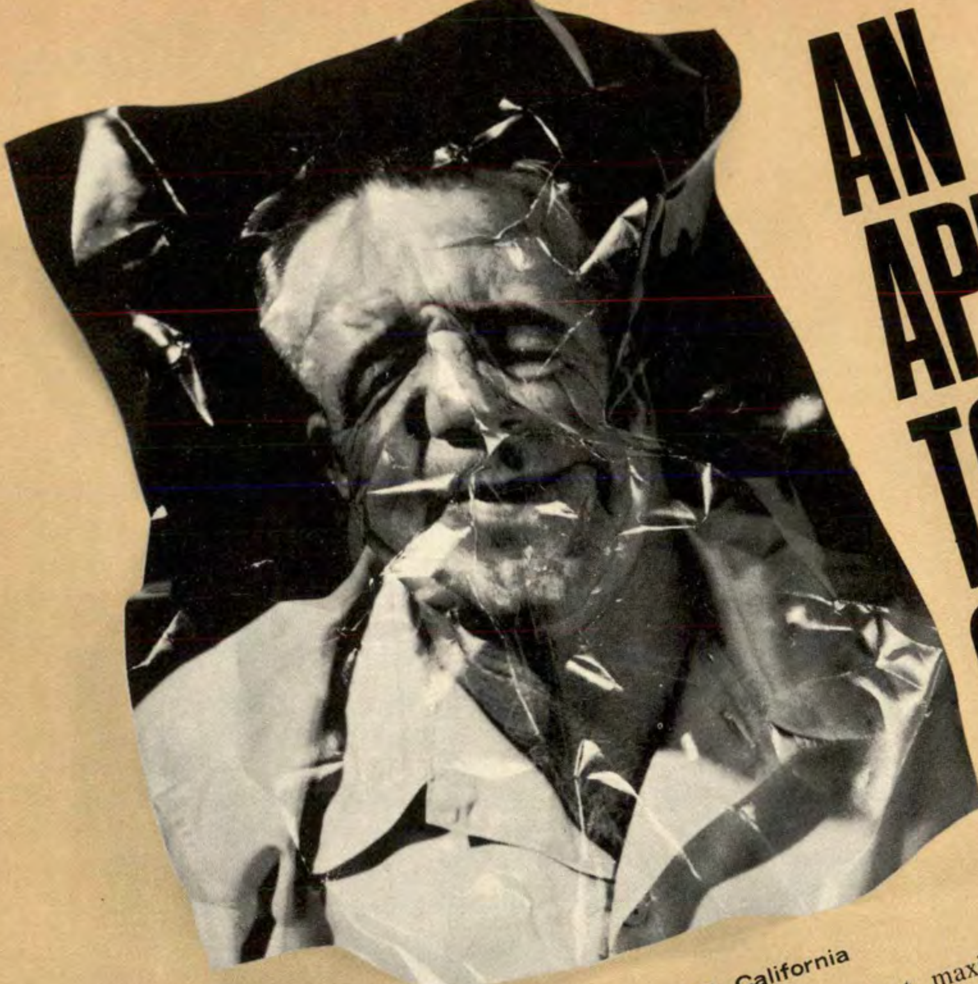
WHAT YOU DON'T SEE won't bother you! A couple of recent experiences have caused me to refute this already dubious statement. And it isn't just the little guys who have to look out for the big ones; the reverse is also vital to crew and passenger longevity. I was on leave flying a Piper 180 recently, on the correct altitude, odd + 500, between Philadelphia and New York City when to my right I noticed a big civilian jet transport going like a striped bottomed ape on a course parallel to mine. He was descending and after he was some distance beyond me, he corrected left to the airway centerline directly in front of my aircraft and was very soon out of sight. I was at 5500 feet, and he leveled at what looked like 5000 feet. I thought to myself, Holy Smoke, I'm glad he was looking out of his windshield 'cause I'd sure hate to be plowed under by that big dude. I wondered if he was 500 feet off altitude and had merely pulled out to the right to pass. Then I reckoned that he was making an authorized descent.

Even though he was on an IFR clearance he pulled out to his right to go around me because he was in VFR conditions and was keeping himself cleared. How many military, and civilians too for that matter, aren't looking for other aircraft at all times under visual meteorological conditions (VMC)? Almost any type of jet, and many recips, cruise much faster than the average light plane. My rented 180 was a cut above the average at 145 mph and that airliner went by me like I was going downhill backwards. Suppose he had been descending on centerline in the opposite direction. Maybe one or both of us would have seen the other; or maybe we both would have been tuning radios, looking at a chart or looking in the wrong direction.

This experience has caused me to be infinitely more conscious of the other birds flying and maneuvering on airways, particularly those much slower and much faster than the one I usually fly for Uncle Sam.

An Operational Hazard Report came in the other day which was another log on the signal fire warning all pilots of the importance of defensive flying. A C-133 was being vectored to an ILS final approach. A small civilian aircraft was passing from right to left on a collision course with the big bird. The C-133 pilot took immediate evasive action and averted a disaster by a mere 200 feet. The light plane took no evasive action so we must assume that he was never aware of his precarious position. None of the ground agencies in the area were painting the little bird. This is true of a significant number of light aircraft because they are difficult if not impossible to skin paint. The transport pilot was keeping himself clear, even though he was looking directly into the sun. At the time he noted the conflicting traffic his copilot was busy changing radio frequencies.

If we don't have someone in each aircraft visually clearing the flight path ahead when we are in VFR conditions, our necks are out a mile because the airways are often full of planes. It is also a documented fact that a large percentage of the time flown on airways is flown when meteorological conditions are such that flight under VFR conditions is possible. ★



AN APPROACH TO STRESS

Maj Joseph A. Lyons
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Military aircraft design is primarily aimed at maximum performance and mission accomplishment. The designer presupposes an aircrew capable of operating at high performance levels for extended periods of time. It is realized, however, that these men undergo both physiological and psychological stresses that are inherent in both the basic operation of the aircraft and in the accomplishment of the mission. It is always assumed that the flyer is an exceedingly healthy individual capable of tolerating these stresses. Studies of aircraft accidents indicate that this is not always the case. There are times when a flyer may impose additional stresses upon himself and thereby create a situation in which the demands put upon him exceed his capabilities.

What is stress? The term is so all-encompassing that it defies a singular definition. Stress can be anything and everything which places a strain on a man's ability to perform at his best. There are many varieties of stress. Psychological stresses take their toll by confusing the mind with anxiety and worry to the extent of sometimes making it almost impossible to concentrate. The aircrew member who can never *count* on having a day off to tend to his family often experiences psychological stress. A physiological stress is a factor which detracts from your ability to do your best at a given task. It could, for instance, be caused by such external factors as poor weather or a malfunctioning aircraft when the task involved happens to be an approach and landing.

All of us are aware of the stresses which are inherent and unavoidable in the aircrew member's job. We likewise know that

it takes a highly efficient individual to fly high performance aircraft within the acceptable parameters of safety. What is often overlooked, however, is that it takes an equally efficient individual to fly "low" performance aircraft *with the same degree of safety*. Regardless of the category of the aircraft, a crewmember must keep fit if he is to consistently fly long hours through all sorts of weather and while operating in all kinds of climatic conditions. Since his job calls for a continuing high degree of mental awareness and physical effort, it follows that he should understand as thoroughly as possible the circumstances and occasions of stress.

FATIGUE

Fatigue is so intimately connected with stress that one finds them inseparable in scientific studies. The subjective descriptions of fatigue include tiredness, weariness, weakness, loss of coordination and attention to details, inability to sustain interest, degradation of accuracy, a lack of enthusiasm, motivation, zest, etc. Part of this fatigue may be exhibited by tired muscles. An even greater part may be psychological.

Acute skill fatigue results in a loss of strength, coordination, and attention to detail. It is both psychological and physical. Most crewmembers have had more than one personal experience with fatigue, for a flyer's job seems to provide all of the necessary factors leading to it. These factors include monotony, repetition, and a sustained requirement for attention and responsibility. We often associate flying fatigue with combat situations, frequently forgetting that prolonged and repetitive flights such as training missions are also conducive to many types of fatigue. When the same people fly the same kind of missions over a long period, a chronic situation resulting in sloppy performance and a loss of interest can develop. A good example of this is when a crew takes unnecessary risks, such as overlooking maintenance discrepancies or disregarding marginal weather, in order to make an on-time takeoff or to get back to a home base. Chronic skill fatigue will occur when the crewmember does not have enough of a "break" between missions. This type of fatigue can often be observed when an outfit flies the same mission day after day with the same demands being made on crew performance.

While good leadership, a high esprit de corps, and professionalism can help prevent some of the problems arising from fatigue, the most effective countering is provided by the flyer himself: eating proper meals (the best available diet); and getting sufficient crew rest before a mission.

SMOKING

Cigarette smoking possibly affects flyers more than it does any other group. This is to be expected, for aircrew members are constantly exposed to higher working altitudes (even in pressurized cabins) than are other people.

For a flyer, the effects of the carbon monoxide and nicotine that are present in cigarette smoke constitute a real danger. The blood's hemoglobin combines with carbon monoxide more than 200 times faster than it does with oxygen. Some scientific studies indicate that the flyer who is a heavy smoker will normally have between five and 10 per cent of his hemoglobin bound up uselessly with carbon monoxide. This could, in effect, raise *his* physiological altitude another 5000 feet above that of the cabin.

Some of the effects of nicotine on the human body include muscular weakness, abdominal cramping, and muscular twitching. There is strong evidence that nicotine also affects the coronary arteries, cutting down on the flow of blood to the heart muscle.

Over 30 studies in eight different countries imply a connection between smoking and lung impairment. In recent years, the number of deaths from emphysema has increased approximately 500 per cent, the chief cause being attributed to heavy smoking. Social Security records indicate that emphysema is the second greatest cause of disablement among men over forty. Further, of the 52,000 lung cancer deaths estimated for 1968, over 80 per cent will be directly attributable to heavy smoking. Because of statistics such as these, many of the airlines have successfully initiated programs among their pilots aimed at cutting down on excessive smoking.

ALCOHOL

Although FAA studies reveal that some civilian private pilots mix booze and flying, it is extremely unlikely that you will ever see a military pilot who will attempt to fly while intoxicated. The professional flyer's problems in this area are usually related to the effects of the well known hangover. An alcoholic beverage or two may help you to relax. Three to six drinks can give you a 0.15 blood alcohol level (legal intoxication). Your whole body absorbs the alcohol, but it is the liver that must slowly process 90 per cent of it. It takes the liver about an hour to "metabolize" two thirds of an ounce of 100 proof liquor or six ounces of average beer. The effects on the brain usually follow a pattern. Alertness and judgment are the first functions affected. Next are the areas controlling muscular coordination. Depending on how much a flyer consumes the "night before" (with slight individual differences), these areas of the brain may remain affected for from 18 to 24 hours.

One of the most dangerous aspects of a hangover is dehydration. The body, having already lost a great deal of fluid, is now exposed to further dehydration from the dry air at altitude and any perspiration on the part of the flyer. Under these conditions, manifestations of poor judgment, lack of mental awareness, and abnormal emotional behavior are common. Let's face it, a cockpit is no place for a guy who feels emotionally depressed and/or has his "head up and locked."

PHYSICAL CONDITION

Recent studies have reinforced the fact that a flyer needs a good program of physical activities. Indications are that the many hours spent *sitting* in an aircraft may be a contributing cause to premature heart ailments, and more flyers are medically grounded for cardiovascular disease than for any other cause.

A program of aerobic exercises such as swimming, rowing, running, and bicycling can raise the body's tolerance to stress and is probably one of the best insurances against coronary disease, for the man who participates in these exercises almost doubles the efficiency of both his heart and lungs. Even more significant is the fact that a flyer whose physical stamina is above average can better sustain prolonged periods of mental alertness than he could if he were in a run-down condition. To put it another way, an individual who is in good shape can tolerate all types of stress much better than one who is not.

HYPOGLYCEMIA

Mental awareness, the ability to know exactly what is "going on" around you as rapidly and as continuously as is possible is a *must* for the flyer. The central control for this awareness is the brain, the proper function of which is dependent on a constant supply of blood sugar (glucose) and oxygen. A low blood sugar level can produce symptoms very similar to hypoxia. Anxiety, disorientation, amnesia, light headedness, and even unconsciousness and convulsions can result. It follows that a flyer should not attempt a mission without eating. Flight lunches of easily digestible foods should be taken on any mission in excess of four hours. Give yourself the benefit of the doubt and eat properly!

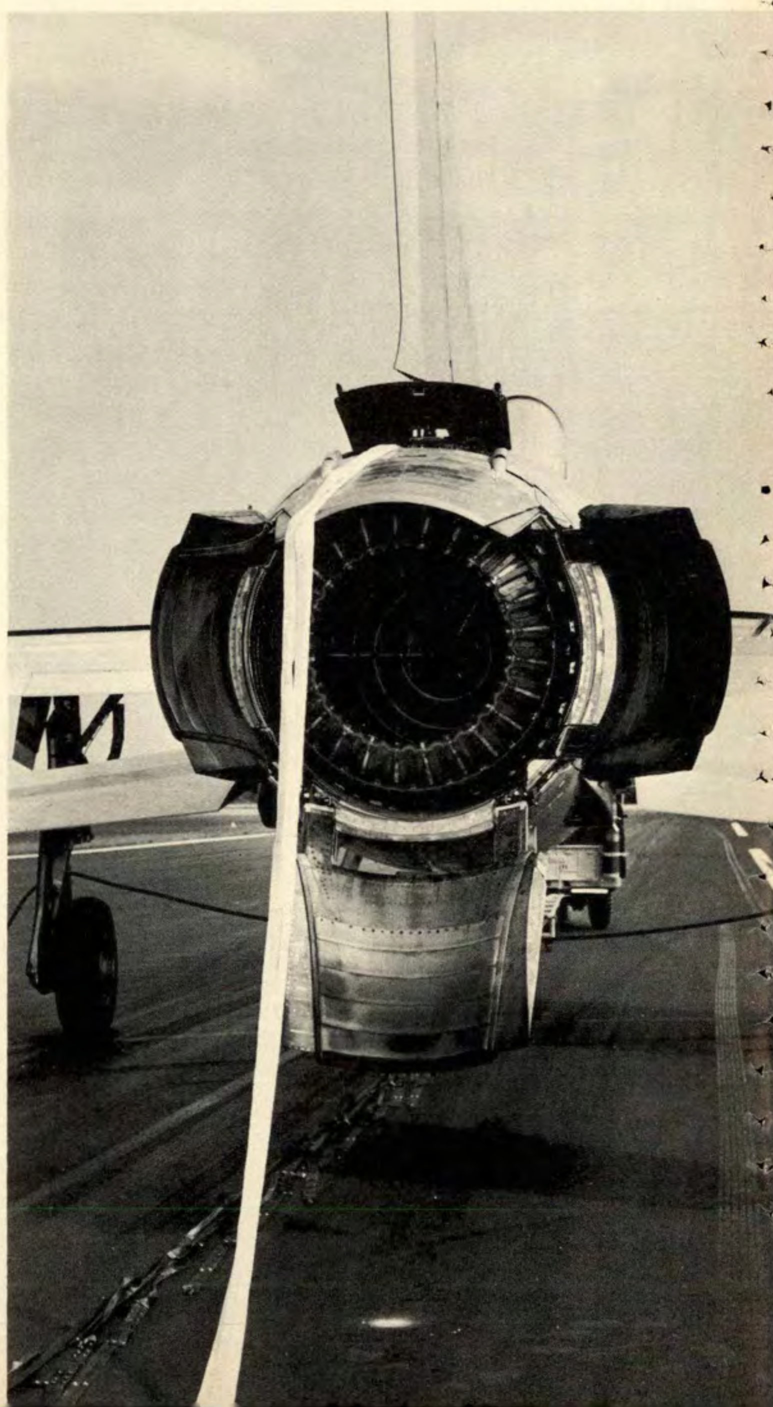
CIRCADIAN RHYTHM

Whether it be referred to as a built in "physiological clock" or a "day/night metabolic cycle," it is well established that each individual has a personal peak performance period. During the 24 hour day, he goes through a work/rest cycle in which very definite changes take place in his bodily activity. Body temperature, blood pressure, respiration, and oxygen consumption subside during the "nighttime" part of the cycle. While the sympathetic nervous system (the system that "turns you on") prevails during the "daytime" for liberation of more energy, the parasympathetic dominates the "night time" hours by slowing you down. There is a cycle of alertness and awareness in the "daytime," and a "nighttime" cycle of restfulness wherein the muscles relax and many of the reflexes temporarily become dormant. The overall pattern (called circadian rhythm), is also manifested by changes in the endocrine activity and blood constituents. Although it is a deeply rooted phenomenon, we do not as yet know the full scope of its effects, particularly with regard to those flyers who go from one side of the world to the other in a matter of hours, or whose flying frequently alternates between daytime and nighttime missions.

As an occupational group, professional flyers are a healthy lot. In the performance of their duties, however, they must adjust to a number of unusual conditions: extremes of temperature, switching rest cycles, many hours of immobility in the cockpit, constant responsibility, numerous tests and check rides, and marginal weather. To stay on top of such a job requires constant effort. The manner in which a man reacts to the stresses imposed on him depends upon his ability, motivation, and mental and physical fitness. In order to avoid "getting behind the power curve" the flyer needs sufficient rest, a proper diet, adequate exercise, and an avoidance of unnecessary self-imposed stresses. ★

THE HOOK AND THE BAKS

The December 1966 *Aerospace Safety* featured an article titled "The Hook vs. the Barrier" by Lt Col Richard R. DeLong. That article got a lot of mileage and recently we've had requests for a reprint, updating the BAK 9 and BAK 12 charts that showed maximum barrier engagement ground speed for most of our hook equipped aircraft. The charts are reprinted here. Chart B, Figure 4, BAK-12 speeds have been recalculated and are not those that appeared in the original article. We are not reprint-



ing the entire original article, but here are some excerpts that seem pertinent.

Note that the engagement speed charts give speeds for two hook strengths, design and yield. To a pilot this means one thing: If you engage on the design strength chart (Chart A), aircraft inspection in accordance with appropriate T.O.s is all that is necessary. However, if you exceed the design hook strength, make sure the hook is replaced! At home base you shouldn't have to worry about this, but on a trip this knowledge will be helpful. In any case, if you exceed design hook strength, include this fact in your Form 781 write-up.

Taking the barrier at yield hook strength limits (Chart B) is acceptable and, all things considered, is safe. By "safe" we mean: The hook won't break and the barrier won't break. By "All things considered" we mean: Provided the barrier is properly maintained (including adjustments) and the aircraft hook has not been previously damaged.

A barrier engagement is an emergency procedure. If for some reason you find yourself in the position of engaging the barrier in excess of the Chart B limits for your aircraft, we suggest you do it! It sure beats ejecting on the runway, if that's the only alternative.

Speeds are based on extrapolated test data. Loads are given to the closest .05G. If and when you have to use this information, remember what has been said about aircraft hook integrity *and* barrier maintenance. Without these—no guarantees and no refunds.

Know your aircraft and barrier limitations, prepare for engagement (time permitting) and hit it squarely, preferably in the center, brakes off.

Test data for the BAK-13 system have not been completely reduced and analyzed. Performance charts will be prepared and published when the data reduction work is completed. ★

FIG. 1

	BAK-9	BAK-12
Installation	Fixed	Optional (Normally Portable)
Energy Absorption Capability	55 Million foot-pounds	65 Million foot-pounds
Nominal Runout	950'	950'
Tape Strength (Ultimate)	70,000 pounds	105,000 pounds
Cable Strength (Ultimate)	84,000 pounds	84,000 pounds
Max. Engagement Speed (Barrier Dynamic Limit)	190K	190K
Max. Allowable engagement weight at 190K	28,000 pounds	43,000 pounds

FIG. 2
F/RF-4 MAXIMUM BARRIER ENGAGEMENT GROUND SPEEDS
CHART A*
DESIGN HOOK STRENGTH 165,000 LBS.

Acft Weight	BAK-9	Acft G Load	Standard BAK-12 1" Pendant	Acft G Load	Modified BAK-12 1 1/8" Pendant	Acft G Load
30,000	188K	2.55	190K	2.8	190K	2.8
32,000	186K	2.35	190K	2.7	190K	2.7
34,000	184K	2.35	190K	2.6	190K	2.6
36,000	182K	2.1	190K	2.45	190K	2.45
38,000	180K	2.0	190K	2.35	190K	2.35
40,000	177K	1.9	190K	2.3	190K	2.3
42,000	173K	1.8	190K	2.3	190K	2.3
44,000	169K	1.7	188K	2.25	190K	2.35
46,000	165K	1.65	184K	2.15	190K	2.5
48,000	161K	1.55	180K	2.1	187K	2.6
50,000	158K	1.5	176K	2.0	185K	2.5
52,000	155K	1.45	172K	1.9	181K	2.4
54,000	151K	1.4	169K	1.85	178K	2.35
56,000	147K	1.35	165K	1.8	175K	2.25
58,000	143K	1.3	162K	1.7	172K	2.15

*NOTE: The F-4 is the only acft in USAF with a tailhook strong enough to accept the capabilities of all barrier systems. No Chart B is required as engagement speeds are the same as Chart A for all systems. All speeds barrier limited.

FIG. 3
F-100 MAXIMUM BARRIER ENGAGEMENT GROUND SPEEDS

CHART A
DESIGN HOOK STRENGTH, 84,000 LBS.

Acft Weight	BAK-9	Acft G Load	BAK-12	Acft G Load
24,000	190K	3.0	190K	3.1
26,000	190K	2.85	190K	3.0
28,000	189K	2.7	190K	2.9
30,000	187K	2.55	190K	2.8
32,000	185K	2.35	188K	2.6
34,000	183K	2.25	187K	2.45
36,000	181K	2.1	186K	2.35
38,000	179K	2.0	185K	2.2
40,000	177K	1.9	183K	2.1
42,000	173K	1.8	179K	2.0

LIMITING FACTOR: Barrier, Both Charts.

CHART B
YIELD HOOK STRENGTH, 96,500 LBS.

BAK-9	Acft G Load	BAK-12	Acft G Load
190K	3.0	190K	3.1
190K	2.85	190K	3.0
189K	2.7	190K	2.9
187K	2.55	190K	2.8
185K	2.35	190K	2.65
183K	2.25	190K	2.55
181K	2.1	190K	2.45
179K	2.0	190K	2.35
177K	1.9	190K	2.3
173K	1.8	190K	2.25

FIG. 4
F/RF-101 MAXIMUM BARRIER ENGAGEMENT GROUND SPEEDS

CHART A
DESIGN HOOK STRENGTH 67,000 LBS.

Acft Weight	BAK-9	Acft G Load	BAK-12	Acft G Load
30,000	181K	2.25	173K	2.25
32,000	179K	2.1	171K	2.1
34,000	177K	1.95	170K	1.95
36,000	175K	1.85	168K	1.85
38,000	173K	1.75	166K	1.75
40,000	171K	1.65	165K	1.65
42,000	167K	1.6	161K	1.6
44,000	163K	1.5	157K	1.5
46,000	159K	1.45	153K	1.45
48,000	155K	1.4	149K	1.4
50,000	151K	1.35	145K	1.35
52,000	148K	1.3	141K	1.3

LIMITING FACTOR: Tailhook, Chart A; *Barrier, **Tailhook

CHART B
YIELD HOOK STRENGTH 77,000 LBS.

BAK-9	Acft G Load	BAK-12	Acft G Load
188K*	2.55	184K**	2.55
186K*	2.35	182K**	2.4
184K*	2.25	181K**	2.25
182K*	2.1	179K**	2.15
180K*	2.0	177K**	2.0
177K*	1.9	176K**	1.9
173K*	1.8	172K**	1.85
169K*	1.7	168K**	1.75
165K*	1.65	164K**	1.65
161K*	1.55	160K**	1.6
158K*	1.5	157K**	1.55
155K*	1.45	153K**	1.57

FIG. 5
F/TF-102 MAXIMUM BARRIER ENGAGEMENT GROUND SPEEDS

CHART A
DESIGN HOOK STRENGTH 47,000 LBS.

Acft Weight	BAK-9	Acft G Load	BAK-12	Acft G Load
20,000	163K	2.35	155K	2.35
22,000	161K	2.15	153K	2.15
24,000	159K	1.95	151K	1.95
26,000	157K	1.8	149K	1,8
28,000	155K	1.65	147K	1.65
30,000	153K	1.55	144K	1.55
32,000	151K	1.45	141K	1.45

LIMITING FACTOR: Tailhook, Both Charts

CHART B
YIELD HOOK STRENGTH 54,000 LBS.

BAK-9	Acft G Load	BAK-12	Acft G Load
174K	2.7	166K	2.7
172K	2.45	164K	2.45
170K	2.25	162K	2.25
168K	2.1	160K	2.1
166K	1.9	158K	1.9
164K	1.8	155K	1.8
162K	1.7	153K	1.7

FIG. 6
F-104 MAXIMUM BARRIER ENGAGEMENT GROUND SPEEDS

CHART A
DESIGN HOOK STRENGTH 60,000 LBS.

Acft Weight	BAK-9	Acft G Load	BAK-12	Acft G Load
14,000	188K	4.3	181K	4.3
16,000	186K	3.75	179K	3.75
18,000	184K	3.35	177K	3.35
20,000	182K	3.0	175K	3.0
22,000	180K	2.7	173K	2.7
24,000	178K	2.5	171K	2.5
26,000	176K	2.3	169K	2.3
28,000	174K	2.15	167K	2.15

LIMITING FACTOR: Tailhook, Chart A; *Barrier, **Tailhook

CHART B
YIELD HOOK STRENGTH 69,000 LBS.

BAK-9	Acft G Load	BAK-12	Acft G Load
190K*	4.4	190K*	4.85
190K*	4.0	189K**	4.3
190K*	3.65	187K**	3.85
190K*	3.35	185K**	3.45
190K*	3.15	181K**	3.15
188K**	2.85	179K**	2.85
186K**	2.65	177K**	2.65
184K**	2.45	175K**	2.45

FIG. 7
F-105 MAXIMUM BARRIER ENGAGEMENT GROUND SPEEDS

CHART A
DESIGN HOOK STRENGTH 50,000 LBS.

Acft Weight	BAK-9	Acft G Load	BAK-12	Acft G Load
28,000	159K	1.7	151K	1.7
30,000	157K	1.65	149K	1.65
32,000	155K	1.55	147K	1.55
34,000	153K	1.45	145K	1.45
36,000	152K	1.4	143K	1.4
38,000	151K	1.3	141K	1.3
40,000	149K	1.25	140K	1.25
42,000	145K	1.2	137K	1.2
44,000	141K	1.15	133K	1.15
46,000	138K	1.1	129K	1.1
48,000	133K	1.05	125K	1.05
50,000	129K	1.0	122K	1.0
52,000	125K	.95	118K	.95
54,000	122K	.9	115K	.9

LIMITING FACTOR: Tailhook, Both Charts

CHART B
YIELD HOOK STRENGTH 57,500 LBS.

BAK-9	Acft G Load	BAK-12	Acft G Load
170K	2.05	162K	2.05
169K	1.9	161K	1.9
167K	1.8	159K	1.8
165K	1.7	157K	1.7
163K	1.6	155K	1.6
161K	1.5	153K	1.5
159K	1.45	152K	1.45
155K	1.35	148K	1.35
151K	1.3	144K	1.3
147K	1.25	140K	1.25
143K	1.2	136K	1.2
140K	1.15	132K	1.15
136K	1.1	129K	1.1
132K	1.05	125K	1.05

FIG. 8
F-106 MAXIMUM BARRIER ENGAGEMENT GROUND SPEED

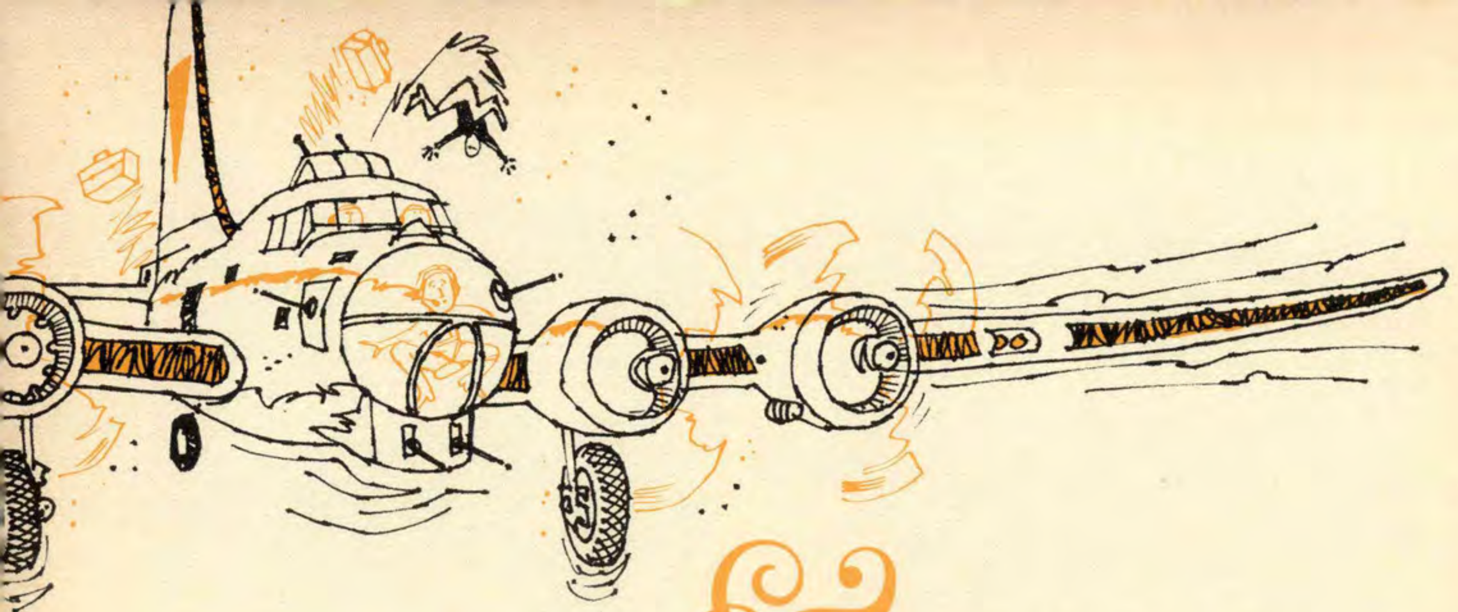
CHART A
DESIGN HOOK STRENGTH 54,800 LBS.

Acft Weight	BAK-9	Acft G Load	BAK-12	Acft G Load
26,000	169K	2.1	161K	2.1
28,000	167K	1.9	159K	1.9
30,000	165K	1.8	157K	1.8
32,000	163K	1.7	155K	1.7
34,000	161K	1.6	153K	1.6
36,000	159K	1.5	151K	1.5
38,000	157K	1.4	149K	1.4
40,000	156K	1.35	148K	1.35
42,000	153K	1.3	144K	1.3

LIMITING FACTOR: Tailhook, Both Charts

CHART B
YIELD HOOK STRENGTH 63,000 LBS.

BAK-9	Acft G Load	BAK-12	Acft G Load
180K	2.4	173K	2.4
178K	2.25	171K	2.25
176K	2.1	169K	2.1
174K	1.95	167K	1.95
172K	1.85	165K	1.85
170K	1.75	163K	1.75
168K	1.65	161K	1.65
167K	1.55	160K	1.55
163K	1.5	156K	1.5



LANDINGS & ARRIVALS

Lt Col Karl K. Dittmer, Directorate of Aerospace Safety

The outfit moved from Kearney, Nebraska, to Sioux City, and we loaded the birds with as many crew chiefs and tool boxes as we thought safe to carry, then launched. That was back in the days before anyone gave much thought to weight and balance, although they had showed us how to figure such things. But the B-17 wasn't too critical, so . . . .

Kearney had narrow 5000-foot runways and we used every bit of 5000 feet plus a little prairie getting off. Other than that the flight went well enough. Coming down final at Sioux City everything looked pretty good. The copilot was calling off a steady series of "one-fifteens" and I muscled the old brute into a three-point attitude at what seemed the proper spot above the runway and glanced his way. He gave me a high-sign and nodded reassuringly. Split seconds later we both got the feeling that all was not well with our little world and the bottom dropped out. I must have leveled that beast some 10 or 15 feet high, and to this day can vividly recall the sound of tool boxes bouncing in the waist to herald our arrival.

Thanks to beefy gear and boiler plate construction, the bird escaped without damage and the copilot and I limited our post mortem to finding out why we both misjudged. The answer was simple enough and had nothing to do with too much weight aft. Kearney had narrow runways while Sioux City had wide ones. We were both inexperienced even though both of us had around 300 hours in the bird, which was fat for that era. But we had not operated off very many different air patches and were in the habit of using the runway itself for most of our landing clues.

It would be nice if I could report that this was the last time I got fooled into making an arrival instead of a landing, but unfortunately. . . . Like when I first started flying fighters and habitually came in a weemite hot just for the wife and kids-to-be. My usual landing technique, to use the word loosely, was to point the bird at the end of the runway, level off at about the right height and wait for the machine to quit flying. Not very scientific but occasionally thrilling. Take the time I brought a Jug in on a sway-backed runway and floated out at a height that would have been perfect had the dumb runway been flat. The left wing was on its way down when the husky Jug and I arrived. A few more feet of fall and it would have been TS.

Fast approaches flourished until the fifties. The home drome had something to do with it. Back in the Korean thing I lucked into F-86s with the 4th Fighter Group. We operated off a marginal runway near Seoul and did so without too much sweat. But our friends in the 51st operated off a nice big 10,000-foot concrete covered world a little farther south. When any of 'em got too pressed for fuel they'd land short at our place. Land "short" is hardly the term. They usually came in long and hot and I've seen as many as three of a flight off to one side of the runway or in the overrun after making square ones out of round ones.

Come to think of it, this practice isn't altogether dead. I've seen the Pepsi generation use this technique too, and they really oughta know better.

But I was talking about runway

induced illusions. Have you ever made an approach into a runway that slopes downhill? If you aren't paying too much attention to airspeed, rate of descent and such, you can end up coming in very steep at normal approach speed, or diving for the end with attendant stopping problems. Hoo boy! 'Tis an awful feeling, especially when the runway is wet and the overrun is a river. This I know first-hand. (One more reason for keeping tab on speed and rate of descent, even if the field has VASI, which many do not.)

Better yet, substitute angle of attack for airspeed. At present the Air Force is attempting to come up with a more or less standardized angle of attack system. We are 'way overdue. Anyone who has ever flown a GOOD angle of attack installation has nothing but praise for it. The device really comes into its own anytime you are working for max performance at low speed.

My first encounter with an angle of attack system was in the late fifties. A Marine pilot was bragging about the system and how his unit relied on it and the mirror landing system to eliminate landing accidents. I expressed interest and was soon in the aft seat of an F-9F shooting landings. It was a piece of cake. The F-9F stays in trim regardless of throttle changes. I trimmed for the optimum angle of attack right after rolling out on final. The angle of attack indicator literally moves with the stick, so this was a simple and natural operation. Then it was pick up the meat ball in the mirror landing system and center it by adjusting throttle to change rate of descent. Again, this was a simple natural operation. Once established at the right angle of attack on the proper glide path, the bird practically flew itself down final. Ground effect broke the descent and all I had to do was retard throttle after each smooth touchdown. To this day I don't know what airspeed that bird comes in at. The last time I'd look at airspeed was turning final.

Not all angle of attack installations are as good. In fact, some are pretty poor and have given this aid a black eye it does not deserve. The biggest gripe with some is that they are subject to turbulence. Yet, just about the most spectacular flying I've seen was in a twin Beech that was equipped with an angle of attack system that took G-forces into account. Several of us flew the bird and each of us was able to make climbs and approaches in a range between three and five knots above stall on a blustery, windy day. Gusts were between 20 and 30 knots and I never dreamed a twin Beech could perform like this one did. It flew like a STOL aircraft—steep, where-is-the-horizon climbs and brick-bat approaches so slow we had to arrest the fall with throttle.

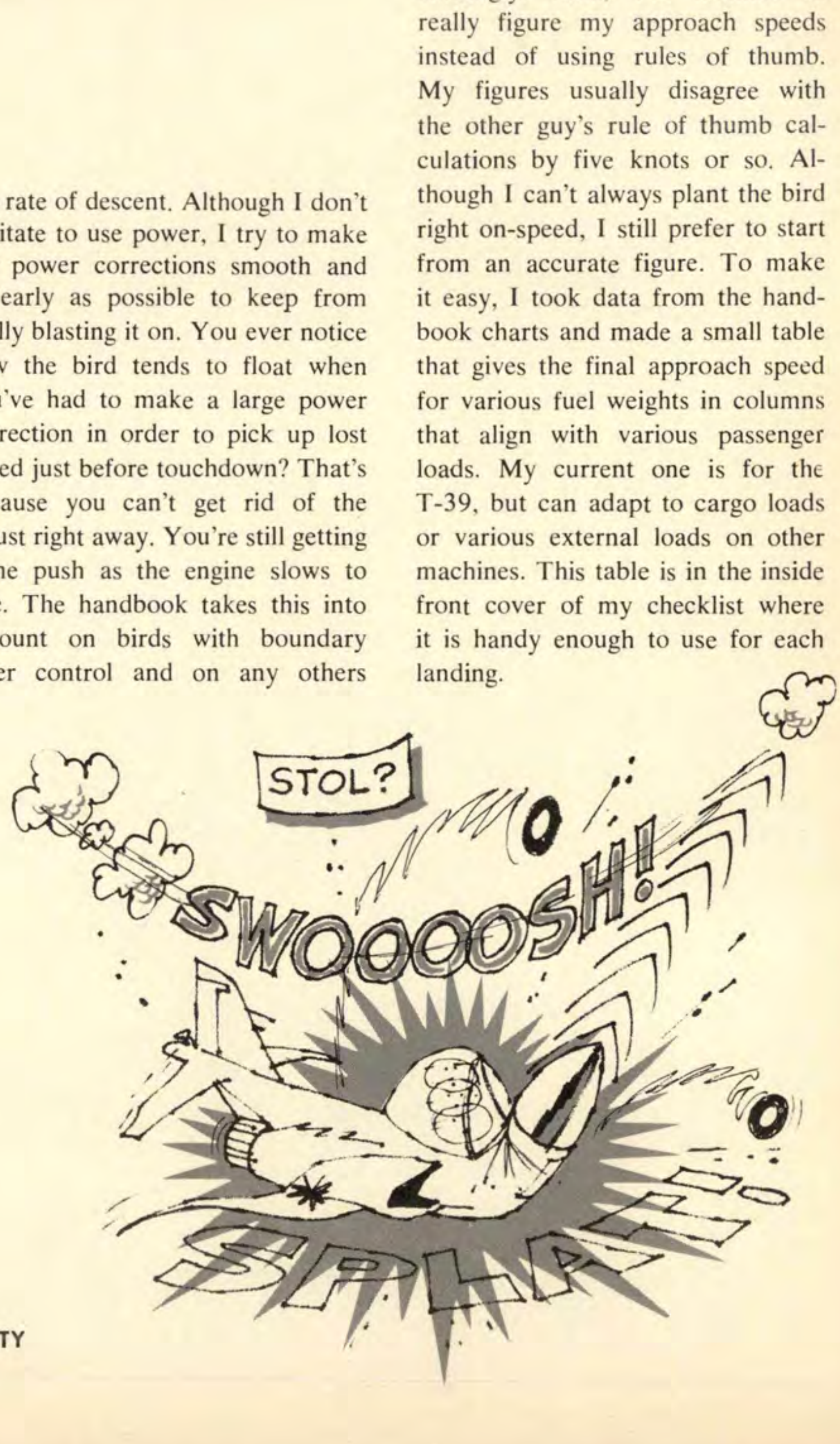
Ah yes, that's the way to make a short field approach, which launches me off onto another tangent. I still run into pilots who fly flat, dragged-in approaches when practicing short field landings. And some of them are IPs, too. In actual practice most short fields are short because there are trees, water or big rocks off each end. I for one have never been able to steel myself into making a flat approach over such stuff. No guts. But really, short fields usually mean

which MUST be flown to touchdown with power-on.

Each bird, of course, requires its own private technique and I generally swing with the Dash One, although many are a little sketchy in this area. They are pretty good about giving the best speed, however. In modern birds I've never felt I could improve on the published figures—not after giving the published figures a fair trial. But as I pointed out, very few approaches are perfect and you must adjust accordingly. Also, I'm inclined to really figure my approach speeds instead of using rules of thumb. My figures usually disagree with the other guy's rule of thumb calculations by five knots or so. Although I can't always plant the bird right on-speed, I still prefer to start from an accurate figure. To make it easy, I took data from the handbook charts and made a small table that gives the final approach speed for various fuel weights in columns that align with various passenger loads. My current one is for the T-39, but can adapt to cargo loads or various external loads on other machines. This table is in the inside front cover of my checklist where it is handy enough to use for each landing.

a steeper than normal approach to most pilots. This creates some pitfalls. The short field procedure for many aircraft calls for a slower than normal final speed. Couple the slower speed with the steeper approach and . . . watch your onions or you'll bend metal.

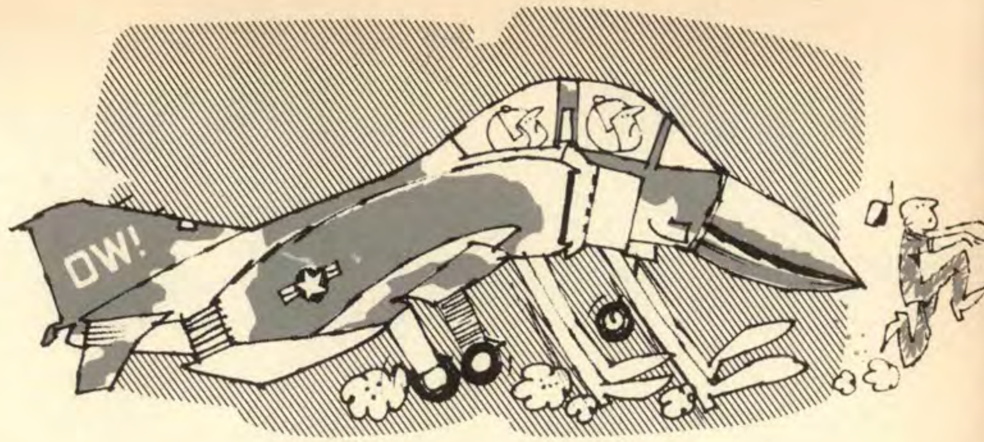
With a perfect short field approach, a pilot should be able to hold speed, power and attitude pretty much as-is until the bird hits slightly harder than normal. The slightly hard touchdown absorbs energy and helps to slow the bird and is desirable on some aircraft. Only difficulty is that different pilots have different definitions of "slightly hard," and darn few approaches are perfect. With steeper than normal approaches to short fields I would rather err on the slightly fast side, up to but not faster than the normal approach speed, than be caught slightly slow. If on-speed and slightly steep, I rely on power to arrest the rate of descent on birds which come down short-field finals in a nose high attitude. Those that come down final with the nose slightly below landing attitude usually have a little speed left with which to break the rate of descent. Although I don't hesitate to use power, I try to make my power corrections smooth and as early as possible to keep from really blasting it on. You ever notice how the bird tends to float when you've had to make a large power correction in order to pick up lost speed just before touchdown? That's because you can't get rid of the thrust right away. You're still getting some push as the engine slows to idle. The handbook takes this into account on birds with boundary layer control and on any others



Gusty winds and crosswind factors are other items I subscribe to and use. Even with a direct crosswind, a nasty gusty one, I have yet to have trouble getting rid of the extra speed such conditions demand. That crosswind helps slow the bird just as surely as does a head wind.

Although I want my approach speed figured right and though I believe in and follow the handbook speeds, I don't do it blindly. That ain't the way to live through one hour 5000 times, or through 50 hours 100 times, either. Meaning, I don't trust any single source of reference. Back when I started learning to fly they made us flop around the area with the airspeed indicator covered up. We supposedly judged our speed by listening to the wind noise and such. Being practically deaf even then, I never cottoned much to that listening bit and I still don't. I used control feel and aircraft attitude. Then, later, when I used to instruct in light planes during that happy, hungry time between wars, I found that attitude alone was an excellent indication of speed. And it still is down in the low speed range, even in century series fighters, provided you know the proper attitude for the configuration.

Most of you sense this unconsciously. You use it during the last phase of an approach after that final look at the airspeed indicator. AND this has caused serious problems at times. Have you ever ground off a wee bit of aft section during landing? Usually this happens on an approach where something has caused you to be tense. Bad visibility, a slick runway, or some other problem that makes you a bit wary. When tense you tend to lean forward in the cockpit which spoils your normal set of references to the extent that you consider an excessively nose-high attitude as normal. And after what appears to be a fine landing the nose goes down and down, and you wonder if you



checked to make sure the nose gear was extended.

The attitude indicator, if accurately set, is a much better reference. To a lesser extent, so is power setting versus rate of descent. If you're not already tuned to these factors, best start paying attention to them.

Like most aging jocks, I am quick to admit that the really critical phase of an approach and landing starts just about the time you cross the fence. That whatever acrobatics and antics that occur prior to this point have little bearing on whether it will be a landing or an arrival provided you can get the bird stabilized at the right speed or angle of attack and with the right rate of sink between the fence and touchdown point. We pretty well proved this with the pitch-up-fall-out pattern back in the big war. But that pattern cost us a lot of hardware and men to prove that a more sensible approach is one where the pilot tries to get stabilized much earlier. You see, the rub with waiting until the last few hundred feet comes when some clod allows sink rate, speed, direction, glide path or any combination of these factors to get too far out of hand and he can't arrest 'em before reaching this magic area. So I swing with the lads who say, "get stabilized well out on final and you'll have it made." This gives more time and space to correct the inevitable errors in judgment and will insure a higher percentage of landings. So will using every bit of evidence you can get provided you apply some good judgment based on knowledge of the aircraft and the various pitfalls. I trust that this little yarn will start you thinking about the many, many things I've left unsaid. ★

AER

"HEY! LOOKY THERE," said one pilot to the other as a T-39 taxied in front of their T-29. The left seater looked at the other bird and thus diverted his attention just long enough to commit the unpardonable: you guessed it, another taxi accident. Their left wing struck the foam fill hopper on top of a fire truck which was positioned to respond to an AirEvac departure. This incident occurred during daylight hours in good weather, and the right seat pilot was an instructor.

Quite a few manhours were required to repair the leading edge assembly, but it'll take a long time to repair the pride of these two new temporary copilots.

ALL UNITS OPERATING AIRCRAFT EQUIPPED WITH WALKAROUND BOTTLES would do well to examine their storage security when the planes are in flight. Recently a jet transport crew experienced two injuries when an oxygen bottle broke loose during climbout and struck both loadmasters on their heads. Luckily it hit them on the top of their heads rather than their temples or they might easily have been killed. The designs of many walkaround bottle mounts do not assure positive lock after a relatively small amount of wear. One outfit which also experienced a break-away installed a small bungee cord loop to secure the mount latch and prevented recurrence of the problem. This modification did not interfere with the normal release feature of the mount. The 438 MAWg at McGuire is manufacturing the bungee loops for use in their birds.

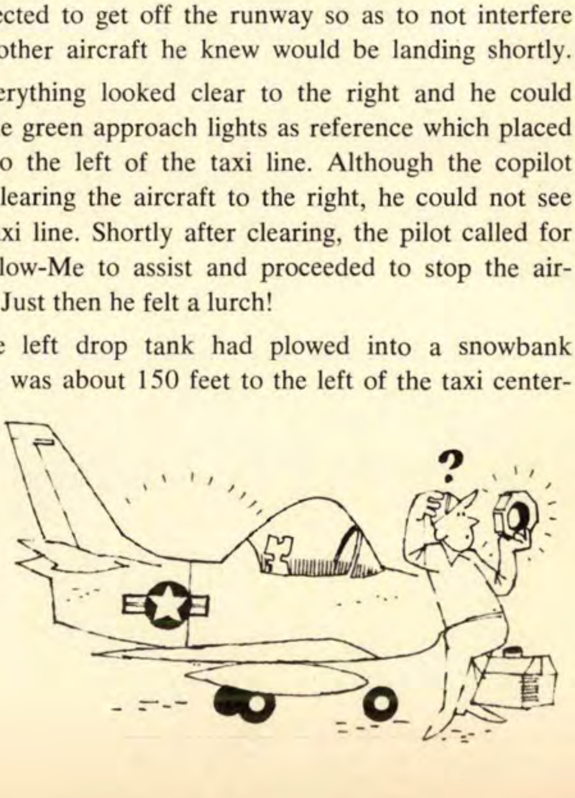
THE MISSION WAS ACCOMPLISHED as planned with the aircraft performing well and its jet engines running smoothly. After it had landed and was taxiing to the ramp, a C-130 approached from the opposite direction with the apparent intention of proceeding straight ahead. However, just prior to reaching the jet, the Herky turned away unexpectedly and blasted it with prop wash. Anyone who has ever pulled up inside a couple of hundred feet directly behind a C-130 can well understand how it can blow foreign objects into a jet engine.

All flight crews must be aware of the FOD dangers to jet engines when other aircraft are running engines near by. If there is any danger of being blasted with prop or jet wash, pilots and maintenance engine personnel are cautioned not to start engines until nearby aircraft shut down or taxi away, then check intakes for FOD prior to cranking up. Also, when *you* are taxiing, be constantly aware of your potential as a distributor of deadly and costly FOD material.

WINTER REMINDER—Here's a mishap from last winter that should serve as a reminder: A pilot discovered that he was having trouble spotting the turnoff and taxi lane after successfully landing his big B-52 at a northern air base. The windows on his side had partially frosted over and there was enough snow in the air to cause a near whiteout. Rather than stop, he elected to get off the runway so as to not interfere with other aircraft he knew would be landing shortly.

Everything looked clear to the right and he could see the green approach lights as reference which placed him to the left of the taxi line. Although the copilot was clearing the aircraft to the right, he could not see the taxi line. Shortly after clearing, the pilot called for a Follow-Me to assist and proceeded to stop the aircraft. Just then he felt a lurch!

The left drop tank had plowed into a snowbank which was about 150 feet to the left of the taxi center-



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line. The main gear was 70 feet to the left of the line but the copilot had been unable to spot the line because of the snow.

The pilot had the right idea . . . but was just a little late.

A NEW ADVANCED EXPLOSIVES SAFETY OFFICER course has been established to meet the growing shortage of explosives safety officers in the Air Force. The course duration is 18 weeks. The first class will convene 15 January 1969 at the Technical Training Center, Lowry AFB, Colorado. The course provides training for officers and civilians programmed for assignment or assigned duty as Explosives Safety Officers. It is designed to provide the individual with the fundamental tools of explosives safety management. The course content includes safety planning, programming, policy development, principles of explosives safety, program management, inspection, test, transportation, maintenance, disposal, manufacturing, handling and utilization of ammunition and explosives.

Officers and civilians who desire to attend the course and who meet course prerequisites should request this training in accordance with AFM 50-5.

THE SEVENTH AIR FORCE recently completed studies of downed aircrew experiences in Southeast Asia. These studies validated the requirements for standardized procedures in the use of RT-10 survival radios. In order to improve the efficiency of the electronic phase of search and rescue efforts, the following instructions will be adopted as standard procedures:

1. Turn off personal locator beacon; remove beacon from parachute if possible, and stow in pocket of survival vest or flight clothing.

2. Attempt voice contact via RT-10 radio; if voice contact cannot be established immediately, institute beacon tone/listen cycle as follows:

- Transmit tone for 15 seconds.
- Transmit call sign.
- Listen for 15 seconds.
- Repeat sequence until voice contact is established.

3. When voice contact is established, survivor will follow direction from aircraft making contact.

4. If ground environment conditions permit, personal locator beacon may be used to provide tone with listening watch maintained on RT-10 radio in order to conserve battery life. (Note: Personal locator beacon must be turned off during listening watch.)

The reason for this procedure is to provide SAR aircraft with tone signals of uniform length and at regular intervals to assist in distinguishing between random testing or inadvertent beacon actuation and actual emergency use. Additionally, the 15-second tone permits aircraft ADF equipment to obtain solid bearing indication. Experience indicates tone signals of short duration do not allow sufficient time for ADF equipment orientation. At maximum range of survival radio capability, tone can provide bearing indication more readily than voice mode, particularly if tone signal is of sufficient duration to permit bearing indicator to settle down and allow the search operator to note the bearing fix. ★

BITS

Mail Call

FROM NYU

I have just finished reading the current issue of *Aerospace Safety* (Sep 1968) and have decided to send my compliments now, although I have intended to do so for some time. Your magazine is commendable particularly because it makes an obvious and severely successful effort to provide informed material on hazards and their control. I have enjoyed reading it and for some time benefited from its articles. Its information, of course, assists the development of our courses under contract with the Air Force, but it is more than just a professional aid. The magazine is done well enough so that I look forward to receiving my copy regularly. It is especially noteworthy, I believe, for avoiding the relatively shallow discourses on safety implementation which typify many safety journals.

Good luck and best wishes for continued successful work.

John V. Grimaldi, Director
The Center for Safety
New York University

LIGHTS

In the text of your most interesting article on cockpit lighting ("Lights in the Cockpit—Red or White." by W. F. Grether, Ph.D.) in the September 1968 issue of your magazine, I came across an editorial note stating that "FAA has no regulation requiring flashing anti-collision lights."

This is not so. Aircraft must be equipped with flashing anti-collision lights (either rotating-beacon or flash-tube types) under current FAA airworthiness regulations, and these lights, under current FAA general operating rules, must be in operable condition when the aircraft is operated at night.

I shall be happy to send you a copy of these regulations upon your request.

Edward C. Hodson
Dept of Transportation
Federal Aviation Administration

The editorial note was, unfortunately, overly brief. It should have stated that flashing anti-collision lights are not specifically required on many aircraft; i.e., the requirement is for those weighing more than 12,500 pounds and on the airworthiness certificates of some light aircraft.

AFTO FORM 781

The following comment is not to criticize, just nice to know information:

On the back cover of the August issue, Rex Riley is shown filling out an aircraft form. It is shown as AF Form 781. It should be an AFTO Form 781. Still, all concerned should get the message.

TSgt Donald L. Chandler, USAF
NCOIC, Det 2, 425th Muns Maint Sqd
Ecowi, Quebec, Canada 00100

Rog, Don, thanks for writing.

KOLLIGIAN TROPHY WINNER

We noted with great pride and satisfaction the article on Major Bruce B. Stocks in your special feature on safety awards in the July 68 issue of *Aerospace Safety*. Major Stocks was awarded the Koren Kolligian, Jr, Trophy for 1967.

Major Stocks not only demonstrated the fighting spirit of the Air Force in SEA but he more particularly exemplified the professionalism, raw courage and tenacity that has become the hallmark of the 355th Tactical Fighter Wing during its SEA operations. Major Stocks was a member of the Wing at the time this event occurred.

We were disappointed to note that this great fighting unit, which has become "the Wing to beat" in SEA, was not identified in the article. The personnel of this Wing are all justly proud of its accomplishments and I feel this omission might have precluded those members of the Wing who were not personally acquainted with Major Stocks from acquiring additional esprit de corps. We sincerely appreciate your magazine and the contribution it makes to accident prevention.

Lt Col Robert D. Nelson
Director of Safety
355 Tac Ftr Wg
APO San Francisco 96273

☆ U. S. GOVERNMENT PRINTING OFFICE 1968 341-211/3

WELL DONE

Major
William O. Mayfield

3d Aerospace Rescue and Recovery Gp
APO San Francisco 96307

On 26 May 1967, while participating in H-3 helicopter aerial refueling training, Major Mayfield made a hookup to demonstrate the proper formation position, and then initiated a normal disconnect. As airspeed was slowly decreased, he noted the amber light illuminate indicating hose travel beyond the refueling range and noted the first five feet of white hose just outside the pod. At this point he expected the disconnect. When nothing happened, he momentarily matched speed with the tanker aircraft, then started decreasing airspeed again. There was a slight pull similar to a disconnect and Major Mayfield saw the end of the hose come out of the pod on the HC-130P. He immediately pulled up the nose of the helicopter to prevent the hose from striking the main rotor blades. As the hose started dropping below the helicopter he lowered the nose and began a rapid rate of descent to prevent the hose from whiplashing back into the tail rotor. The helicopter was then leveled at 1500 feet with an airspeed of 65-70 knots; the hose was trailing underneath at about a 60 degree angle. Sufficient aircraft control seemed possible with the exception of the AFCS indicator which showed an extreme forward CG.

Observing the excess side load being put on the refueling probe, Major Mayfield instructed the copilot to retract the probe about halfway. At this point the probe appeared stable and he still had full visual contact with the inflated drogue. An enroute descent was set up over the Bay of Da Nang so that arrival at Da Nang would be at 400 feet AGL. Since the hose was 90-95 feet in length, Major Mayfield set the radar altimeter at 100 feet and started a normal approach to a grassy area between the parallel taxiway and the runway. As airspeed decreased he instructed two people in the cargo compartment to move to the extreme aft of the helicopter to aid in any CG problems and then, after establishing a hover, started a slow descent. When the flight engineer reported the hose was touching the ground, Major Mayfield slowly moved the helicopter forward as altitude decreased to lay the hose on the ground and to keep it under the aircraft to preclude any unusual effect on it by the rotor blast. A successful landing was accomplished. Major Mayfield, by taking prompt corrective action to cope with this potentially disastrous situation, prevented the potential loss of a combat crew and the helicopter. WELL DONE! ★

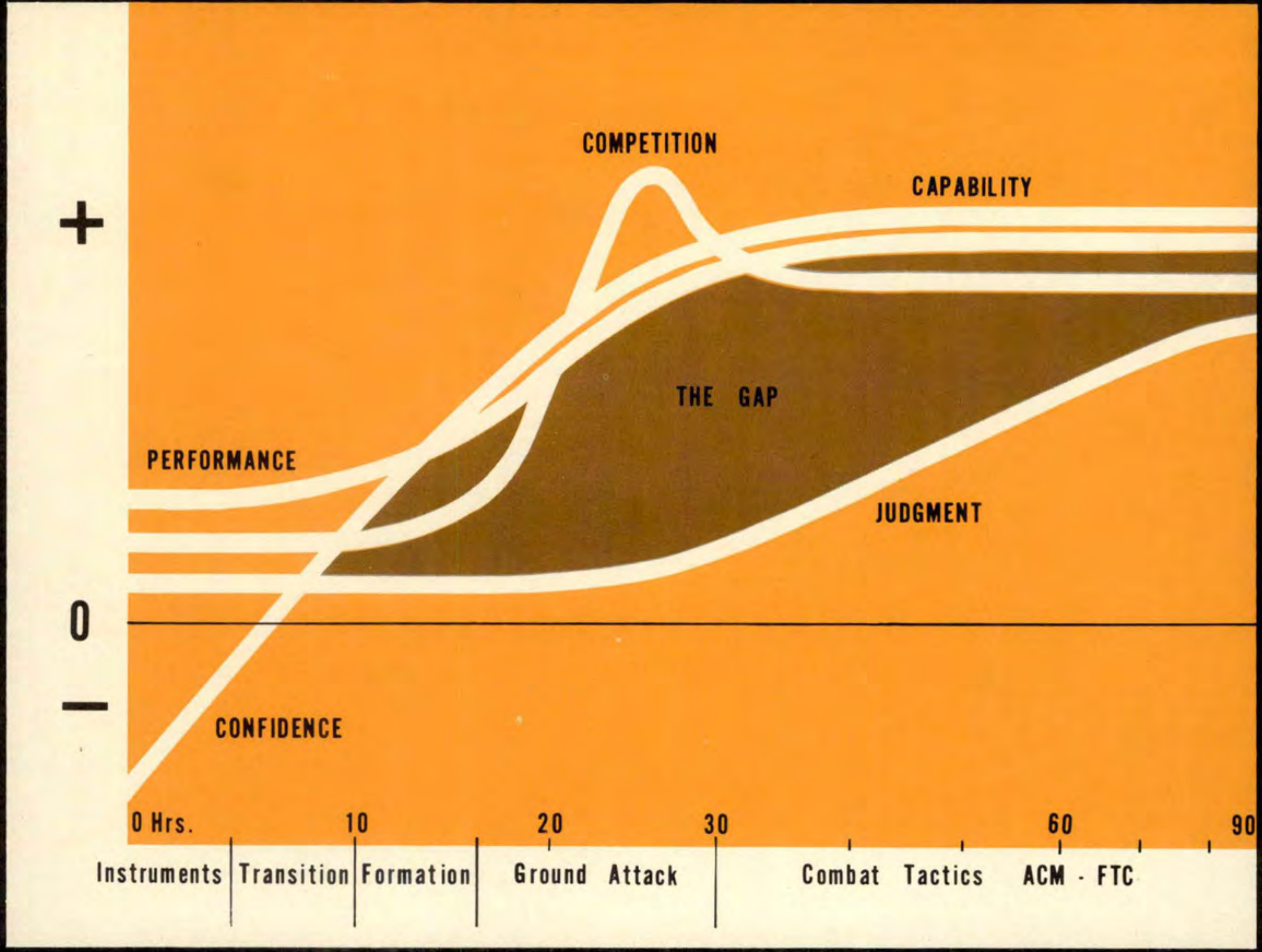
Major
Carl D. Spaeth

1st Air Commando Squadron
APO San Francisco 96262

On 4 June 1967 Major Spaeth led a flight of two A-1Es that had been diverted to provide emergency close air support for a U. S. Army Special Forces team that was surrounded by a large force of North Vietnamese Army Regulars. He led several CBU and napalm passes on enemy gun positions, encountering intense ground fire. Three gun emplacements were destroyed, and Major Spaeth's aircraft sustained at least four damaging hits. His wingman informed him that there were two large holes in the belly tank and fuel was streaming overboard. At this time the wingman's aircraft, which had taken a hit from 37mm ground fire, lurched violently into Major Spaeth's aircraft, went into an inverted spin and crashed. The collision jerked the control stick from Major Spaeth's hand, and caused his A-1 to roll violently to the right and pitch nose down in an inverted attitude. Engine RPM deteriorated rapidly. Reacting instinctively, Major Spaeth was able to regain control of the aircraft approximately 300 feet above the ground. The wingman's vertical stabilizer had ripped through the right aileron, bending a large portion of the aileron up to a 45 degree angle. The lower portion of the vertical stabilizer became imbedded in a napalm tank hung under the right wing, crushing the tank up into the release rack. The impact turned the wingman's aircraft 90 degrees to Major Spaeth's A-1E and the propeller cut two large gashes, two feet in length, through the leading edge, severing the pitot tubing.

After jettisoning his ordnance, Major Spaeth discovered that the crushed napalm tank would not release. Napalm jelly flowed over the wing, the engine was surging and he had no airspeed indication. At cruise power, engine operation appeared normal, but full left aileron and left rudder were required to maintain control, and the aircraft still flew with a pronounced right yaw. He elected not to attempt a forced landing for fear that the ignitor plug in the crushed napalm tank would activate. Unable to control the aircraft at what appeared to be normal approach speeds, he seriously considered bailout. However, he decided to attempt a "hot" landing by establishing a long, flat final approach at an estimated 15-20 knots above normal. At a point where almost full control pressures were required and the right wing began to drop, Major Spaeth touched down on the right gear, straightened the landing roll and stopped the aircraft safely at the far end of the runway. WELL DONE! ★

The Capability-Judgment GAP



Early in a training program students begin to develop skills and confidence that enable them to become quite capable in manual tasks. Simultaneously, their judgment of the human and environmental factors involved begins to develop, but more slowly than their manual skills. This produces a capability-judgment gap which must be filled by the instructor. The above chart illustrates several parameters in a pilot training