Interceptor

THE HOLE CARD . . see page 5

SEPTEMBER 1969

FOR THE MEN RESPONSIBLE FOR AEROSPACE DEFENSE

Interceptor

volume 11
number 9
ADCRP 127-2

Aerospace Defense Command
Lt Gen Arthur C. Agan
Commander

Published by the Chief of Safety
Col H. C. Gibson

Editor
Maj Philip A. Tague, III

Assistant Editor
Maj Richard P. Coulter

Managing Editor
Mary W. Conover

Art Director
Craig T. Schafer

Illustrator
SMSgt Kenneth L. Gray

Contributing Cartoonist
1/Lt James A. Kanters

spotlight

Freedom is moving easily in harness.

— Robert Frost

departments

special features

OUR COVER

A figure of speech on film. The bird awaits; the pilot stands ready. Tucked in the recesses of his cockpit wardrobe are "Hole Cards," the symbols of a man prepared for any eventuality.

memo
from the CHIEF OF SAFETY

Know Yourself

Col H. C. Gibson

A one-million dollar fighter was lost recently due to excessive heat, smoke, and fumes in the cockpit. At this writing the primary cause of the accident is listed as materiel failure of the engine bleed air duct. The first contributing cause is listed as pilot factor in that the pilot failed to follow the "smoke, fumes, or fog elimination procedure as specified in the Dash One" (jettison canopy if smoke becomes severe). Thankfully, the pilot made a successful ejection at approximately 1,000 feet above the surface, and will be around to fly again. We'd much rather have the pilot back than the aircraft, if given the choice. If at all possible, we'd like to have *both* man and machine back in the system since hardware is becoming impossible to replace.

"The words that are worth ten thousand pictures" is a phrase that prefaces the Flight Manual of one of our fighters. It is an appropriate description of the invaluable guidance offered by the Dash One, especially the emergency procedures section. This section was produced as the result of much careful research and thought, and these procedures have saved numerous aircraft and lives when followed properly. Experience has shown that under an emergency situation with a time compression factor involved, an immediate reaction is necessary to perform the critical actions successfully. In most circumstances, this can only be achieved by using a preconceived plan of action. This is what the emergency procedures section gives us.

Coupled with a thorough knowledge of the emergency procedures should be each pilot's personal conception of how *he* will react to any given emergency situation. Only the individual pilot is familiar with his own personal problems, limitations, physical condition, and state of mind as they affect his ability to hack the mission. In short, book knowledge must be supplemented by knowledge of one's self.

The Flight Manual is directive in nature and should be followed to the letter until such time as a flaw is identified. In the above-mentioned accident, it is almost certain that had the established procedures been followed, one of our fighters would still be in the inventory. While flying our aging fleet of complex aircraft, it behooves all of us to be prepared for that "moment of truth" when we might be called upon to prove our grasp of the Flight Manual and knowledge of ourselves.

COL H. C. GIBSON

HOT LINE

CHECK THAT SEAT PIN! Aircraft was on an active air defense scramble. Before takeoff the pilot removed the seat pin, wrapped the streamer around it and placed it in his pocket. After completing the mission and during the after-landing check, it was discovered that the housing for the internal workings of the pin was still in place in the seat handle. The armrests will not rotate with this portion of the seat pin in place, so ejection would have been impossible. At the risk of seeming naive, we recommend that pilots eyeball the pin after pulling it, just to make sure the whole nine yards come out.

"GEE" SUIT HAZARDS. If you ever have occasion to wear the "squeeze bag," don't load the lower leg pockets with heavy, bulky objects. During ejection at speeds in excess of 300 mph, injury will most likely occur in the shinbone and thighbone areas. To some extent, this also applies to the flying suit, even though the lower leg pockets are not located frontally.

WANTED: READERS INTERESTED IN AIR DEFENSE.

Headquarters, Aerospace Defense Command, ADOTT-D, calls attention to the USAF Interceptor Weapons Instructor Manual (IWIM), 51 series, published by the Air Defense Weapons Center, Tyndall AFB, Florida. These manuals, prepared by instructors of the Interceptor Weapons School (IWS), are written with the thought in mind that controllers (SAGE and Manual) and aircrews should strive to launch armament at the enemy with the best possible results.

Perhaps some background information is in order. A few years ago, we (ADC) had a tactics manual (ADCM 55-5) which also contained special "techniques" of each environment (ECM, Low Level, Snap Up, etc.). "55-5" was replaced, *in part*, by AFM 3-16. We say in part because "3-16" does not spell out the details of "how to" conduct the intercept. Many immediately called attention to this fact but were told to "hang loose . . . we plan to publish that poop in the form of a USAF IWIM series." One year ago the first chapters were published and distributed to the field. These 51 series manuals are the *official techniques* documents for the air defense business. Many diagrams and charts are included in these documents which can be reproduced for training aids, either as 35mm or Vu-Graph slides (Artwork by Lew Hackey, Gil Olvera, Walt Garwood (IWS), and Bronco Aleksich, Ontario ANG.). There's plenty of meat for training missions, ORIs, Tac Evals, or the real thing. Try it.

While we have your attention, and in the interest of getting the latest "poop to the troops," we want to insure that you are receiving the Interceptor Weapons Newsletter. This is our quickest means to keep the field abreast of latest developments. (Example: Winter Issue —Resume of T-4 Flight Testing.)

The IWIM and Newsletter are classified Confidential, but every IND, Tech, aircrew, and supervisor of ADC weapons systems or personnel, have the "need to know." Why not make them available!

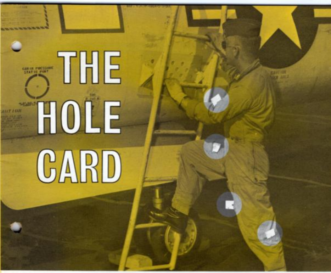
A final note to COs, SDs, Ops Officers, and Flight Commanders: Your W.T.O. and IWS grads have briefed and instructed the techniques in the "IWIM." They are champing at the bit for that opportunity to prove their salt. Your support and cooperation are required if they are to contribute to your unit training program.

If you are not now receiving the Interceptor Weapons Newsletter or have not received your copy of the USAF IWIM, drop a letter to the Commander, USAF Interceptor Weapons School (IWS), Tyndall AFB, Florida 32401.

T-39 BRAKES

New type binders are being installed in the T-39. They are more efficient than the old brakes and longer lasting. Using a given amount of pedal pressure, quicker deceleration is definitely noticeable. Total landing rollout can be trimmed by as much as 2,000 feet in some cases. Pilots should exercise caution when making short field landings because of the danger of locking the wheels and causing tire failures.

THE HOLE CARD



A headquarters assignment has its advantages. (After the laughter subsides, read on, because it gets funnier yet.) Aside from sitting behind an unsympathetic desk in a stuffy cubicle, you get a pretty good overview of what's going on out there in actionland. Every day (weekends excepted), shortly after first light (neon variety), an avalanche of reports pour in until, alas, even the ashtray is covered. Most are routine unclassified EFTO describing the events leading up to such crises as: military hunter shoots prize cow; F-102 AC fails; rats infest C-ration storage area; and F-106 loses canopy. There are others, though, which cause much squirming in swivel chairs. They involve pilot (naturally) factor in incidents at best and accidents at worst.

No!!! We are not going to hitch up our 1505s and start pummeling pilots again with the standard cliches like poor judgment, complacency, heads up and locked, etc. There's a time and place for everything. These catchwords usually apply to after-the-crash denunciations of the unfortunate mortal who failed to protect himself at all times. We are interested in prevention, not weeping over yesterday's smoldering hole. And so, here's a piece of the 8x10 headquarters glossy as viewed by us guys who like to think and talk pilot matters (during secretary coffee breaks, of course).

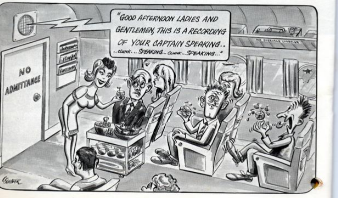
After sifting through mounds of reports, analyzing the implications, and discussing the local fishing situation, we find that fewer and fewer pilots are taking their machines aloft with a hole card stuck in their oil-stained goatskins. What do we mean by that? Simply this: jocks are flying without guaranteeing themselves the benefit of an alternative, a contingency plan, a back-up move, a bag of tricks. They are allowing themselves to get painted into corners without so much as a pogo stick. The problem, as we see it, is not one of neglect or carelessness, etc, but rather one of overconfidence in systems, both aircraft and flight support systems. Here are a few classic examples which show how easy it is to get faked out of your hat, spats, and shorts.

Two pilots in a T-bird received an enroute descent into an area of mountainous terrain. After entering weather, they advised the controlling agency that their instruments indicated they were in the vicinity of a very high mountain. The controller reconfirmed positive radar contact and proceeded to give gyro-out directions. The aircrew followed instructions and collided with the mountain. They had been misidentified. In this case, the pilots smelled a rat. But because they had confidence in the capability of the controller, they foolishly elected to disbelieve their instruments and accept his instructions without first doing something to make sure their instruments were really in error. They gave up control of the situation and it cost them their lives.

Another pilot penetrated on the wing into an overcast with tops at about 5,000 feet. Shortly afterwards, he fell off and was given individual control. Again, the terrain was mountainous. He was at 3,000 feet in the weather when radio contact was lost during a channel change. He flew for more than 4 minutes on his last assigned heading until he hit the top of a hill. Why didn't he at least climb the 2,000 feet to VFR conditions and work out his radio problem in safety? Because it didn't occur to him that he had been given a heading and altitude which would eventually put him into rock-filled clouds. He was confident that approach control instructions would keep him out of trouble and so he didn't act for himself. It was a fatal mistake.

The last mountain story involves a pilot who penetrated and was picked up by GCA. Traffic was heavy and GCA misidentified his aircraft. He subsequently plowed into a hillside. Although ILS, TACAN, and VOR were available at the field, the pilot chose to obediently follow radar instructions instead of monitoring his position on instruments. When he assumed that radar had him, he sat back, emptied his pockets on the floor, and waited to be ushered to the runway.

When you focus in on the circumstances, it's not difficult to see how these situations and others can develop. Over the years, the task of driving an airplane has been made easier and more convenient through automation and expanded service facilities. A pilot can now take off with a radar departure, hit the George switch for automatic climb and cruise, navigate confidently with TACAN and DME plus constant radar surveillance, get an enroute descent to a coupled ILS final approach, and land using an angle of attack indicator. We've come a



long way since the days when mad mathematicians published those geometric departures and approaches, not to mention the thrills of having to outguess the ADF in-between position reports. And there are promises of more luxuries to come. (which reminds us of the airline joke: "Good afternoon, ladies and gentlemen, this is a recording of your Captain speaking.") It's no wonder that some pilots have subconsciously grown accustomed to relying on a system, manned or otherwise, to do their thinking for them. Everything is rosy until that system breaks down. Then one of two things happens. The pilot is either totally unaware that the situation requires his immediate attention, or he suddenly finds it necessary to scramble up a desperate plan of action which has no more than an equal chance of coming up heads or tails.

To be completely fair and honest, it's not a pilot's fault that someone or something failed in a system which by design limitations is no more or less foolproof than the pilot himself. And yet, can he be considered pure as the driven snow for yielding to the temptation of overconfidence? We don't think so because, after all, there's no satisfaction in being **dead** right! Take, for example, the pilot who took off on a cross-country which approached the range limits of his bird. As often happens, the winds were not as forecast. It looked like he could make it all the way in spite of the bad wind poop, so he passed up suitable alternates. Following a few unexpected traffic deviations, he finally got it on the ground, only to flame out before he could reach the chocks. His fuel gauge lied to him in the bargain. Progressively, he let himself get boxed in by events he wasn't responsible for, and made it by sheer luck.

Pilots are no exception to the rule when it comes down to pinning a cause on the other guy's donkey. But in the final analysis, it serves no useful purpose to line up statistical ducks which prove something that everyone already knows, namely, that a system is not perfect; and then turn around and expect the system to provide 100% reliability. From a pilot's standpoint, accident prevention can better be served by accepting the fact that limitations exist, to become suspicious by nature, and to keep that hole card handy.

We could go on for volumes, but we won't, because we think (at least hope) the point has been made. If you are the overconfident type who:

- dumps the nose 100 miles out on an enroute descent,
- flies a speedy final approach because you have a drag chute,
- extends speed brakes on a low fuel final approach,
- leaves the ETE spaces blank on AF Form 70 because you have DME,
- etc,

then you better get a hole card before it's too late. ★

MAIN BOOST PUMP FAILURE (HEART)

WARNING INDICATIONS

1. Smoke emitting from main intake.
2. Excessive gross weight.
3. Boost pressure high.

CAUTION

These indications are particularly significant if the airframe in question has high time or was manufactured by a company with a history of early main boost pump failure.

ACTION IN THE EVENT OF MAIN BOOST PUMP WARNING INDICATIONS

1. Contact your flight surgeon for IRAN.
2. Avoid high stress maneuvers until cleared by your flight surgeon.
3. Consult weight and balance data for ideal operating gross weight (your flight surgeon has this data).
4. Avoid smoke entering the main intake.

WARNING

Smoke entering the main intake is abnormal operation. This can lead to failure of other systems in addition to the main boost pump.

the MEDICAL DASH 1

by **MAJOR C. LEE McFARLANE, USAF, MC** / *Office of the Command Surgeon, ADC*

". . . . Tower, this is Smoky 21, four miles south of the field with an inflight emergency. . . ." You pilots amaze me with your ability to respond appropriately in any flight emergency. If you think about it, our bodies are in many ways similar to that finely tuned machine you fly.

Just as the aircraft does, the body has systems which can deteriorate and malfunction. The maintenance officer knows that inspection and preventive maintenance can help reduce malfunctions in aircraft systems. Similarly, the flight surgeon knows that examination and preventive medicine can help reduce malfunctions in our bodies.

For purposes of this discussion I have chosen only one system, the heart. Each year more Air Force pilots are permanently suspended from flying duties because of coronary heart disease (disease caused by narrowing and hardening of the blood vessels supplying the heart muscle) than any other single cause. In fact, it is still the leading cause of death in the United States today.

Do not be lulled into thinking that coronary artery disease of the heart is only a disease of the elderly. Autopsy studies of young males (average age 22 years)) killed in combat during the Korean conflict revealed that over 75% already had gross coronary artery changes that might have led to eventual coronary heart disease. This incidence of coronary artery disease was shown to increase sharply with increased age. It is estimated that virtually all American males over the age of 35 years have at least the early changes of coronary heart disease.

So coronary heart disease is common. But even more distressing, when we view this disease in our aircrew population, is the fact it is insidious and highly lethal. Coronary artery disease may suddenly, without ominous warning, render a pilot incapable of controlling his aircraft. Further, his dead body may obstruct the controls preventing safe recovery by a second pilot.

Probably almost every active professional pilot in the U.S. today has heard the April 1966 account of a Lockheed 188C that crashed on an ADF/VOR/DME approach in weather to Ardmore, Oklahoma. The pilot sustained a fatal heart attack while at the controls. The copilot attempted to recover but was unsuccessful.

During the period January 1961 through April 1968 there were 17 such instances of civil airline pilots dropping dead from unsuspected heart disease while performing flying duties. Five of these instances occurred during critical phases of flight and resulted in aircraft accidents despite the fact that a second pilot was at the controls. The airlines do not have a monopoly on this problem. As recently as February 1969 ADC lost an ANG pilot and aircraft from just such an accident.

RISK FACTORS

I have stated that there are frequently no ominous warnings of impending heart failure. It is true that there is no MASTER CAUTION light, or MAIN BOOST PUMP FAIL light, but there are important warning signs. These are known as coronary risk factors.

Certain of our coronary risk factors are unalterable; there is no possible corrective action. These include:

1. Age. There is no specific age when we become susceptible to coronary heart disease. It has occurred in individuals in their twenties, but more frequently occurs after age 35. We are as old as we are, and so far, nobody has been able to alter this.

2. Sex. Males are about 9 times more prone to coronary heart disease than women (age 30-49). While there have been rare instances where this risk factor has been changed, the Air Force is still selecting males exclusively for pilot training.

3. Heredity. Offspring from parents who have a strong family history of heart disease have a greater risk of continuing the trend than do offspring of parents who live to old age. We cannot, however, choose our parents.

4. Ability to metabolize fats and carbohydrates. In the disease diabetes, fat and carbohydrates metabolism is impaired. Diabetics have a higher than expected incidence of coronary heart disease. Similarly, people who have elevated blood cholesterol (fat) levels for any reason also have increased incidence of the disease. Neither elevated

blood cholesterol nor mild diabetes is necessarily unalterable. Some individuals with these conditions have returned to normal following weight loss and physical conditioning. Many of them are still flying today.

There are other risk factors, clearly associated with increased incidence of coronary heart disease, which we can alter at will. These include:

1. Cigarette Smoking. Virtually everyone now knows that smoking "may be hazardous to your health." It is linked to numerous diseases of the lungs including cancer. But did you know that if you are a man aged 30-59 who smokes one package of cigarettes per day or more, you have nearly 5 times the risk of sudden death than does a nonsmoker? After all, sudden death is what we are worried about in aircrew members. We are not talking about emphysema, bronchitis, nor even cancer, all of which give warning signs obvious to the aircrew member as well as his flight surgeon. We are talking about sudden death of a previously "healthy" crewmember on ILS final approach. This was exactly the case when, in December 1962, the pilot, aged 38, of a Lockheed 1049 freighter died or collapsed at the controls while on a night ILS final to North Hollywood, California. The copilot was unable to recover during this critical phase of flight.

2. Obesity. The workload placed on the heart by excess body weight has long been known to be a factor in coronary heart disease. A good recent statistical study has shown that obese individuals have over 2.5 times the risk of the disease that do comparable non-obese individuals. In addition, these obese individuals are more likely to have high blood pressure, and elevated blood cholesterol.

3. High Blood Pressure. This is another physical condition associated with significantly higher risk of coronary heart disease. It is true that not all individuals who have high blood pressure are able to control it without the use of medications. However, some types of high blood pressure respond to weight loss and physical conditioning. These persons continue active flying careers.

4. Physical Inactivity. As a result of modern trends, most people's jobs today require more executive or managerial function and less physical labor. This may be desirable from some points of view, but it leads to deconditioning of the heart as well as other body muscles. Just as the legs or arms are easily overtaxed in this situation, the heart can also be overtaxed if an added stress is placed upon it. We see examples of this each fall when a few deconditioned deer hunters drop dead in the mountains, or in the winter when previously sedentary snow shovelers overtax their hearts. Closer to home, we occasionally see examples of heart failure when a long boring flight is terminated by jet penetration and IFR precision approach. Heart rates at this time may exceed 180 beats/minute in veteran pilots. Of the 17 previously mentioned instances of death due to coronary heart disease in pilots while performing aircrew duties, 13 occurred during final approach or just after landing.

Now I have told you what some of the known risk factors are which make you more likely to develop coronary heart disease and increase your risk of sudden death. I know that they are not popular to think about and you are probably saying to yourself "there must be an easier way." Well, if there is, no one has discovered it yet.

All is not bleak, however. There is something that can be done. All of us have some risk factors. What we should do is to evaluate those which apply to us. Some risks will allow no possible corrective action. The others should be listed in the order in which they will be eliminated. The risk factors are cumulative. The more factors we eliminate, the less will be our risk. Simple? No! Possible? Yes!

How can you find out your score on risk factors? Most people can make a pretty good evaluation of this themselves. However, your flight surgeon is trained in this field and can be of assistance to you. He can help you assess family risk, check for abnormal carbohydrate metabolism (diabetes), measure blood lipid levels, measure blood pressure and record the electrical activity of the heart. He can help you estimate your ideal body weight, suggest appropriate diet, and suggest a suitable exercise program.

The last mentioned point is important. Unless you already exercise regularly, your goals and pace should be coordinated with your flight surgeon. There have been numerous examples of permanent heart damage done to individuals who were over-zealous in their exercise programs.

Now we have reviewed the Dash-One concerning failure of the main boost pump. You should memorize the warning signs and have clearly in mind your proposed corrective action. Remember, I may ask questions on your next check ride, i.e., physical examination. ★

References:

Statistical data presented in this article are based on *The Coronary Profiles 12-Year Follow-Up in the Framingham Study*. Journal of Occupational Medicine, Vol 9, Dec 1967. Other data was from a paper by Timothy N. Caris, Col, USAF, MC, entitled *Epidemiology of Coronary Heart Disease*. Briefs of the 17 instances of airline pilot incapacitation appeared in Aerospace Medicine, Vol 40, Jan 1969, page 64.

the aircrew & ground egress

by LT COL VICTOR J. FERRARI, JR. and ROBERT H. SHANNON

Difficulties encountered during ground egress from ejection-seat-equipped aircraft are resulting in the unnecessary loss of USAF aircrews. The introduction of more sophisticated weapon systems into the inventory with more complex egress systems has significantly increased the problem of ground egress. For example, some systems may require as many as six to nine separate actions before the crewman can leave an aircraft on the ground completely unencumbered. Experience has shown that man's varying psychophysiologic capabilities play an important role in escape and survival.

This study was initiated to further define and analyze those psychophysiological factors which affect man in the emergency ground egress situation.

During the five-year period, 1 Jan 1963-31 Dec 1967, there were 189 major aircraft accidents in ejection-seat-equipped aircraft involving emergency ground egress. This represented 16% of the total major accidents in these aircraft. The percentage of accidents involving emergency ground egress ranged from 10% of the total major accidents in 1963 to 26% in 1967. The number for 1967 was more than twice that of previous single years. There were 301 crew members involved in these accidents; 12 were fatally injured, 45 received major injuries, 8 received minor injuries, and 236 were uninjured. The 12 fatalities were directly attributable to egress difficulties. In 10 cases, the crewman received fatal burn injuries and 2 died from impact injuries when they ejected on the ground to escape severe fires. In the 45 major injury cases, 22 (49%) were burn injuries and 23 (51%) were nonthermal injuries.

Difficulties in effecting ground egress were experienced by 93 or 31% of the total crew members involved.

In order to evaluate ground egress difficulties, the following factors were investigated: aircraft model, phase of flight, occurrence of fire, personnel injury data, egress difficulties, psychological reaction of crew members, and effect of training on egress performance. For the purpose of this study, only those persons whose crew stations withstood impact forces were considered.

The distribution of emergency ground egress occurrences by phase of flight disclosed that the majority, 231, were associated with the landing phase. These included accidents that occurred on landing and those in which in-flight emergencies necessitated subsequent crash/emergency landings. Fifty-eight were during takeoff and the remaining twelve during other phases of operation such as taxiing, engine runup, or after the aircraft came to a stop.

The relationship of egress difficulties to phase of flight shows that 27% of the personnel involved in the landing accidents experienced subsequent egress difficulties, as opposed to 50% of the personnel involved in takeoff accidents. The reason for the higher incidence in takeoff accidents is due in part to the high gross weight of the aircraft and the limited corrective action which may be taken by the pilot. Also, most of these cases involve loss of directional control or power failure too late to effect successful abort.

Fire is the most critical factor in a ground egress situation. This has already been demonstrated as the primary causative agent of the fatalities and major injuries incurred. The magnitude of this problem is evidenced by the fact that approximately 50% of the personnel involved in ground egress accidents were exposed to fire. Significantly, the incidence of egress difficulties was twice as high when fire was present. This clearly demonstrates the adverse effect of psychological stress, such as fire, on the performance of a highly trained population.

The difficulties experienced during ground egress were quite varied. The largest single category was canopy/hatch operation which was reported in 30 or 28% of the total cases. It should be emphasized that these were not the result of failure of the normal canopy/hatch function per se. Difficulty locating and actuating canopy controls and impact damage were primary cause factors. Other difficulties involved the following:

1. Personal leads .... 19 cases
2. Survival kit .... 19 cases
3. Restraint system........ 13 cases
4. Personal equipment interference .... 13 cases
5. Injury .... 9 cases
6. Other .... 4 cases

In most cases, the crew members involved experienced a single difficulty; however, 18 did experience multiple difficulties.

Behavior factors were categorized as effective, degraded and ineffective. This was a judgment determination based primarily on the narrative description of events. The numbers were relatively small since there has been no emphasis on the reporting and recording of these factors until quite recently. In spite of the small numbers, they graphically illustrate the consequences of adverse behavioral reactions. In 19 cases, it was determined that degraded behavior was evident, and in 7 cases totally ineffective behavior ensued. Fire was present in 13 of the degraded behavior cases and all of the cases involving ineffective behavior. This undoubtedly was a major factor. The latter contributed to at least one of the burn fatalities and both fatal ground ejections. In the ejections, it is believed the crew members ejected to escape the fire while the aircraft was stationary. Four other crewmen involved in these accidents survived.

In the majority of the cases, training compatible with the current state of the art in ground egress procedures and equipment was evident. However, as in the case of behavior, training factors were not routinely reported. This, too, was a judgment determination in an attempt to identify those cases where good training was evident and prevented injury or the lack of training possibly contributed to injury and death. There were 39 definite cases found through this evaluation where the crew exhibited deficient training that could have resulted in a greater number of injuries or deaths had severe fire occurred. This is substantiated by the fact that deficient training was definitely indicated in eight of the injury/death cases.

The role of personal/protective equipment and fire suppression devices in ground egress accidents was also studied. However, these factors are not pertinent to this paper and will not be detailed at this time. Generally, it was apparent that fire retardant materials for clothing as well as personal equipment are necessary to reduce the severity of burn injuries in accidents involving fire. Failure to wear available equipment and premature discarding of equipment before ground egress were contributing factors in the incidence of burn injuries. With regard to fire suppression devices, it was obvious that these devices alone cannot be relied upon in the prevention of burn injuries and fatalities in ground egress accidents involving fire. The availability of necessary equipment and the time required to respond are limiting factors. There must be continued emphasis on a rapid ground egress capability.

The following case histories illustrate the basic types of behavior observed in emergency ground egress situations:

• An example of effective behavior under extremely adverse conditions involved a prelanding cockpit fire. The pilot successfully landed the aircraft in spite of intense heat and smoke. After landing, the lox bottle ruptured converting the fire to blast furnace intensity. The pilot attempted to leave the aircraft but was trapped by his foot restraints. He forced himself to sit back down in the fire and then proceeded to cut himself free. He exited the aircraft after having suffered major thermal injuries. This fire was so intense it melted the parachute, which ran down the pilot's legs into his boots, causing most of his injuries.

• A classical case of degraded behavior involves a highly experienced F-102 pilot. On an ORI scramble, the aircraft caught fire during the starting procedure. After the pilot failed to exit the aircraft, the crew chief replaced the ladder to assist him. In his confusion, the pilot had accomplished everything to effect egress except release the lap belt. Upon later questioning, he could not explain having overlooked this basic and vital step. Only the quick thinking of the crew chief prevented possible serious injury to the pilot.

• Totally ineffective behavior contributed greatly to a fatality in one F-101 aircraft. In this case, an aborted takeoff resulted in a major accident involving catastrophic fire. The pilot opened the canopy, removed his helmet, stood up, and attempted to jump over the side. He was probably restrained by the strap of his chute. He screamed, into the cockpit, and was not observed to make further egress attempts. The RO exited the aircraft wearing his helmet and chute and received only second degree burns to hands and buttocks. The severity of the fire in this case was not as great as in the first case which was an oxygen-fed fire located between the man's legs. It is obvious that, confronted with the psychic stress of fire and faced with a single failure in the escape process, this man experienced a psychological incapacitation and died.

• A category of behavior not previously discussed, but evident in many situations, is the tendency of pilots in a post-crash environment to revert to former reflex habit patterns. An example of this is the first major accident in an F-111 in which the pilot refused to pull the emergency quick disconnect handle because it was identical in size, shape, color, and location to the ejection actuation handle in the aircraft he was most familiar with.

Having defined the major types of behavior problems seen in our population, we now turn to an evaluation of training factors and their interrelationship with human behavior.

Egress training in the USAF has two major components: First, the crewmen are taught the design and function of egress equipment to provide them with an understanding of the basic procedures and the ability to troubleshoot malfunctions. Second, they receive initial and recurring training in egress simulators which develops correct reflex habits. The major problem in egress training results from the transition from one weapon system to another, because of the great diversity of egress systems. In this situation, the crew member must first unlearn his former reflex habits, then build a new one. Experience in the laboratory shows that retrained animal and human subjects often revert to former habit patterns when subjected to sudden stress. This phenomenon is amplified by increasing the complexity of the task. This has been vividly demonstrated in accident experience. One advanced weapon system involves as many as four options. These options require eight separate actions for canopy removal, egress with the parachute, egress without the parachute, and survival kit. Looking at the difficulties encountered with this particular weapon system, it was found that during one period this aircraft accounted for 58% of the egress difficulties in all aircraft. This was in spite of the most intensive ground egress training program devised to date. This clearly demonstrates that the major factor to the design of egress systems is man's psychophysiologic capability.

In summary, the following factors are evidenced in USAF accident experience:

1. Man's performance capability deteriorates with increasing psychic stress, e.g. fire.
2. There is a definite correlation between performance decrement and injury.
3. There is a definite relation between human behavior patterns in an emergency ground egress situation and the unique problems of egress training.
4. Man's psychophysiologic capability to perform in extremely hostile environments must be considered the most important parameter in egress system design.
5. The chances of egress difficulties increase dramatically with an increase in the decisions and actions which a pilot must make to effect a successful emergency egress.
6. Egress system R&D must minimize the options and actions required for emergency egress. ★

THE AUTHORS

Robert H. Shannon began his civil service career in April 1946 following three years military service during World War II. He joined Aerospace Safety, then the Office of Flying Safety, at Langley AFB, Virginia, in November 1946 and has worked exclusively with this organization. He was assigned to the Life Sciences Section in 1948, when at that time a System of Medical Data Collection was initiated. Subsequent to the functional transfer of the organization to Norton Air Force Base, California in 1950, Mr. Shannon supervised the data collection unit and was civilian supervisor of the Crash Injury Branch. During the past eight years, his efforts have been devoted almost entirely to the Air Forcewide accident experience in the area of aircrew escape systems, and personal and survival equipment. He has prepared numerous articles and papers for publication in aerospace periodicals. The papers are prepared in support of new USAF equipment or improvements to existing equipment and for use in the establishment of safety educational programs with the USAF.

Victor J. Ferrari, Jr., Lt Colonel, USAF, MC took his undergraduate training at the University of Arkansas and graduated from medical school in 1957 at the University of Arkansas Medical Center at Little Rock. He was in private practice for two years, and came on active duty with the Air Force in 1960. He attended the Primary Course in Aerospace Medicine in the fall of 1960, and went to Charleston AFB, South Carolina, as Chief of Aerospace Medicine from 1960 to 1962. From there he was assigned as Commander of the 7244th USAF Dispensary at Dhahran, Saudi Arabia, until July 1963. He then entered the USAF Residency in Aerospace Medicine, obtained a Master's Degree in Public Health (MPH) from John Hopkins University in June 1964, and completed residency in July 1966. Colonel Ferrari has subsequently been assigned to the Life Sciences Group of the Directorate of Aerospace Safety, Deputy Inspector General for Inspection and Safety, Norton AFB, California.

Presented at the Sixth National Flight Safety, Survival and Personal Equipment Symposium, October, 1968.

Reprinted with permission of SAFE Engineering Magazine.

ORI

OPERATIONAL READINESS INSPECTION TEAM
HQ, ADC

"BANG! . . . BANG! . . . YOU'RE DEAD???"

EVENT: ORI

TIME AND PLACE: We won't tell (NO NOTICE, you know).

"Kilo November-One-Three, MA, breaking starboard," proudly announces the interceptor pilot.

"Insert a kill, on J045," says an IND to his tech.

The computer's automatic umpire program kindly spits out a "Kill" and the weapons people heave a sigh of relief. After all, that was the last "faker" and it looks like the DC has done their job in fine fashion. (Or, so they think.)

The ORI team member queries, "What ammo did KN13 fire?"

"Kilo November-One-Three, what state ammo?" transmits the IND.

The pilot replies, "One primary."

"Sorry, 'bout that; no kill," declares the inspector as that last "faker" races toward its assigned ground target.

The IND turns and screams, "No kill? What d'ya mean? It's right there on my display."

"You inserted the wrong armament in the computer and got an invalid Pk," explains the inspector.

The identification troops were really "on-the-ball" and the track has been reclassified "Bee." The IND is frantically trying to get it changed to "faker." Of course, the "chicks" were directed away from the "Killed Faker" and none are in position for reattack. Well . . . maybe KN13 can still get him; but WOW, what a tail chase!

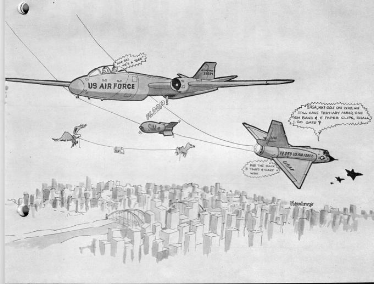
The "faker?" would you believe . . . 60 miles from BRL? . . . "Kilo November-One-Three, Port Two-Four-Zero . . . Go Gate . . . Go Gate . . . Kilo November-One-Three, target bearing, two-three-zero at this five." "Kilo November One . . . " (and on another frequency) . . . "SAGA Control, SAGA One-Six-Five . . . Bombs Away!!!"

What happened? We know WHAT — the question is WHY?

In this sad episode the problem was a failure to communicate. The pilot failed to report his ammo with mission results as required by ADCR 51-6. Therefore, the IND didn't know "secondary" had been used. To make matters worse, the IND assumed that primary armament had been fired instead of confirming it with the pilot. The Pk for primary armament was higher than secondary and the inspector had to nullify the "Kill."

Although Pk would only be a planning factor in a real situation, it is a very important scoring tool for exercises and evaluations. Yet we see the wrong armament used for scoring at least once on almost every ORI. It's apparently not intentional, because there have been cases when a lower Pk was used. For example: The pilot fired a weapon with a Pk of .70 and the controller scored the "Kill" using armament with a Pk of .60. The game is tough enough without giving away points.

Why did it happen? Was it the result of poor R/T during daily training? Could be! If pilots would make it a practice after every intercept to give the mandatory



ammo report with mission results (and controllers insist that they do), this important item wouldn't be so easily forgotten.

One air division had an excellent procedure for use on daily training missions. The pilot reported ammo remaining according to the tactic he desired to fly on the next intercept. One mission briefing called for three co-altitude front attacks, two low level sterns and RTB. After each "front" pass the pilot reported primary armament until he no longer wanted anymore "front" attacks. Then he reported secondary to indicate he wanted a "stern." When he had "BINGO" fuel or wanted to return to base, the pilot reported "Ammo zero." The pilots developed the habit of reporting their ammo and the controllers received training in considering armament with tactic selection.

We aren't in the training business but thought the above procedure was worth mentioning. Whatever your training methods, emphasis needs to be placed on making **mandatory** ammo reports. It's difficult to understand why a controller will do his part at conducting a perfect intercept and then guess about the armament used, possibly giving away the "Kill."

Why not be SURE? Then you can say . . . "BANG! BANG! . . . **YOU'RE DEAD!!"**

BILL NORRIS, Colonel, USAF
Team Captain, ADC ORI Team

a BACKWARD GLANCE

During one of our infrequent (not by choice) visits to the field, we ran across one of those "other guys" who was forced to get out of a sick seagull. In response to our request for some soul-searching words of wisdom, Major Jim Hayes, Ops Officer of the 460th FIS at Oxnard AFB, forwarded the following observations. Read and heed from one who's been there.

The Editors

TO THE EDITOR:

A pilot today can sit and hangar talk for many hours about the need for emergency procedures to be of second nature. But until confronted with the sudden reality of an actual emergency, one cannot conceive of the speed with which all that drilled-in, second- nature knowledge must emerge from the depths of his mind, or the incredible acceleration of his reflexes in order to apply those procedures. After all, a normal overhead traffic pattern flown with impending problems, other than making a grease job on touch down, really seems fairly remote.

What happens when your bird flames out on the down wind as the gear is being lowered? Your brain sizzles with a myriad of questions: Can I make the runway? Will it start? If it won't start, when do I eject? Where do I eject? These are only a few of the thoughts that flash through your mind intermingled with immediate action processes of the Air Start, the Forced Landing and Ejection Procedures. At this point, the base to final turn is in progress and the controls freeze. Immediate action on the RAT, and back to the air start attempt. Altitude is being lost in order to keep the air speed. You're still praying for the air start, but no soap. It won't make it; and even if it did, time wouldn't allow clearance, and the distance makes the runway an impossibility. Nothing works and the only thing left to do is eject. By this time, you're 90° in the turn and your altitude is decreasing rapidly. You spot an open field, aim the aircraft's nose at it, and eject. The ejection system is designed to work at ground level, but the greater the altitude, the better. This ejection took place between 100 and 200 feet with no complications or injuries. It all happened in just a few impossibly crowded and active minutes.

I'd like to point out a few items of major import: Know your procedures backwards and forwards. They may have to come automatically and like greased lightning. Realize that time compression, as in this situation, can play an active role; that events which usually take minutes to occur may happen in seconds and split-seconds. Be intimate enough with your aircraft to know the difference between when she is just sick and when she is in her death-throes. In the latter situation, the decision to eject must be made as rapidly as possible. The longer one delays, the less are his chances of survival. And ejection is better than ending up in a heap of twisted metal in a plowed field short of the runway.

JAMES E. HAYES, Major, USAF

√ POINTS

We would sincerely appreciate your inputs mailed directly to: The Editor, INTERCEPTOR, Hq ADC (ADCSA-E), Ent AFB CO 80912

√ Maintenance operational checks will be accomplished on the "ground" to assure that aircraft systems, or components, have been repaired, reassembled, or adjusted satisfactorily. T.O. 1-1-300 does not provide for airborne maintenance operational checks. When it is not feasible to determine safe and/or required functioning by means of ground or shop tests, an FCF should be requested. Ref: T.O. 1-1-300. (4600WGMME-Q)

√ Flight line noise will usually affect hearing in the high frequencies first. If your stereo does not seem to perform as well as it used to, ask yourself if you've been conscientious in the use of the issued ear plugs or muffs. Remember, permanent hearing loss due to noise is just that — permanent. There is no way to correct that type of hearing loss by medication or surgery. (ADCSG)

√ One of our ANG units recently experienced a reportable lost-time accident which was caused by a crew chief slipping on the wet step of a flight line tug. The unit will apply the same nonskid material to the steps and brakes of their tugs that has been so effective on aircraft ladders. (ADCSA-F)

√ A recent change to AFR 167-3 now authorizes aircrews to obtain two pairs of the standard aircrew spectacles and two pairs of the aircrew sunglasses. If you need to wear glasses, make certain you obtain the extra pairs. (ADCSG)

√ September 1948. Maj Richard L. Johnson, flying an F-86A, set a world speed record of 671 miles per hour at Muroc Lake, California. (ADCPS)

√ Pengun flares are 2-year time change items and occasionally a certain lot number is declared unsafe before that time is up. If you carry your own, better have your friendly PE man check them for currency. (4600WGOOT-L)

√ September 1947. The United States Air Force was established as a separate service. (ADCPS)

√ To insure effective scheduling, it is desired that aircraft takeoff within plus or minus five minutes of the stated time. The aircraft will normally be cancelled after mutual agreement between the chiefs of maintenance and operations, if takeoff cannot be effected within 30 minutes of the scheduled time. (Ref: AFM 66-1/ADC Sup 1, Para 2-13e.)(4600WGMME-Q)

A radial tire is considered one of the contributing factors in a recent private motor vehicle accident which resulted in the death of a U.S. Air Force airman. According to safety officials, the "death" vehicle was equipped with a radial tire on the right front wheel and conventional tires on the other three wheels. The combination most likely, report safety officials, caused the automobile to enter a skid, ultimately causing the fatal accident. Leading trade magazines and bulletins distributed by major tire companies emphatically warn that mixing radial and conventional tires is very dangerous. Without exception, they agree that radial tires should be installed on all four wheels and recommend an additional radial tire as a spare. If only two radial tires are installed on a vehicle, tire officials state, they should always be placed on the rear wheels. Radial tires should never be installed on the front wheels with conventional tires on the rear. This is because of the positive gripping action of radial tires. With radial tires mounted on the front wheels and conventional tires on the rear wheels, a severe skid could easily result. (ADCPS/Norton Globetrotter)

September 1960. The last F-104 interceptor left the ADC inventory. (The F-104 rejoined ADC in 1963.) (ADCPS)

One safety-minded state, renowned for its big game hunting, requires rifle hunters and those hunting with a shotgun firing a single slug to wear a head covering and an outer garment containing fluorescent blaze orange color. A total of 300 square inches of fluorescent blaze orange material is required to be distributed between the outer garment and the head covering. (ADCSA)

September 1951 Congress, in passing Public Law 150, directed that the U.S. Air Force would have three major commands: Air Defense Command, Strategic Air Command, and Tactical Air Command, and such other commands and organizations as may be established from time to time by the Secretary of the Air Force. (ADCPS)

The SRU-21/P survival vest is mandatory for all ADC aircrews flying ejection seat aircraft. Remember — anything you carry in the leg pockets of your flight suit may easily be lost. (4600WGOOT-L)

During deployments, most units furnish manpower to the airlift aircraft loadmasters. As a result of a recent incident, it is suggested that unit mobility officers caution the loading augmentees to load and off-load only under direct supervision of the loadmaster. This could prevent a ground accident — particularly where heavy rolling stock is concerned.

(ADCSA-F)

BLUE ZOO

"OK, when I say break, break right!"

CROSS WINDS AND WIND SHEAR

Watch those surface winds!

by **LT COL JAMES H. AIKMAN**/*Hq USAF, SAFOI*

Ed. Note: This article appeared previously in the Special Edition of the INTERCEPTOR, Weather for Air Defense, published in December, 1963. Colonel Aikman was then a member of the INTERCEPTOR staff.

Gusts and Wind Shear

The variation of wind velocity and direction throughout the atmosphere is important because of its effect on the aerodynamic forces and movements on an aircraft. As the aircraft traverses this variation of wind velocity and direction during flight, the changes in airflow direction and velocity create changes in the aerodynamic forces and produce a response of the aircraft. The variation of airflow along a given direction exists with shear parallel to the flow direction. Hence, the velocity gradients are often referred to as the wind "shear."

The effect of the *vertical gust* is quite pronounced on the aircraft at high speeds, because of the possibility of damaging flight loads. The basic mechanics of the vertical gust are quite simple; namely, that the vertical gust velocity is added vectorially to the flight velocity to produce some resultant velocity (Figure 1). The principal effect on the vertical gust is to produce a change in aircraft angle of attack; i.e., a positive (up) gust causes an increase in angle of attack, while a negative (down) gust causes a decrease in angle of attack. Of course, a change in angle of attack will effect a change in lift and, if some critical combination of high gust intensity and high flight speed is encountered, the change in lift may be large enough to cause structural damage.

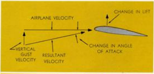


FIG. 1 EFFECT OF VERTICAL GUST

At low flight speeds during approach, landing, and takeoff, the effect of the vertical gust is due to the same mechanism as the change in angle of attack. However, at these low flight speeds, the problem is one of possible incipient stalling and sinking, rather than overstress. When the aircraft is at a high angle of attack, a further increase in angle of attack due to a gust may exceed the critical angle of attack and cause an incipient stalling of the aircraft. Also, a decrease in angle of attack due to a gust will cause a loss of lift and allow the aircraft to sink. For this reason, any deficiency of airspeed will be quite critical when operating in gusty conditions.

The effect of the *horizontal gust* differs from the vertical gust effect, in that the immediate reaction is a change of airspeed rather than change in angle of attack. In this sense, the horizontal gust is of little consequence in the major aircraft airloads and strength limitations. Of greater significance is the response of the aircraft to horizontal gusts and wind shear when operating at low flight speeds.

The response of an aircraft is to a large extent dependent upon the aircraft characteristics, but certain basic effects are common to all aircraft. Suppose that an airplane is established in steady, level flight, with lift equal to weight, thrust equal to drag, and trimmed so there is no imbalance of pitch, yaw, or roll movements. If the aircraft traverses a sharp wind shear equivalent to a horizontal gust, the resulting change in airspeed will disturb such an equilibrium. This change would cause the aircraft to accelerate in the direction of the force imbalance; that is, it would accelerate down and forward until a new equilibrium is achieved.

The response of the aircraft to a horizontal gust will differ according to the gust gradient and aircraft characteristics. Generally, if the aircraft encounters a sharp wind shear which reduces the airspeed, it tends to sink and incur a loss of altitude before equilibrium conditions are achieved. Similarly, if the aircraft encounters a sharp wind shear which increases the airspeed, it tends to float and incur an altitude gain.

During gusty conditions every effort must be made for precise control of airspeed and flight path, and any changes due to gusts must be corrected by proper control action. Under extremely gusty conditions, it is advisable to utilize approach, landing, and takeoff speeds slightly greater than normal, to provide a safe margin for adequate control. Also, the crosswind component across the runway will define certain requirements of lateral control power. The aircraft which exhibits large dihedral effects at high lift coefficients is quite sensitive to crosswind, and a limiting crosswind component will be defined for the configuration.

Gust Load Factors

Gusts are associated with the vertical and horizontal velocity gradients in the atmosphere. A horizontal gust produces a change in dynamic pressure on the aircraft, but causes relatively small and unimportant changes in flight load factor. The more important gusts are the vertical gusts, which cause changes in angle of attack. This process is illustrated in Figure 2. The vectorial addition of the gust velocity to the aircraft velocity causes the change in angle of attack and change in lift. The change in angle of attack at some flight conditions causes a change in the flight load factor.

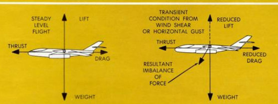
As an example, consider an aircraft flying at sea level at 350 knots and encountering an effective gust of 30 ft/second (severe turbulence). The gust would produce a load factor change of 1.61. This increment would be added to the flight load factor of the aircraft prior to the gust, e. g., if in level flight before encountering the gust, a final load factor of $1.0 + 1.6 = 2.61$ would result. As a general requirement, all aircraft must be capable of withstanding an effective gust of approximately $\pm$ 30 ft/second when at maximum level flight speed for normal rated power. Such a gust intensity has relatively low occurrence frequency in ordinary flying operations.

The properties of the aircraft exert a powerful influence on the change in load factor due to gusts. An aircraft with a straight, high aspect ratio wing (C-47) would have a high lift capability and would be quite sensitive to gusts. On the other hand, the low aspect ratio, swept wing aircraft has a low lift capability and is comparatively less sensitive to turbulence.

The apparent effect of wing loading (aircraft weight divided by wing area) is at times misleading and is best understood by considering a particular aircraft encountering a fixed gust condition at various gross weights. If the aircraft encounters the gust at lower than normal gross weights, the accelerations or actual aircraft vertical displacements due to the gust condition are higher. This is explained by the fact that essentially the same lift change acts on the lighter mass.

The high accelerations and inertia forces magnify the impression of the magnitude of turbulence. If this same

FIG. 2 EFFECT OF WIND SHEAR



aircraft encounters the gust condition at higher than ordinary gross weight, the accelerations due to the gust condition are lower, i.e., the same lift change acts on the greater mass. Since the pilot primarily senses the degree of turbulence by the resulting accelerations and inertia force ("seat of the pants" sensations), this effect can produce a very misleading impression.

The effect of airspeed and altitude on the gust load factor is important from the standpoint of flying operation. The effect of altitude is related to density, e.g., an aircraft flying at 40,000 feet would experience a gust load factor one-half as great as at sea level. This effect results because the *true* airspeed is twice as great, and only one-half the change in angle of attack occurs for a given gust velocity. Airspeed effect is illustrated by the fact that the gust load factor increases with true airspeed. Such a relationship emphasizes the effects of gusts at high flight speeds and the probability of structural damage at excessive speeds in turbulence.

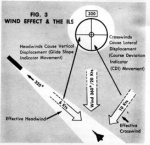
The operation of any aircraft is subject to specific operating strength limitations. A single large overstress may cause structural failure or damage severe enough to require costly overhaul. Less severe overstress repeated a sufficient number of times will cause fatigue cracking and require replacement of parts to prevent subsequent failure. A combat fighter aircraft need not be operated in a manner like the "Little old lady from Pasadena" driving to church on Sunday, but each aircraft type has strength capability only specific to the mission requirement. Due regard must be given to operating limitations. The combination of climbing turn, afterburner climb speed, heavy fuel load (just after takeoff), and turbulent air can cause loss of external stores, which in many instances goes unnoticed by the pilot.

Wind Effect and the ILS

A wind problem affecting an ILS approach should have the same effect on a radar approach. However, while a radar controller may conduct 50 given approaches during a training day, a pilot may experience but two or three. Consequently, it stands to reason that the radar controller experiences more practice in wind analysis for approaches than does the pilot. The resultant force of wind on an instrument approach in average conditions, though not of great magnitude, can cause considerable difficulty for the pilot on an ILS, who must direct his concentration on good basic instrument control.

By use of trigonometric functions and a computer, in a sample problem (A/C ground speed, 120 knots; ILS inbound course, 320°; wind, 360°/20 k.), let us examine the wind effect. It is determined that the direct crosswind component of 10 knots, if uncorrected, can cause a lateral shift of approximately 20 ft/sec on the localizer course. Disregarding vertical wind currents, headwind components of wind on final approach would affect the glide slope by varying the aircraft's ground speed. If a given rate of descent is maintained on final approach, a change of 20 knots in ground speed will cause the aircraft to climb or descend on the glide slope at the rate of approximately 100 ft/min. With a constant wind, these facts might present no problem to the pilot. However, the wind never remains constant, but changes in direction as well as velocity as the aircraft descends on final approach.

FIG. 3
WIND EFFECT & THE ILS



Certain facts concerning the wind might aid the pilot in making his own wind analysis. Upon receipt of destination weather, the pilot should determine the proximity and rate of movement of any fronts. In addition to low ceilings, a front may have wind shear, turbulence, and gust winds, the intensity of which is strictly dependent upon the air masses involved.

Temperature inversions are accompanied by wind shear. These inversions are most prevalent in the early morning hours and are raised or dissipated with the sun's radiation. Therefore, ceilings at destination during the morning hours would prevent the sun from dissipating the inversion.

Gusting surface winds can give the pilot some idea of the winds at radar or ILS pattern altitude. For example, if the surface winds are 10 knots, with gusts to 20, the winds at ILS pattern altitude will generally be 20 knots. In other words, the winds at pattern altitude are usually the same as the peak gust velocity at the surface.

Turbulence on final approach should tell the pilot that he is encountering wind shear.

The pilot should also know that due to cooling in the late evening, while the surface winds may dissipate, the winds at pattern altitude will most likely increase. Therefore, in late evening, on the ILS, he should be aware of a need to decrease the amount of drift correction as he proceeds down the glide slope.

There is very little that can be said about a standard variation between surface and pattern altitude winds. It has been theorized that the Coriolis Force (earth's rotation) causes the direction of the surface winds to be deflected 30-40° to the right at pattern altitude, while the frictional forces of the earth's surface cause the pattern altitude winds to be decreased at the surface by approximately 50%. While this may be true, this theory is unwieldy for practical application, and the results are undependable. Consequently, it must be reiterated that *the relation between surface and pattern altitude is strictly dependent upon the air masses involved.*

The azimuth and glide slope corrections mentioned earlier have generally been good rules of thumb for pilots' use in reaching safe landing minimums, regardless of wind effect. But, during VFR practice of ILS approaches, how much better is that second approach, when you have had a chance to experience the wind effect? During weather, we cannot always have two chances at the approach; we must be successful on the first attempt. Consequently, it behooves the pilot to get a thorough briefing on destination weather with respect to lower level winds when he anticipates an ILS approach. This thorough briefing will aid him in his wind analysis and help him to anticipate a few of the necessary corrections.

Crosswinds and Aircraft Control

In the supersonic era, all aircraft are not as conventional as taught in our early basic flying programs, and the faster and more sophisticated they become, the greater the demands that are placed on the pilot.

Although landings are very easy under normal conditions, slight abnormalities or variations can catch even the most experienced unaware. Crosswind landings have caused far too many "close calls" in many of our century series fighters. One can enumerate many reasons for loss of control and blown tires during a crosswind landing. Here are some techniques that may help:

1. Many pilots tend to use the same final approach speed as with a no-wind condition. The best procedure is to add speed for the gusts and fly the aircraft on the ground, rather than holding it off. The added speed (half the gust factor) is still not landing any faster if you consider your headwind component. So don't be afraid of adding a few knots for the short runway.

2. On final approach, use a crab, a wing-down, or a combination of both. The true crab is difficult to remove at the proper moment just prior to touchdown. Timing is critical here, and you risk subjecting gear to

excessive side loads. If necessary, land the bird on one gear — if longitudinally down the runway with normal sink rate, you will not damage the gear.

3. Beware of the use of aileron alone for directional control. On a wet runway you may go out of control immediately. Use a combination of nose wheel steering, rudder, and brakes for all circumstances, so no turning moment or skid can develop.

• High pressure air on the right side of the tail causes the nose to go right.

• Very high pressure causes aircraft to skid the main gear to the left.

4. Weathervaning tendency in the Deltas depends on total area fore and aft of main gear. The F-102, with greater forward area, will become unconventional (nose goes downwind) to crosswind. The F-106, having a greater aft plate area, will go conventional (nose goes upwind). As drag chute effectiveness decreases with speed, lateral displacement of aircraft varies directly with crosswind component.

5. Points to Remember:

• Use a good drift reference (white line or edge of runway).

• Avoid touchdown in crab; kill drift on final.

• Do not overuse ailerons on landing roll — avoid letting a skid develop.

• Increase final approach speed in a crosswind or gusty condition. Fly the bird on the runway. Lower nose sooner than on normal landing.

• Don't let the drag chute bother you. Your momentum is down the runway. It will help straighten out crabs and skids, and will aid in directional control. If, after slowing down, crosswinds are too severe, jettison the chute.

• Don't let the abnormal landing situation panic you. Fly the bird "all the way" to the chocks. ★

DOWN and out

F-106 SPIN

A flight of four clean F-106As were scheduled to perform an ACT training mission. The pilots were briefed in accordance with the squadron briefing guide. All were ACT qualified except the number 1 man who was on mission number 7. Weather presented no problem and so the aircrews proceeded to their aircraft. No discrepancies were noted on preflight or during pretakeoff checks. Formation takeoffs and joinups were accomplished. Enroute to the training area, the flight separated into elements to accomplish inflight pre-ACT aircraft checks. Patrol formation was then assumed for the remainder of the climb to 30,000 feet.

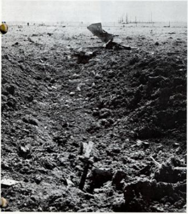
After level-off, the flight was split for the first engagement by giving Fighters 1 and 2 a 360° turn to the left and continuing the second element north, followed by a 180° left turn. During the left positioning turn, the IP in Fighter 2 assumed the lead of the first element to demonstrate the initial attack. Minor corrections were given to position the elements head on for the first engagement. Lead element was stabilized at 29,000 feet. The elements acquired radar contact of each other as the distance closed. Initial visual contact was made by the first element, burners were selected and a hard left climbing turn initiated into the second element. When lead element lit afterburners, the second element acquired visual contact and entered a hard descending left turn. The flights passed within a mile of each other, canopy to canopy, each in a left turn. After passing Fighters 3 and 4, the lead element reversed to the right and decreased rate of climb. Fighters 3 and 4 continued turning left and at approximately 180° of turn, Fighter 3 leveled his aircraft in preparation for a climb to intercept the lead element. At some point during this part of the maneuvering, the IP in Fighter 2 observed one of the aircraft of the opposing element in an apparent 50 to 60 degree nosedown attitude, venting fuel and rotating or oscillating. He immediately transmitted that someone was in a spin and to disengage.

Shortly after Fighter 3 sighted the first element and began the left descending turn to engage, the pilot of Fighter 4 selected afterburner and crossed to the inside of the turn to establish fighting wing position. Fighter 3 lit burner after completing 20-30 degrees of turn. In the meanwhile, Fighter 4 thought he had too much overtake in min burner. He relaxed "G" forces to diverge from the established turn and then reapplied stick presure in an attempt to regain the correct position. While applying the corrective stick force, the aircraft rolled violently to the right, back to the left, and then to the right again. Prior to the roll-off, the pilot did not encounter buffet associated with near stall condition, nor could he recall an abrupt pitch change. The rolling action was in the vicinity of 60-70 degrees. The nose dropped at some angle to the right when the last reversal to the right occurred. The pilot indicated that he may have tried to fight the roll with control inputs which could have aggravated the condition. He believed the rolling action was caused by his leader's jetwash.

When the spin developed, the pilot estimated his pitch angle as 10-15 degrees with no significant variations. The direction of rotation was readily apparent to the pilot, so he neutralized controls, reduced power to idle, and then applied full right aileron in slightly aft stick position. Other members of the flight confirmed spin direction and from their statements, it was estimated that the spin began at approximately 25,000 feet. The pilot maintained control recovery inputs until he felt the nose drop 25-30 degrees, and then neutralized everything in anticipation of recovery. At this point, the pilot felt spin rate increase slightly and then slow down. He reapplied recovery inputs because he did not see an airspeed increase. A member of the flight recommended drag chute deployment, which the pilot did without apparent effect. When the recovery controls were reapplied, the pitch attitude stabilized at slightly more than the initial estimate of 10-15 degrees. Several turns later, the aircraft again seemed to recover because the nose dropped and the rotation appeared to decrease. Controls were again neutralized, with the same negative effect as previously experienced. The pilot reapplied recovery inputs but shortly afterwards was advised to bail out. He did so below 14,000 feet. According to the other members of the flight, the aircraft recovered from the spin prior to impact. Evaluation of the impact area and debris pattern substantiates this, since the aircraft struck the ground in a 20-30 degree dive, at a nearly wings level attitude, with approximately 340 knots forward velocity. The pilot landed safely in trees and was rescued promptly.

The accident board concluded that procedures used by the pilot in attempting to recover from the spin were in accordance with those prescribed in the Dash One. This conclusion was reached after thoroughly analyzing the F-106 Spin Test Report, the available history of F-106 spin experience, the pilot's efforts in this accident, and the procedures as defined in the Dash One.

A study of eight known F-106 aircraft spins revealed that the Dash One procedures were successful in effecting the recovery of only two aircraft. In the remaining six instances, pilot attempts to effect recovery using the prescribed procedures were not effective. In two of these instances, the aircraft recovered after aircrews ejected and presumably the controls returned to a near neutral position. In another case, the aircraft recovered after the pilot released the controls while assuming the ejection position. Two other aircraft recovered after the aircrews used what was described as forward stick, following unsuccessful Dash One procedures. In the remaining spin, the aircraft was abandoned following unsuccessful attempts to recover using prescribed procedures and it could not be determined whether the aircraft recovered after the aircrew ejected. In other words, based on experience, pilot efforts to apply prescribed procedures have not been effective in a significant number of cases. The problem seems to be associated with the requirement to use slight aft stick for recovery. The neutral pitch control position is difficult to interpret by feel. It is possible that aircrews have unintentionally exaggerated application of "up elevon" and thereby degraded recovery.



After weighing the evidence, the Accident Board concluded that the primary cause was a Technical Order deficiency in that the pilot was not provided with spin recovery procedures that were effective, or if the existing procedures are technically correct, they are not presented in such a manner as to allow them to be effectively employed. A contributing cause was determined to be pilot factor in that he controlled his aircraft in such a manner as to allow it to enter a post-stall gyration and spin. During staffing of the report, the primary cause was considered to be pilot factor for the reason that the pilot allowed his aircraft to enter a spin and then did not effectively employ recovery procedures. The T. O. deficiency was listed as contributing cause.

Pilots will wince and swallow hard over the reversal. It's true beyond question that if you spin, crash, and burn during air combat, you might just as well have been shot down.

This must be understood during practice or real engagements. But in this accident there are elements which are not as truly black or white. The pilot was on a directed, authorized mission in which aircraft maximum performance was required. While attempting to apply his skill in a maneuvering situation, he inadvertently lost control of his aircraft for a reason which apparently had not previously been considered a potential hazard, namely, jetwash. After entering a spin, the pilot used what were determined to be correct spin recovery procedures. His efforts were not effective and he abandoned the aircraft which subsequently recovered by itself prior to impact.

During the investigation, experts who conducted the F-106 spin test program reaffirmed the technical correctness of prescribed recovery procedures. The poor success rate of squadron pilots was attributed to (a) pilots not neutralizing the controls and waiting until the aircraft either recovers from a post-stall gyration or stabilizes in a spin before applying spin recovery procedures, or (b), pilots are misinterpreting aircraft movements and applying incorrect recovery procedures. This analysis is strangely reminiscent of an analysis made during the days of the F-101B pitchup crisis. Voodoo pilots were told that there was absolutely no reason in the world why they shouldn't be able to recover from pitchup by using the prescribed procedures. And yet they continued to crash. Then it came to pass that one of the experts entered pitchup inadvertently, lost the airplane, and very nearly his life. The event confirmed what pilots had suspected all along: that there was a mysterious difference between recovering from an inadvertent pitchup and one which was entered under closely controlled conditions. The point was driven home. Pilots became convinced that a serious deficiency existed in the recovery procedure, and they took the necessary precautions to stay out of pitchup. The number of incidents and accidents reduced drastically.

If the F-106 spin recovery procedure had a 100% success rate, spin entry would be of no concern. However, the demonstrated lack of success in pilot attempts to effectively utilize the procedure is the critical factor which has prevented recovery and therefore caused accidents. It's not difficult to see how the accident board reached its conclusions under these circumstances. Had pilots been forewarned that spin entry would more than likely result in an accident, there would then have been a direct connection between this pilot-induced spin and the accident. The situation has changed. Although still advertised as technically correct, the procedure is being investigated to increase its effectiveness. But, in the meantime, a word to the wise. If you're interested in avoiding a pilot-factor accident, stay out of spins, period.

safety officers'

FIELD REPORTS

T-33A ZERO OIL PRESSURE. Before takeoff checks were completed and oil pressure was normal before starting takeoff roll. Shortly after takeoff the pilot noted zero PSI oil pressure. Emergency was declared and immediate landing was made. Investigation revealed a broken (open) lead on the oil pressure transmitter electrical connector. The connector was repaired, following day without recurring oil system malfunction. No other oil system malfunctions were noted.

F-101F FIRE WARNING. A practice intercept was being performed at 34,000 feet MSL, full military power. After breakaway the aircrew observed both fire warning lights to be illuminated. EGT on #1 engine was 630°C and #2 engine was 620°C. Both throttles were retarded and both fire lights extinguished. No other indications of fire were noted. A precautionary landing was immediately performed. Investigation revealed that the 16th stage air duct connectors on both #1 and #2 engines were leaking, as well as the bleed valve actuator on #1 engine. The 16th stage duct connector seals and bleed valve actuator were replaced. A functional check flight was flown and the aircraft was released.

T-33A GEAR PROBLEM. Shortly after takeoff the pilot heard a loud noise followed by complete hydraulic failure. A chase aircraft was vectored to observe the aircraft for external damage. The right main gear was observed to be extended with the hydraulic actuating cylinder and lines hanging free on the wing attachment support. Alternate gear extension methods were attempted to no avail. An emergency landing was made on the one extended gear. No injuries and only minor damage (less than 100 manhours) were sustained by the aircraft. Cause of the hydraulic failure was materiel failure of the actuating cylinder cap at the mounting hole. The failure occurred in a stress concentration manufactured for the installation of a grease fitting.

F-101 MULTIPLE PROBLEMS. Twenty minutes after takeoff, the right generator out light illuminated. The pilot decided to return to home base. Two minutes later the utility system telelight illuminated and the utility gauge read zero. The pilot declared an emergency and diverted to the nearest AFB. The failures were unrelated. The right generator had failed, followed by the right utility pump causing the utility hydraulic fluid to escape.

F-102A MULTIPLE PROBLEMS. On the last leg of a cross-country to home plate, the UHF radio was lost for about five minutes, but came back on. Then the heading indicator was noticed to be inoperative, followed by loss of the standby attitude indicator, dampers, trim, cockpit temperature control, and cockpit lighting. The lighting was checked for trouble shooting purposes, even though the pilot was in VFR conditions on top of scattered clouds at dusk. The pilot never received a warning light even though the DC generator shaft was found sheared. The battery was also found to be dead (shorted internally). The warning light failure to function is believed to have been caused by a defective reverse current relay in the DC control panel. The panel was changed.

T-33A VIBRATIONS AND RUMBLE. The aircraft was being flown on an annual proficiency check and the flight had been normal in all respects. As the throttle was reduced to begin a descent, engine vibrations and rumbling occurred. The vibrations and a high pitched whine continued at speeds between 200 and 250 knots, with power settings between 65 and 80% RPM. Emergency fuel was selected, but had no effect on the malfunction. Engine instruments indicated a normal and stabilized operating condition and the precautionary landing was made without incident. Post-flight inspection of the engine indicated an irregular flame pattern (hot spot). The engine was replaced and a satisfactory test flight flown. Subsequent flights have been conducted without further difficulty.

safety officers'

FIELD REPORTS

T-33 ENGINE NOISE. While climbing through 23,000 feet at 100% power, a rumble was experienced in the aft section of the aircraft. The noise disappeared and returned about a minute later. Power was set at 92% and "gang-start" was selected causing the noise to disappear. An uneventful landing was made. The oil was examined and found to contain a large quantity of iron, which indicates bearing failure. The engine was pulled and replaced.

F-102A FLAMEOUT. Aircraft flamed out on start-up when the pilot switched to the emergency fuel system at 28% to expedite what he felt was a sluggish start. The pilot did not note if the emergency fuel light came on when he selected emergency fuel. Pilot made several more starts and switched from normal to emergency system several times at RPMs ranging from 25% to 80%. The systems operated normally. He then aborted the aircraft. The aircraft system was checked out and the emergency fuel switch was removed and replaced.

F-106A OXYGEN. While climbing to altitude, pilot noted beginning symptoms of hypoxia. Although the oxygen quantity and pressure indications were normal, there was no drop in pressure during breathing. The pilot descended and accomplished a routine landing. Investigation revealed the oxygen regulator flow control was out of adjustment and was not delivering oxygen to the pilot.

F-106B, FUEL LEAK. On takeoff roll the pilot noted strong fuel fumes in the cockpit. Shortly afterward he noted excessive fuel consumption and declared an emergency. After landing a broken fuel line on the fuel pump was discovered. The line was replaced after which the system was checked OK.

F-106A RECOVERY PROBLEM. Q-intake broken, caused by drag chute straps wrapping around leading edge of vertical stabilizer during inadvertent spin recovery. Aircraft was performing rudder roll maneuver and entered spin at 33,000 feet. Normal spin recovery procedures were not effective. Drag chute was deployed passing through 24,000 feet with normal spin recovery procedures again utilized with negative results. Controls were then neutralized and the control stick moved full forward. The nose of the aircraft pitched down and airspeed started to increase. Dive recovery started at 160 knots with aircraft leveling at 12,000 feet. Visual inspection by another aircraft confirmed drag chute wrapped around vertical stabilizer and Q-intake broken. Aircraft recovered with no further problems. Q-intake replaced.

F-106A ELECTRICAL PROBLEMS. Aircraft had multiple electrical failures after forty minutes of flight. After breaking off from high altitude intercept, 100 miles from home, the AC power fail light illuminated. The air turbine generator did not come on the line with resultant loss of fuel boost pumps, AMI, and AVVI. DC and MA-1 power losses occurred intermittently, then completely failed 40 miles from home plate. Difficulty also encountered on automatic transfer of UHF radio. Aircraft successfully recovered after partial panel weather penetration. CSD removed, replaced, and tested satisfactorily.

F-101B, CONTROL MALFUNCTION. Over-sensitive flight controls prompted the pilot to engaged the AFCS. With the altitude hold position selected, the aircraft began a high G pullup exceeding the warning horn boundary and engaging the pusher. The pilot activated the paddle switch and pulled the AFCS circuit breaker. He declared an emergency and a precautionary landing was made without incident. Investigation revealed leaking bellows unit, defective CADC converter, and erratic pitch rate gyro.

F-106B, VIBRATIONS. During flight pilot noted excessive vibrations from an unknown source. A precautionary landing was made. Investigation revealed the 056 generator had failed.

THE WAY THE BALL Bounces

ACCIDENT RATE

1 JAN THRU 31 JULY 1969

	ADC	ANG
Thru July 1969	*5.3	*5.6

MAJOR — ALL AIRCRAFT

ON TOP OF THE HEAP

MO	ADC	MO	ADC	MO	ANG
63	48 FIS	24	343 Ftr Gp	78	162 Ftr Gp
38	4603 AB Gp	22	49 FIS	76	112 Ftr Gp
30	75 FIS	17	71 FIS	57	148 Ftr Gp
28	4758 DSES	16	78 Ftr Wg	35	147 Ftr Gp

ACCIDENT FREE

BOX SCORE

ACCIDENTS FOR Jul / CUM TOTAL	1st AF	4th AF	10th AF	ADWC	4600	ANG
T-33		1				2
F-100						
F-101	1		1			
F/TF-102						2
F-104						
F-106	2	2	1			
B-57	1	1				
F-89						
EC-121	1					
OTHER CONV						

MINOR ACCIDENTS THIS PERIOD – 0
MINOR ACCIDENTS CUMULATIVE – 3

CUMULATIVE RATE

1 JAN THRU 31 JULY 1969

		ADC	ANG
	JET	*6.7	*6.1
	CONVENTIONAL	*1.7	0.0
BY AIRCRAFT	T-33	*1.9	*18.1
	F-89		0
	F-100	0	
	F-101	*9.8	
	F TF-102	0	*3.7
	F-104	0	
	F-106	*14.0	
	B-57	*18.1	
	EC-121	*3.3	

RATE: MAJOR ACCIDENTS PER 100,000 FLYING HOURS

*Estimated

we point with PRIDE

Major Donald L. Hedrick
49 Ftr Intcp Sq
Griffiss AFB, NY

CSD FAILURE

Major Hedrick was scheduled for a high altitude intercept mission in an F-106A. Preflight, start, taxi, and takeoff at 0920 EST were normal with no malfunctions encountered. He flew as a high target at 49,000 feet for the first thirty minutes of flight. He was then committed as interceptor on a front co-altitude attack at 45,000 feet.

After breakoff from the intercept at 1.3 Mach and 47,000 feet, the aircraft AC electrical power fail light illuminated. Major Hedrick slowed the aircraft to .93 Mach, turned, and requested an RTB to Griffiss AFB, some 100 miles away. The air turbine generator did not transfer automatically with resultant loss of the fuel boost pumps, AMI, and AVVI. The aircraft was above a solid overcast at this time with homeplate weather at ten thousand overcast, seven miles visibility in light snow showers.

As Major Hedrick started his penetration, 60 miles from home, the DC electrical power fail light came on. Corrective measures worked intermittently with ultimate failure of the DC electrical system occurring three minutes later. The aircraft then began to vibrate with a subsequent failure of the MA-1 power system. The TACAN and UHF radio did not transfer immediately, requiring Major Hedrick to continue his partial panel penetration without navigational aids or voice contact. The UHF radio started working in the final portions of the penetration and the approach and landing were made without difficulty.

The aircraft was carefully checked by Maintenance and the cause of the incident turned out to be internal failure of the CSD. The faulty part was removed, replaced, and tested satisfactorily.

Major Hedrick's astute handling of the multiple failures he incurred was indeed noteworthy. His cool judgment and outstanding airmanship resulted in the direct save of a valuable Aerospace Defense weapons system, and for this "We Point with Pride."

RENICK'S SWAN SONG

The F-104 is, in its most basic form, the fulfillment of an idea. The idea envisioned a fast, simple, and reliable aircraft that could enter a piece of sky and gain control of that piece of sky from enemy aircraft. The idea was highly dependent upon two things: aircraft performance and pilot ability. Lockheed supplied the aircraft; we have some pilots equal to the task. Once airborne, the F-104 becomes wedded to her pilot in a bond understood only by the few that have experienced it. They become one. The sweet little bird respects the aggressive attitude of her master by the firm grip on her stick. The significance is in the fact that she makes her perform. She likes to pull G's and loves to go fast. When her needle reads 700, she starts to hum, for she has entered her own private territory in the sky where lesser birds fear to tread. At 800 she is singing.

It wasn't until installation of the GE J79-19 engine that the F-104 completely entered the dreamy world described. Dreamy as it may sound, it is very very real. And if you listen real close at 700 KIAS, she really is hummin' . . . a pleasant little hum, like she was enjoying herself. Over the past year, many Air Force pilots have been introduced to this little sweetie. The introduction was usually brief, consisting of a zip and a zoom and she was gone. The question of air superiority capability against more maneuverable aircraft has received a very concise answer. The answer is read on the miles of gun camera film processed in the past year. The rustic thinking of those who "turn" has literally been shot out of the sky by those who "go."

The North Vietnam skies were what finally convinced the powers that be that we really needed an air superiority fighter. So now we will get this super fighter probably in 1975. This is certainly good news to every fighter pilot who has strapped on an airplane that has too much weight, too little thrust, not enough wing, and no gun. The sad news is that once this aircraft gets airborne, it will have probably 80% of its combat capability being realized by an aircraft that is 18 years old and cost one-fourth as much. Another advantage that proponents of big airplanes with two engines refuse to recognize is the tremendous asset to small size. Over and over again the result of not being seen is more and more feet of gun camera film.

These comments have been almost passionate. This is only natural, for I have truly loved this bird. In sober moments, I try to find objectivity in analyzing the performance of the F-104, realizing that love is often blind. Yet, objectivity seems to have no effect on the final conclusion. And that is that the F-104A, when employed according to tactics developed by the 319th FIS, is a superior day fighter. In the past she has been misunderstood and misused. Today she is understood, at least by those who fly her.

Capt Joe Renick
319 Fighter Intecp Squadron
Homestead AFB, FL

***Capt Joe Renick, fighter pilot and Safety Officer for the 319 FIS separated from the service in August 1969 to try the student life at Arizona State University. Any guy who can feel about an airplane the way Joe does will be sorely missed. We wish him well.**

CREDIT WHEN CREDIT IS DUE

The Mechanics Creed, featured on the back cover of the February INTERCEPTOR, was "signed" ANON. It may interest you to learn that the creed was authored by Jerome Lederer, who at that time was Managing Director of the Flight Safety Foundation, Incorporated. It was first printed in the AVIATION MECHANICS BULLETIN in May, 1953.

Jerry is currently connected with NASA and resides at 311 "N" Street, Washington, D.C. 20024.

Please accept my congratulations on the job you are doing on INTERCEPTOR. It is a great little publication.

Joseph M. Chase
Editor, Aviation Mechanics Bulletin
Flight Safety Foundation, Inc.
Walnut Creek, California

***We're sorry, our Research Department fell down on the job.**

OUR ENGLISH FRIENDS

We at No. 228 (Phantom) Operational Conversion Unit have had our "British" Phantoms for some months now. As the training unit, the OCU has been tasked with training the student crews in three roles. These roles are air defence, ground attack, and reconnaissance.

A number of our instructors have commented very favourably on the USAF Magazine INTERCEPTOR. This magazine has some very good articles on all aspects of Air Defence, resulting from your vast experience in this field.

We would like, if possible to be placed on the distribution list of INTERCEPTOR as we can certainly benefit from reading the magazine.

Thank you in advance.

Squadron Leader J. M. Nunn
Chief Ground Instructor
RAF Coningsby
Lincoln, Lincolnshire, UK

***As we have said before, Safety everywhere is our business.**

Flying Safety

PILOT FAILURE IS THE CAUSE OF 70 TO 80 PERCENT OF ALL AIRCRAFT ACCIDENTS

PILOT FAILURE RESULTS FROM

- IGNORANCE
- CARELESSNESS
- DISOBEDIENCE
- BAD JUDGMENT
- POOR PHYSICAL CONDITION

In the campaign to defeat these enemies of safety, proper authorities have prescribed rules, regulations, and standard practices; but they can only point the way —

SAFETY OF FLIGHT DEPENDS UPON YOU

- KNOW THE RULES
- ABIDE BY THE RULES
- KEEP CONSTANTLY ON THE ALERT
- USE CONSIDERED JUDGMENT
- PLAN IN ADVANCE FOR POSSIBLE EMERGENCIES AND WORK OUT IN YOUR OWN MIND PROCEDURES YOU PROPOSE TO FOLLOW FOR EACH.
- KEEP YOURSELF PHYSICALLY FIT

Flying IS AN EXACTING, SERIOUS BUSINESS. IT DEMANDS EVERYTHING YOU HAVE OF KNOWLEDGE, ATTENTION, EFFORT, JUDGMENT, AND SKILL. IF YOU GIVE IT ANY LESS THAN YOUR BEST, IT EXACTS A HIGH PRICE FOR YOUR MISTAKES.

Cold Hard Facts..