UNITED STATES AIR FORCE • JULY 1970 •

Aerospace SAFETY

COVER ART—Courtesy McDonnell-Douglas Corp.

UNITED STATES AIR FORCE

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JULY 1970

FOR AIRCREWS, MAINTENANCE & SUPPORT TECHNICIANS

SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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The F-15 AND SYSTEM SAFETY

LAST DECEMBER after more than five years of studies and intense competition, the McDonnell Aircraft Company was awarded the contract to build the F-15 air-superiority fighter for the Air Force. Pratt and Whitney is building a brand new afterburning turbofan to power this twin-engine airplane. This will be the first new fighter aircraft for the USAF since the F-4 and the first USAF fighter designed specifically for air superiority in almost 20 years.

With very few exceptions, Air Force pilots have always been at a disadvantage in thrust - to - weight ratio, turning ability, and some of the other performance factors that are important in a technically unexcelled "air superiority" fighter. In World War II, the *Thunderbolts* and *Lightnings* were technically outperformed by some of the lighter, faster enemy aircraft. In Korea the F-86 came close to matching MIG-17 performance but was still on the short end of the stick. In the air

Major Robert M. Greene,
Directorate of Aerospace Safety

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The F-15 AND SYSTEM SAFETY

war over North Vietnam, our F-4s and F-105s were still outperformed by the MIG-17s and MIG-21s when it came to the classic "turn and grunt" rat race. Nevertheless, from World War II through Korea to Vietnam, the American airman has compiled an impressive record of kills which stands as a tribute to his training, skill, courage and determination. This individual excellence has masked the aircraft performance edge that has generally gone to the enemy.

But the F-15 brings a new era to air superiority. The American pilot will have a greater thrust-to-weight ratio, lower wing loading, better cockpit visibility, and better armament (including the SRM or "dogfight" missile) than any aircraft possessed or forecast for the "threat" powers through the 1980s.

For the first time, the American fighter pilot can go into combat in a machine that will outturn and outshoot his opponents.

How are we going to build an aircraft like this? It didn't just happen. It has taken years of agonizing effort by some of the best people in the Air Force. These people realized that we could not build an "all things to all people" aircraft and have a true air superiority fighter. The concept of energy-maneuverability has been very diligently applied to this aircraft. Consequently, weight has been kept to an absolute minimum, as has the gadgetry and systems that inevitably try to attach themselves to any system.

PERFORMANCE is not the only aspect of F-15 development that has been considered. The reliability requirements established for the F-15 are more stringent than in any previous fighter. Avionics, airframe, and armament systems reliability requirements have necessitated a new approach. System/cost effectiveness procedures have been applied to evaluate the functions of the total system, insuring that each function and each component are combined to produce the best weapon system for the dollars expended. In addition, the total cost of the F-15 weapon system has been under continuous scrutiny, so several features which would increase the system's overall effectiveness have been eliminated due to the austere funding environment.

Survivability/vulnerability (S/V) is receiving more emphasis than ever before. Our S/V lessons from the war in Southeast Asia are being applied to the F-15.

Extra attention is being given to the all important maintainability of the F-15.

These are just a few of many specialized disciplines that are being applied to the F-15 and its engines. The final result of all these efforts that are being expended before hardware is produced should be a weapon system that will require fewer redesigns, modifications and retrofits, and less money spent as a result of ECPs than any other fighter aircraft yet built.

Pratt and Whitney is running a similar program on the design of the engine for the F-15. The designation for the engine, under the new system, is "F-100," of all things!

But one of the most remarkable managerial aspects of this program is the long range planning by the SPO to reduce the cost of the program by reducing the accident rate. Each year we waste millions of dollars by bashing aircraft all over the world. Aircraft and lives are lost due to many cause factors, including combat, weather, pilot errors, materiel failure, and a whole host of other miscellaneous reasons, some of which we have little or no control over. But a substantial number of aircraft (not to mention missiles, munitions and other equipment) are lost each year due to what we call *design deficiency,* and this is something we *do* have some control over.

Millions more are spent in the retrofit and modification of aircraft and other systems to eliminate design deficiencies. This is not to imply that aircraft designers are negligent. There are several reasons why safety critical design deficiencies appear in the final design of an aircraft. Some are as a result of the simultaneously increasing complexity and performance of our new aircraft. It becomes more and more difficult for a single individual to have sufficient visibility over the system to foresee all the design safety problems. Designers of individual components or subsystems do not always have the "big picture" as to how their designs integrate into the total system and interface with other designs. This has made it necessary to employ a formalized safety engineering program on our new systems. If the point is not yet made, then consider the fact that we do not have an aircraft flying today which has not undergone a major retrofit modification as a result of an accident or series of accidents!

So with this knowledge in mind, the managers of the F-15 program are requiring McDonnell and Pratt and Whitney to perform several different types of safety analyses on the design of the aircraft and engines. These analyses are directed toward eliminating the features in the design that could eventually cause an accident. This relatively new approach to accident prevention is called "System Safety Engineering." Although we say that it is a new approach, it has actually been applied to nuclear weapons since their beginning. And the record for nuclear weapons is impressive in that there has never been an accidental nuclear detonation.

THE FIRST TIME System Safety was applied to another type of system was with the Minuteman missile, and the reduction in accident rate for the Minuteman over previous missiles has been substantial. System Safety was first applied to an aircraft during the development of the C-5A and then later to the A-7D. As a result of the system safety analyses numerous safety deficiencies were corrected in both aircraft before the hardware was ever flown.

The basic philosophy behind the system safety approach is founded on the assumption that sooner or later parts will fail, maintenance

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personnel will perform improper installation or repair operations, and pilots will make mistakes in judgment, technique, etc. The system safety engineer asks, "What happens if one of these failures occurs?" The result is a list of hazards which are categorized as to consequence. A hazard that would result in the loss of the system and/or the crew is called a Category IV hazard. Hazards that *could* cause loss of aircraft and/or crew if rapid action is not taken are called Category III. Category III and IV hazards are eliminated by redesign, or warning or protective devices are provided or appropriate procedures are inserted in the flight handbooks.

Another area where more safety emphasis is being placed is in the "lessons learned" category. Data from previous accident experience has been analyzed as has AFM 66-1 maintenance data. Bad design practices which have caused hazards in other aircraft have been identified and steps are being taken to insure that these practices are not repeated in the F-15. In addition, these lessons learned are inserted into the AFSC Design Handbooks for future reference and use.

Here are just a few examples of hazards that already have been designed out of the F-15. Each of these hazards has caused the loss of several aircraft of a particular type and some aircraft types have suffered losses due to all of these hazards.

1. In case of flight control linkage disconnect or battle damage, control surface(s) will fail to a nominally neutral position rather than to a full travel position.

2. In case of a jammed stick (tools/FOD in the works) stabilator control is still available through the command augmentation system (CAS) which is actually an electrical (fly-by-wire) connection between the stick grip and the control surface actuator. The aileron has a safety spring cartridge which allows control of one aileron, if the other is jammed.

3. The fuel system requires no management by the pilot except for drop tank selection.

4. Fuel lines are submerged in the fuel tanks, except where absolutely necessary for them to be outside.

5. The primary heat exchanger is as close to the compressor bleed air valve as possible. Air exiting the primary heat exchanger is below the autoignition temperature of aircraft fluids.

6. Most equipment and lines have been removed from the engine bay to reduce the possibility of an engine bay fire.

There are many more examples of hazards that are being closely watched in the design of the F-15, but these few illustrate the fact that more safety is going into the *original* design of an aircraft than we have ever had before.

Another significant requirement to be applied to the development of the F-15 is the construction of a mathematical model of the system. This model is a computerized representation of the F-15 that is used to evaluate the safety impact of changes in the design, to identify safety problem areas and to actually predict F-15 safety performance and accident rates. There are other mathematical models of the F-15, including a reliability model and a performance model. All of these models are put together in the system cost effectiveness model which predicts total system performance.

And speaking of predictions, the F-15 is the first fighter aircraft to have a contractual requirement as to accident rate. The requirement is directed toward the objective of achieving no accidents during the first 5000 hours of flying time starting at first flight. In addition, McDonnell has been given the goal of a maximum cumulative accident rate of eight per 100,000 flight hours at the 200,000 hour time point. This reduced accident rate is better than what could be expected from improved technology alone, and McDonnell is predicting that, with the rigorous application of system safety engineering, the accident rate goal can actually be bettered.

System Safety is something that *will* pay off for the F-15. Our hardware is too expensive for us not to put a full time effort into a safety oriented design. So the young pilots coming up will enjoy a unique mating of two seemingly contradictory characteristics. They will truly be operating the world's best and safest fighter! ★

THE I.P.I.S. APPROACH

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

VFR TAKEOFF

Q Can a tower controller deny me permission to take off VFR if I filed an IFR flight plan?

A No. FAA Manual 7110.8A specifically states that "if the facility responsible for issuing the IFR clearance is unable to issue a clearance because of traffic conditions, (the tower controller will) relay this information to the pilot and (will, most likely,) suggest the delay be taken on the ground." If the pilot insists on the VFR takeoff, the controller will issue takeoff clearance as traffic conditions permit.

VISUAL SEPARATION

Q What does the term "Visual Separation" mean and how does it affect me as a pilot?

A The term "Visual Separation" is used by air traffic controllers as a means of separating IFR, and special VFR (SVFR) aircraft in terminal areas. In order for the air traffic controller to use "Visual Separation" he must see the aircraft involved and issue information and instructions, as necessary to ensure that the aircraft avoid each other. As a pilot, you must see the other aircraft involved and upon instructions from the Controller, provide your own separation. You may have to follow in-trail or keep the other aircraft in sight until it is no longer a hazard. If you accept the traffic information and instructions to follow or provide visual separation from another aircraft, the Air Traffic Controller considers this acknowledgement that you see the other aircraft and will avoid it! Ref FAA Manual 7110.8A.

ENROUTE DESCENT

Q Do I have to accept a turbojet enroute descent?

A It is the pilot's responsibility to *request* a high altitude penetration/approach if he does not want normal arrival handling (enroute descent). It is still the pilot's prerogative to elect to conduct a published high altitude penetration instead of an enroute descent. Ref FAA Manual 7110.8A.

MINIMUM ALTITUDE/DECISION HEIGHT

Q Are FAA GCA Controllers required to call minimum altitude/decision height?

A Ref FAA Manual 7110.8A, para 750. No. Only United States Air Force and Navy Controllers are required to inform the aircraft when it reaches the published altitude minimum/decision height.

Q As a helicopter jock, what category minima do I use for approaches?

A Presently, helicopters use published Category A minima. It has been proposed that USAF helicopters be allowed lower visibility minima (one-half Category A minima) to determine if an approach may be started. This would apply only if there was not a specific helicopter procedure published in accordance with AFM 55-9 (TERPs). If the proposal is approved, it should be included in the next revision of AFM 60-16.

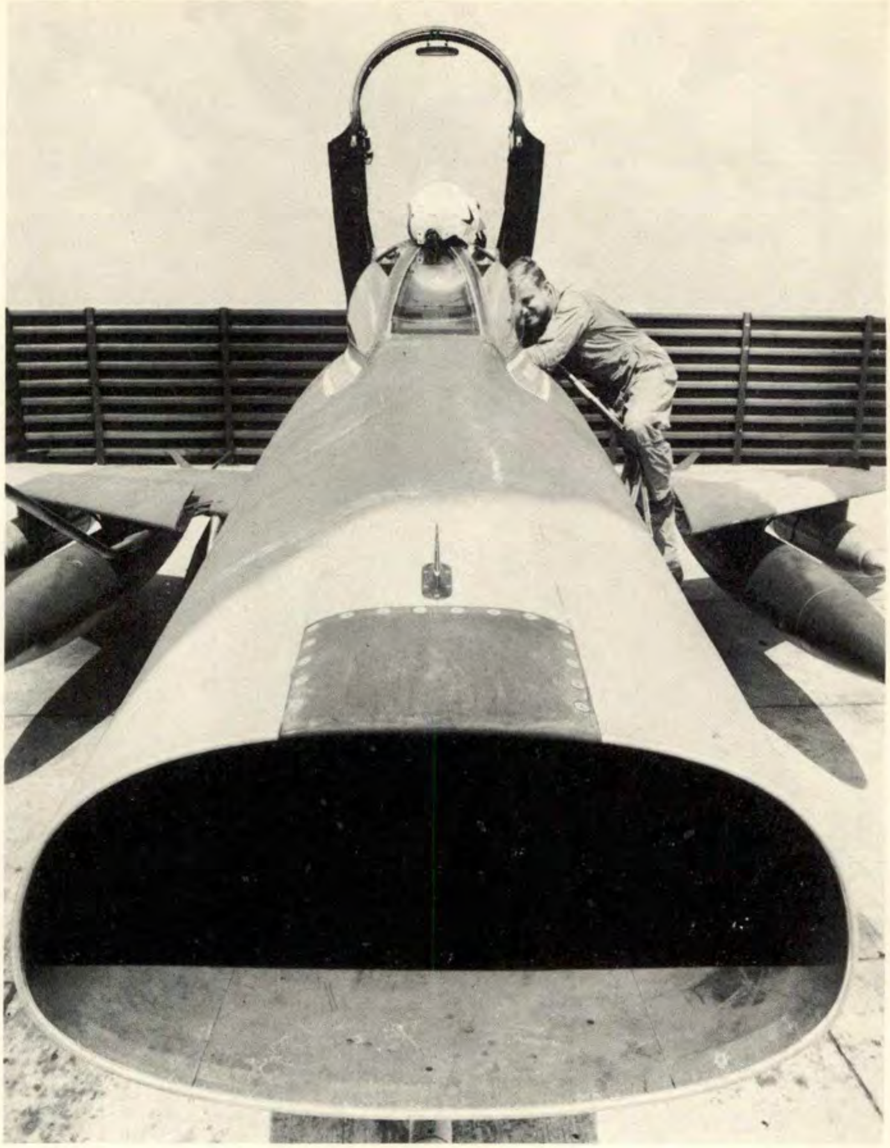
POINT TO PONDER

The revised AFM 51-37 will delete the maximum outbound times for the procedure turn. This was done to allow the pilot to utilize the airspace allocated for the published procedure. A maximum time outbound of one and one-half or two minutes is an unnecessary restriction when a *remain within* distance is published in the profile view of the procedure. The pilot himself can best determine the necessary time outbound after considering speed, wind, descent gradients, etc.

NOTICE

Reference March 1967 "IPIS Approach" article. The answer to the question, "What are the tolerances for operational check of the aircraft's TACAN equipment?" is now erroneous. FLIP, Section II, paragraph 1c(3), lists TACAN receiver check point tolerances. "TACAN receiver check point tolerances: Military bases normally designate a specific ground point for checking the accuracy of aircraft TACAN receivers. The tolerances for the ground check are similar to the VOR within + or − four degrees of the designated radial and within one-half mile or three per cent of the distance to the facility, whichever is greater." ★

tech orders cannot supplant judgment



BY THE BOOK?

LT COL ROBERT PICHT, DIRECTORATE OF AEROSPACE SAFETY

After all the effort expended by both the pilot and the maintenance types, there are times when an aborted sortie really hurts. You may feel that you need a pretty good reason to turn down the bird and sometimes it's tough to convince other people that there really is something wrong. Both pilot and crew chief may be tempted to press on and the pressure to accomplish the mission may be pretty strong.

The critical time arrives as your crew chief prepares to strap you into the cockpit. The heat reflecting off the ramp has soaked through your flight suit and G-suit, you've timed your walkaround and conversation with the crew chief so you arrive in the cockpit with just enough time to run the checklist, make an on-time start and check in with the flight leader. Although you've spent no extra minutes perspiring in the cockpit, you're eager to get in the air and get the cool air flowing through the vents. The crew chief is anxious to cool it in a shady hangar.

Then on engine start something goes awry. An engine instrument reads high—or low; it's not where it usually is. But it's within tech order limits. Do you check it out? Do you abort?

In one case about like this, while starting an F-100, the pilot saw the EGT go considerably higher than he had seen it before in the 1500 hours he'd been flying the Hun'. There was no tail wind, no external reason for the high temperature. And although it hadn't exceeded the limit for a start, it was definitely different from a normal start.

He aborted the flight and wrote up the bird. The maintenance people screamed loudly about the lost sortie. They insisted the aircraft was okay and signed off the write-up as "entered in error, temperature was within TO limits." They made no investigation to determine what caused the unusually high starting temperature.

Several flights later, a pilot reported an over-temp that went beyond limits. This time the maintenance folks dug into the engine and diagnosed a faulty fuel control. But the engine had to be pulled and sent to overhaul.

On another occasion, while he was preparing for an FCF, a pilot discovered 15 minor squawks before he had completed his preflight. He refused to fly the bird and requested a QC spot inspection. Of course, the maintenance types were ready to string him up. They insisted that none of the squawks warranted grounding the airplane and that he should have flown the FCF.

Quality Control inspectors found eight (count 'em—8) red cross discrepancies. They were all in locations where a pilot's preflight wouldn't find them.

The point of all this is that good judgment should dictate an automatic investigation when an unusual situation arises. Sure, the TOs set limits and prescribe what conditions ground an airplane, but blind adherence to these limits isn't the way to prevent accidents. (It may keep the abort rate down.)

A suspicious attitude toward out-of-the-ordinary occurrences may cost a few sorties, but it can save an aircraft—to say nothing about the pilot. ★

LOST and DOWNED

BRIEFS OF RECENT AIRCRAFT ACCIDENTS

A-1H Student pilot on initial flight in an A-1H (single-seat) aircraft had previously completed 23 sorties, three solo, in the A-1E. First landing was good, but slight veer on TD caused pilot to go around. Second landing was a perfect three-point touchdown, but right wing came up and the aircraft veered right. Pilot applied power and aircraft yawed abruptly to the left. Landing gear separated as aircraft slid across the runway. The pilot evacuated successfully. Pilot had no tail wheel experience prior to entering A-1 transition. However, with some 60 landings in the A-1E prior to the accident, he was not inexperienced. He failed to use proper corrective measures for crosswind.

RF-4 Following electrical failure the pitch aug, INS and fuel low level lights came on. Then intercom, UHF radio, flight instruments and generators failed, leaving the pilot on needle and ball. During landing pilot found controls sluggish, got into high sink rate. Aircraft struck a tree on final and the navigator ejected successfully; pilot landed the aircraft. Depot-level maintenance caused the electrical malfunction. Pilot unfamiliarity with sluggish control when pitch aug is inoperative contributed.

B-52D Aircraft was returning from a day combat crew training mission with Nr 7 engine shut down due to an indication of low oil pressure. Gross weight was 270,000 pounds when a VOR/ILS penetration was started. Weather was clear with a four knot crosswind. The aircraft appeared to flare higher than normal and float excessively. At about the 9000 foot remaining marker on a 13,500 foot runway, the pilot applied power for a go-around. Improper pilot techniques and procedures for the go-around resulted in loss of control. The aircraft entered a low speed buffet, hit the ground to the side of the runway in a slight wing down, nose high attitude and was destroyed by fire. Three crewmembers received major injuries, while six received minor injuries.

T-37 During a Cuban 8, solo student misapplied controls and got into a spin. When he noticed 4000 feet on the altimeter, he ejected; however, IP flying at 12,000 feet saw the student in his parachute above his (IP's) altitude. Apparently student misread the altimeter by 10,000 feet and ejected at about 14,000.

F-100 Aircraft was lead of a two-ship flight. At about 145 kts, the pilot aborted after deciding the aircraft was not accelerating properly and would not become airborne. The aircraft engaged the BAK 9 and MA-1A barriers and came to a stop on the overrun 500 feet from the end of the runway. Nose gear collapsed and the aircraft caught fire. The wingman became airborne easily at the time the leader initiated abort. A rupture found in a pitot line could have been caused by inadequate draining and subsequent freezing. Cause of the upper and/or lower nose landing gear link assembly failure could not be determined, but it is possible that torque value for the upper torque link of the nose gear scissors was incorrect. ★

a sure thing

ANYBODY LIKE TO BET on a sure thing? That's a pretty rare item these days, but we think we have one that will fill the bill. No horses, stock market or roulette. Just a simple hash-out of statistics. The old story is that you can use figures to prove anything, but this time we'll cover all bets.

Our bet is that some jock will ding an airplane short of the runway when there is *nothing* wrong with the pilot physically, the bird mechanically or the approach aids on the ground. In other words, the only answer will be that some wise guy delivered several loads of liftless air to the approach end of the runway and dumped them there. We'll even go you one better; this short landing will happen under VFR conditions and is just as likely to occur during the day as dark time.

Any takers? Is somebody going to bet it won't be he? We've pretty well covered our tracks, too. If you're a proficiency-only pilot, you find yourself down at the bottom of the proficiency scale; if you fly a bunch, you're highly skilled but your exposure is high. In a nut shell, nobody is immune! If you happen to be the unlucky guy, you'll find yourself in some rather fancy company —from squadron commanders to UPT jocks.

So you say, "What's the answer?" We wish we knew! It's like how do you keep from three-putting? If there were a sure-fire cure, you'd be the first to know. We often wonder, though, if the birds that do hit short, for no *apparent* reason, have operators that are using all the landing aids available to them. After all the tons of type that have flowed across the printer's press, we think that just about every type of illusion, nav aid, wx phenomenon and pilot factor has been discussed. But we press on in hopes that a sentence may stick in a pilot's mind and save just one life or aircraft. Maybe someday we'll find the magic formula so let's dissect some of our past bashes and see if there's a helpful clue hidden between the lines.

REMEMBER the one about the T-33 on a night instrument mission? The weather was CAVU. The guy under the bag had just turned final on a VOR non-precision approach and was descending to 1500'. Gear was down and flaps set prior to low station passage. About this time there was a hairy jolt followed by numerous bumps and bounces. That's right—the bird had touched down miles from the runway, fortunately on fairly smooth terrain. Cause: The back seater had misread his altimeter 1000'. That's understandable, but how about the guy in front. He had not checked his altimeter but why should he? It was VFR and after all he could see, couldn't he?? From this accident we derive *Axiom #1*—the eyes don't have it. They will lie to you, just like the seat of your pants. An added piece of advice: On a clear night, without good reference points, lights will appear closer than they really are.

NOW LET'S TALK about the *Thud* pilot faced with 200' and one—day —light wind—wet runway of 9000'. Of course he'll take a GCA! His plan is to get about a mile and a half from the runway and then start dropping "5-10-40" feet low to make sure he lands on the first 1000' - 1500' of concrete. Why? Some of us haven't really looked into the geometry of why, but the Aeronautical Systems Division (ASD) did.

ASD knew the big birds with reverse thrust and short landing rolls don't sweat long landings too much so they took a close look at our fast flying finalers. On a standard 2½° glideslope, Fred Fighter Pilot is about 160' above his landing point and 4000' from it horizontally. At this very same point, using a typical overhead pattern, Fred is at 100' instead of 160'. To get into a position where his visual cues tell him he should be, he's got to get rid of an extra 60' of altitude. He subconsciously knows that unless he attains this familiar approach, he'll land long—thus he instinctively starts to bleed off some of this extra air farther out so that he breaks out from a GCA or ILS at what he "estimates" will be this familiar slot.

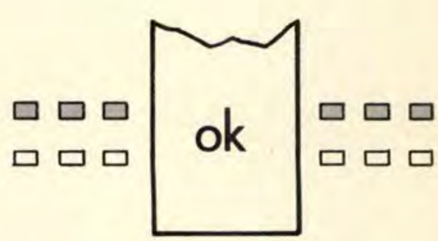
Estimates being what they are, instead of a breakout, we get a break up and burn out. "Pilot was advised by controller he was dangerously low on glideslope just prior to impact." Sure, some guys don't fly such good gages, but we think some intentionally try to hedge on a precision glideslope for the reason we mentioned. Do you?? If you've read this far you may begin to think we've painted ourselves into a corner.

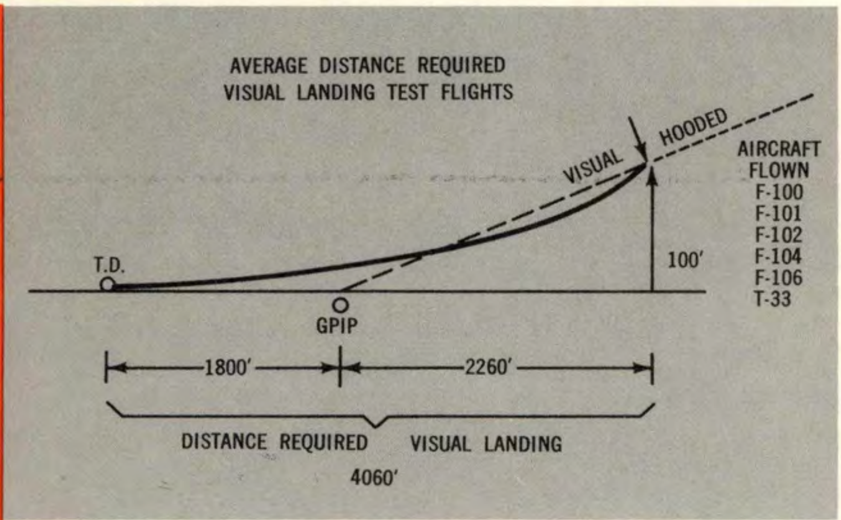
First, we say, if you stay on the glideslope you land long, and if you slide under, you got a good chance to wrap it up in a ball, short. So what do you do? No one advocates flying low on GCA final but we know it's done. Follow the controller's instructions until you are visual and can pick up the VASI.

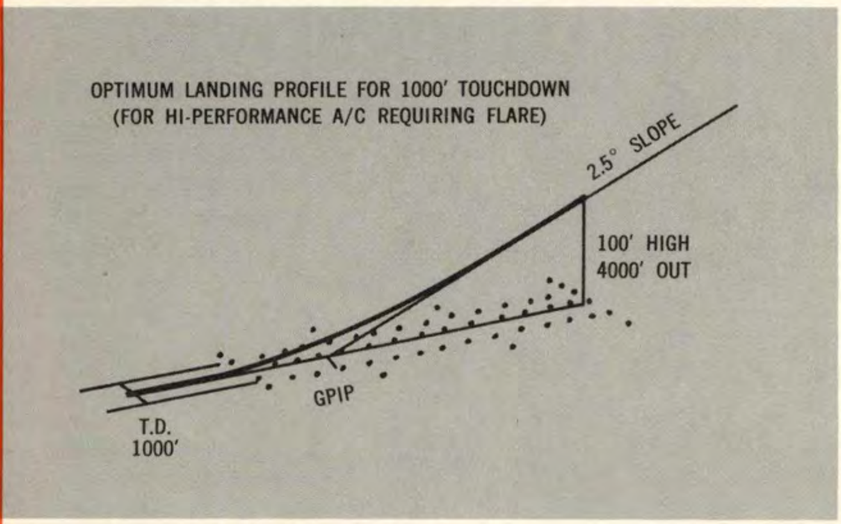
The next move you don't make is to dive at the runway. Struts are valuable and so are vertebrae. If you get into this box, land it normally. Much better the barrier than a busted bird. If you know the weather is so low that the Dash One says you will have problems stopping, perhaps a closer look at the operational requirements of the mission will dictate a delay 'til conditions improve.

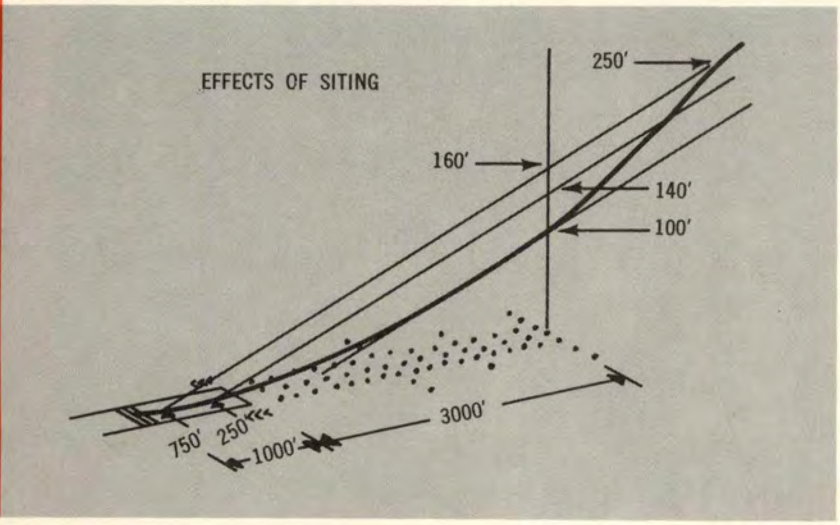
We all pride ourselves on the ability to "hack it." Maybe we can, but sometimes the law of physics slaps us right on the behind when we need it least. Our proficiency may be good enough for 50' and an eighth but when the time comes to flare out, we find our touchdown point is opposite the 4000' marker on an 8000' strip. It takes X long to stop an aircraft weighing Y much and going Z fast, and nobody can change the laws of deceleration. So — it's no reflection on your ability when you cancel out because of poor conditions.

Axiom #2. A precision GCA glideslope is *not* designed to land you zero-zero. You've got to have some space left when you break out to "do your thing." If you're in a bird that doesn't have reverse thrust but requires a high speed final, and









CONTINUED

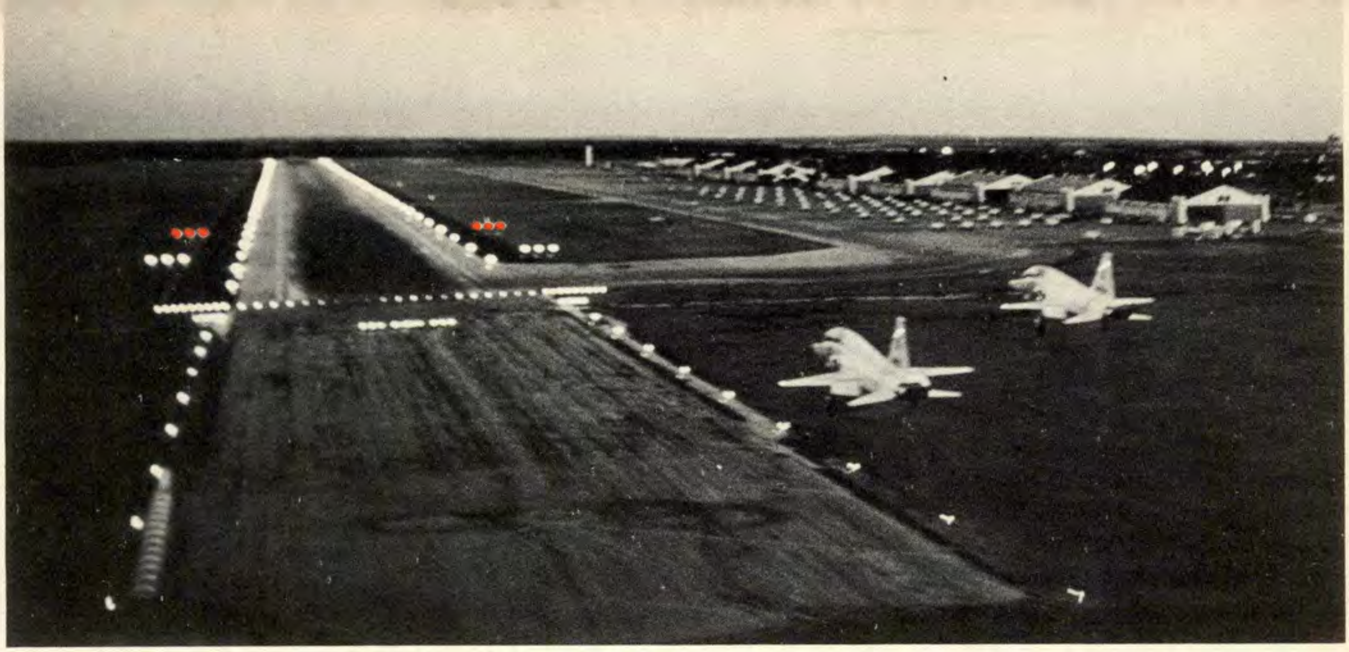
a sure thing

you have to fly the glidepath to 100' and a quarter, *you're going to land longer than normal!* (Except perhaps in the F-4.)

We can't give you a solution for every situation. There are too many combinations, but we can tell you what SAC did to make their glidepath more realistic for their B-58s.

Several years ago a number of B-58s landed short of the runway over a short period of time. In their analysis of the problem, it was decided that the primary factor for the short landings was that the pilots were having to dive at the runway in an attempt to land on the first couple of thousand feet. The reason they had to make this dive was that the GCA glidepath placed them too high at minimums to make a "normal" touchdown. Solution—relocate the GPIP (the point where the glideslope intercepts the runway). In order to place the pilot where he wanted to be, the GPIP was located short of the threshold!

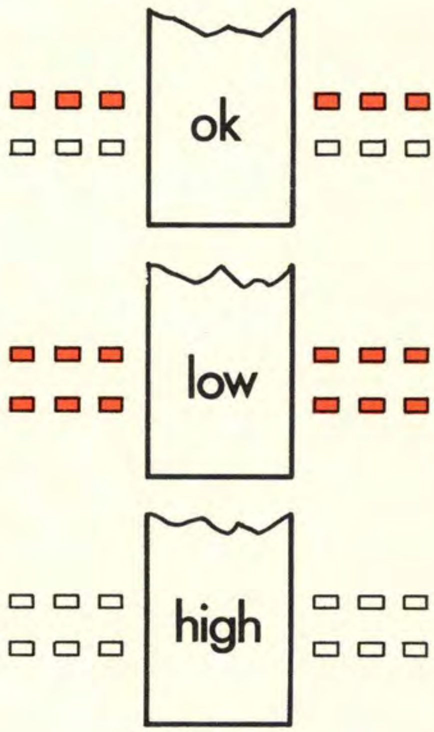
Dangerous? We don't really think so. After all, we are not equipped for CAT III (zero/zero) and are really in a bind for CAT II (100-¼) RVR 1200, so in effect you will have to break out and land your bird contact. If the present state of technology were such that everybody flew the glideslope to a landing on the spot where the glideslope intercepts—*then* there would be a



problem. As yet, unfortunately, the Air Force does not possess this kind of equipment (i.e., certified zero/zero).

So far, we've talked about those approaches where you get guidance from the ground in the form of ILS or GCA. How about the old fashioned method of "You bet your bird" on your eyeballs and throttle technique? Plain ole VFR traffic pattern. We won't even go into the marginal cases of "Maybe it's VFR" —just those where you're in clear weather day or night. Be it a rectangular or overhead pattern, all pilots face the same problems. The files are full of "It looked like I had it made until all of a sudden I ran into the patch of liftless air and landed short."

We know our eyes lie to us. We've seen this many times in those crazy stacks of blocks and diverging lines used to illustrate the point, and these visual deficiencies also exist when we are landing an aircraft. Awareness of this physical limitation and acceptance of the fact by the pilot *should* radically reduce the number of short landings. How? By pilots using all the aids available. There's no regulation that prohibits use of the ILS during a VFR approach, so why not use it? Just set the frequency and bring the instrument into your visual cross check. If you're two miles out from touchdown and the glideslope is caged at the top of the instrument, *you're low*. Sure, we know you want to be low on the gage over the threshold but out there a couple of miles you can get an *instant* clue that you just might be setting yourself up for a short landing.



HOW ABOUT VASI? We know a few pilots use it and rely on it—not completely, but simply as an *aid* (as advertised). Rolling out on final from an overhead, or on a five mile straight in, two red bars means *low* on the glideslope (which in most cases coincides with the GCA and ILS slope). Sure, we know you'll depart from this slope for landing and see red on both bars over the threshold, but if you *were* on the slope at ¾ of a mile from touchdown, on proper airspeed, chances are you won't land short unless you plan to set up a much higher than normal descent rate for the remainder of the landing phase. It's the old story that "if you haven't tried it, don't knock it." Get familiar with VASI and you'll find it a valuable aid. *Axiom #3:* Use all aids available to you to minimize the danger of short landing.

Now let's review what we've said:

• Don't rely on what you *think* you see. Your eyes sometimes play tricks on you.

• Don't expect GCA or ILS to get you in position to land in the first 1500′ if flown to minimums of the runway. It isn't designed to do this. Don't duck under the glideslope. If conditions are so low you are *planning* to fly low on the final approach, maybe you ought to reconsider the operational requirement of the mission.

• Use *all* of the landing aids available. Don't just rely on "seat of the pants" flying. No extra charge for use of the ILS or VASI. ★


U.S. AIR FORCE
U.S. AIR FORCE
US AIR FORCE

the VICIOUS CIRCLE

Major David H. Hook, Canadian Armed Forces, F-101 Project Officer, Directorate of Aerospace Safety

"How'd the trip go, Sir? Any problems with ol' Bess?"

"Nah, Sarge. She's okay." The Lieutenant checked off the 781, waved a cheery goodbye, and sauntered over to discuss the flight with his wingman.

"Hey, man," greeted the latter, "that crate of yours was really bouncing around at first. You have some kind of problem taking off on my wing?"

"Yeh, I got stuck with 127 again, and it took me a few seconds to settle her down. Boy, is that beast sensitive in pitch! However, you probably noted how quickly the ace of the base subdued her girlish wiggles."

"Um-m-m, about five minutes, I'd say."

At this point the conversation drifts back to Topic A, and the participants pass beyond our hearing. However, the part we did hear should have had a familiar ring for many pilots because aircraft discrepancies are not being written up. Because of either complacency or a desire not to cause extra work, pilots learn to live with imperfect systems in their aircraft.

Such a situation constituted the background for the loss of an RF-101 last spring. Because the pilot was also lost, the history of the accident will always remain incomplete, but enough facts are available to substantiate a reasonable reconstruction of the events.

Shortly after leveling off at medium-altitude for an area cover photo mission, the pilot transmitted a "Mayday," stating that the aircraft had pitched up and he was punching out. Unfortunately, during the ejection sequence he was fatally injured in a collision with the ejection seat.

Investigators had only a few components of the flight control systems to examine, as most of the aircraft was destroyed by fire after impact. No discrepancies were found, so an intensive review of the maintenance records was made. Three flights earlier the Altitude Hold function of the autopilot had been written up as erratic, but on the next two flights neither pilot checked out the results of the repairs. Because the accident occurred at a point in space where the pilot is likely to have turned on the autopilot for the first time, a malfunction of the autopilot was strongly suspected.

However, further digging revealed more interesting facts. The aircraft had a history of oversensitive pitch control that extended over more than two years. Indeed, for a period of time the controls were so bad that the squadron prohibited the aircraft from making practice refueling missions. On at least one occasion a flight control team had been assigned to work on this aircraft. Both operations and maintenance supervisors were aware that this bird had a problem.

Even with this long history, no one seemed to be overly concerned. The aircraft was released for flight with the problem unresolved and everyone "keeping an eye on it." The crew chief who had the aircraft for the last two years of its existence, said that it continued to have problems with sensitive controls—both before and after the major overhaul which occurred a year before the accident. Eventually, pilots who flew the aircraft seldom bothered to write up the condition.

Investigation also revealed that a calibrated test G-meter was not available in the unit for performing functional check flights of the anti-pitch control system. Because the investigators were unable to determine when a G-meter was last used on an FCF, the integrity of the pitch control system on the last flight is uncertain.

This crash which cost the life of a very experienced pilot is only one of several that have resulted from a vicious circle of complacency. Because of crewroom stories, pilots conceive a distrust of a certain system in their aircraft; consequently, such systems are disused or their imperfect operation is tolerated; without write-ups and other indications of operator concern, maintenance personnel don't put a system into perfect shape; finally, one day the system is needed, it fails, and a new hairy tale is born to feed pilot distrust. Or an aircraft crashes!

Everyone of us can help to break this vicious circle. If pilots demand the best, maintenance will be proud to provide it. The only way to ensure that a system is reliable is to exercise it regularly, write up discrepancies accurately, and repair it conscientiously. It all depends on you, regardless of where you fit in the circle. ★

Wes Robinson
The Boeing Company

PERHAPS FORTUNATELY, nature provided man with only limited hearing—roughly in the region of sound vibrating at frequencies between 16 cycles and 20,000 cycles per second. Thus man does not hear the rattle of air molecules bumping into each other in a breeze or the rumble of a growing tree. Yet there are such sounds, in fact a complex universe of sounds above and below man's range of hearing. It is a wonder more human eavesdropping has not taken place in these supposedly silent regions.

Work now under way in Boeing's aerospace laboratories clearly indicates that tuning in on this cacophony of silence may be of tremendous benefit to both man and machine. The Boeing work is the brainchild of Harvey Balderston, a research specialist in Boeing's failure analysis laboratory. Balderston reasoned that it might be possible to hear tiny mechanical defects if some way could be found to screen out unwanted noise.

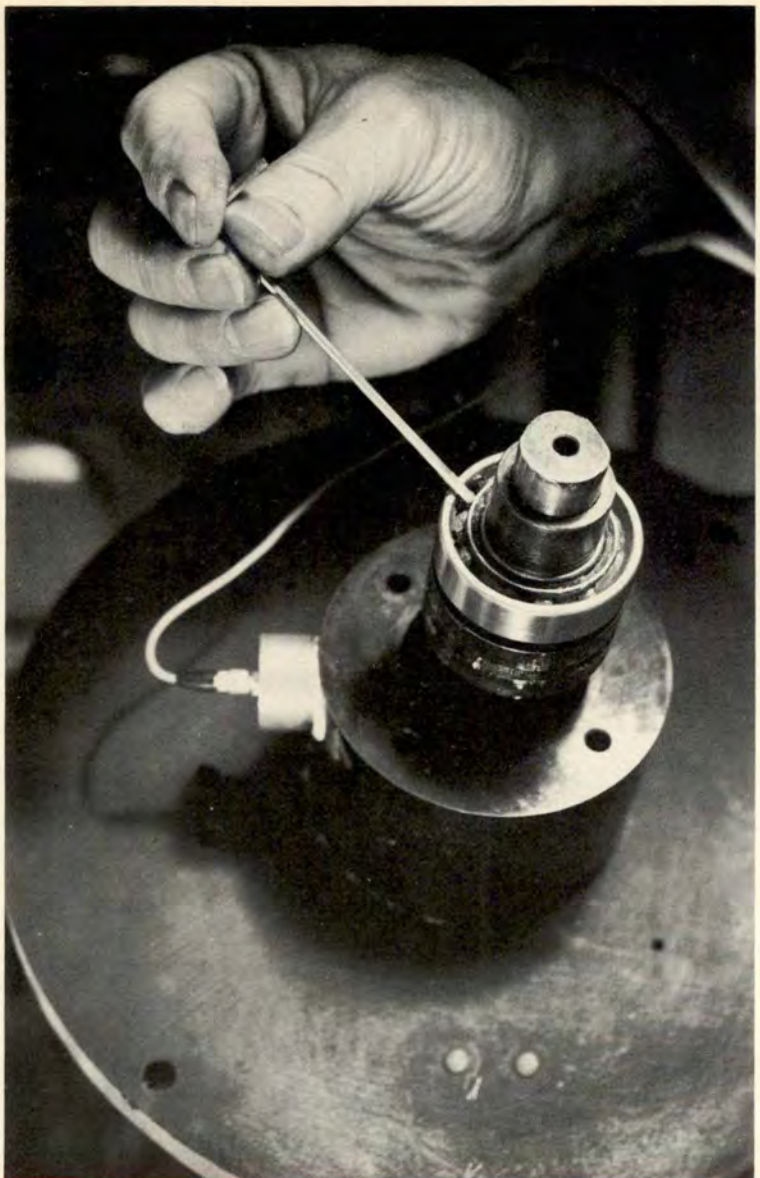
By recording only extremely high frequencies and then slowing them down to the range of human hearing, Balderston *did* screen out unwanted noise. A bearing with only a tiny scratch on its surface sounds like a lively xylophone solo when recorded and played back at a slow speed. A worn hydraulic valve nearing failure sounds like a flushing toilet. Every operating part, according to Balderston, has its own unique, high-frequency beat, hiss or tinkle which changes as it wiggles and waggles and wears out.

Balderston has listened to the sounds of life itself. He found that an artificial heart valve in a human patient had an acoustic pattern different from a real heart valve. His work with hydraulic fluid flow indicates there is a distinct possibility equipment may someday be developed to listen to the sound of blood flowing through a patient's body, much the way a doctor now listens to a heartbeat with a stethoscope.

At present, detecting these silent sounds requires expensive, bulky equipment. However, in 10 to 15 years when microelectronic designs are more fully developed, the failure detector could consist of 5000 circuit elements interconnected in a structure the size of an ice cube and sold for under $10.

A LIKELY EARLY USE of failure detectors would be to tune in on automobile problems. Relatively inexpensive equipment could be developed to attach briefly to a transmission, engine, or other automobile power equipment. The mechanic then could listen for indications of trouble. Auto makers already have shown interest in de-

Boeing's Harvey Balderston listens in on bearing failure.



Bearing, wired for sound, sings a worried song.

veloping this kind of diagnostic equipment.

Balderston is currently at the equipment - designing stage of his work, piecing together hardware that could detect the beginning stages of failure in structural, mechanical, hydraulic or electrical/electronic systems during normal operation. Balderston has discovered several important rules for listening to the silent sounds of failure in the course of his research: (1) all failures are either the result of structural defects or chemical contamination; (2) a defect in one part of a system sets everything in that system to vibrating, and (3) the energy level of the frequencies associated with a failing part is ten thousand to a million or more times higher than normal resonant frequencies. For example, the energy level of bubbles from leakage in a hydraulic valve near failure is an astronomical three billion times higher than the level in a good valve.

With these and a few other rules of thumb to go by, Balderston expects to perfect equipment that will quickly and automatically isolate trouble in aircraft and other mechanical systems long before there is any other indication of trouble. A programmed card would be inserted in the test equipment to check bearing surfaces, for example. All bearings could be checked at once, and a meter would indicate the relative amount of wear. More important, red-line emergency condition could be pre-set on the card, and if detected noise exceeded a certain level, a light would flash, indicating that one of the bearings should be replaced. As visualized by Balderston, the test equipment could be made small enough to be hand-held and, with a change only of the programmed card, one piece of equipment could be used to check any number of sys-

'HE SOUND OF SILENCE CONTINUED

tems, whether mechanical, electrical or structural.

SOUNDS AUDIBLE TO MAN would not be required for checking most systems. But when the sounds of failure are brought into the range of human hearing, they provide dramatic evidence of the secrets being discovered. Especially surprising is the noise of crack-resistant metal trying to sew itself into a strong lattice-like structure to stop a crack from spreading. Slowed to human hearing range, this sound is a series of bell-like tinkles not unlike falling splinters of glass.

"It is the sound of molecules falling into stronger structural units," Balderston explained.

Perhaps the most spectacular proof of the new failure detection system came about quite by accident. Demonstrating his technique to a group of Boeing officials, Balderston set out to show how a deliberately damaged bearing registered a much higher resonant frequency than a new bearing. However, to Balderston's surprise, just the reverse happened. The new bearing had a higher frequency reading than the damaged bearing. Disassembly showed the new bearing had a deep gall across its face, a flaw actually more severe than that inflicted on the test bearing.

Such are the secrets whispered by the sounds of silence.

(Reprinted from BOEING Magazine) ★

alert

Useful tips from UEIs

Observations noted during Unit Effectiveness Inspections

Aircraft placed in hangar and **maintenance performed without removal of 20mm ammunition** in violation of TO 11A-1-33.

Power production personnel responsible for inspecting and maintaining barrier arresting systems were not authorized a radio for contacting the control tower. Consequently, **more time was lost in getting on the runway** due to poor communications than was spent in inspecting and maintaining the arresting systems.

Unit had no program to insure that personnel who entered the cockpit of assigned aircraft had received cockpit familiarization and/or egress system training.

LOX servicing deficiencies included lack of protective caps on LOX servicing hoses, some trailer tires were low, substitute forms used in lieu of AFTO 134 were not annotated to show which aircraft had been serviced, some safety equipment not available, there was no record of the last purge of oxygen flasks.

Simulated exercise indicated that **emergency procedures for evacuating pilots** from fighter aircraft by crash rescue and LBR firemen were unsatisfactory.

Review of aircraft records and lists of personnel authorized to clear Red X conditions indicated that **unauthorized persons were clearing Red Xs on assigned aircraft.** Red X authorization lists were published quarterly and frequently amended. Suggestion was that list be updated every 30 days and published in the monthly maintenance plan to insure dissemination to all maintenance supervisors.

Unsafe AGE practices: Two tractors with engines running were left unattended, one attached to a unit being refueled. An NF-2 generator engine was left running unattended in the AGE yard. The battery caps had been removed and electrolyte had corroded the battery compartment.

Inspection of the **Com/Nav shop revealed many discrepancies,** e.g., electrical grounding system serviceability questionable and not properly marked, high voltage signs not prominently displayed, emergency lights inoperable, first aid or safety board not available, work benches cluttered and floor dirty. ★

EGAD! EGRAS, THE ELEPHANT'S BROKE

A TRUE??? ACCOUNT OF AN HISTORIC INCIDENT

Willis C. Brenton, CMSgt, USAF Ret.

Hannibal was leading his army into the low foothills of the Alps when it happened. The elephant he was riding buckled at the front gear and went tumbling down into a deep ravine. Hannibal attempted an emergency ejection, which was only partially successful, but at least he cleared the elephant enough to escape serious injury. It was pretty obvious, after the dust settled, that the elephant was damaged beyond economical repair. Hannibal summoned his crew chief over to his side.

"Egras," he said reluctantly, "get the head bowman over here and have him finish off this elephant." As Egras turned away Hannibal called out, "and have the EMCO (Elephant Maintenance Control Officer) report to me on the double!"

The EMCO came puffing up to the edge of the ravine and surveyed the carnage. It was a good thing it wasn't Hannibal's favorite elephant that had fallen. But from what he could see of Hannibal's face, it was going to be tough enough. By the time he climbed down to the elephant, Hannibal and Egras were already going over the Elephant Discrepancy scroll.

"No wonder!" Hannibal snarled, shaking the scroll under Egras' nose. "Look at this list of uncleared discrepancies! Elephant ears overdue inspection, right tusk sway brace loose, front knee locks out of adjustment. It's a wonder he made it this far!"

"But Sir," wailed Egras, "I'm in charge of your number one elephant. I just started crewing this one this morning."

"Well, you ought to be more careful; everyone of these write-ups is motion essential!"

"Yes Sir," Egras replied, "but this beast was just transferred in about a week or two ago. And the transferring unit is supposed to have it ready to go."

Since a crowd had gathered, Hannibal did not want to argue the matter further. He dismissed Egras with one of his famous Hannibalisms, "The best laid plans of men and elephants often go astray."

That night Hannibal called his Director of Elephant Maintenance and gave him orders to get to the bottom of things before morning.

Hannibal was up early and stood outside his tent watching the morning sun glance off the ice-encrusted peaks of the mountains towering over him. He could see Egras at the elephant parking line methodically going through the pre-motion scroll on his number one elephant. The boys in the Elephant Control Center had already snuffed out their lamps, abiding by his latest directive on saving oil, but across the way in the

EGAD! EGRAS, THE ELEPHANT'S BROKE

CONTINUED

operations tent several lamps still burned. Hannibal made a mental note of this violation. His survey of the camp was interrupted by the appearance of the DEM and the EMCO coming up the trail with a young pale-faced officer in tow.

After Hannibal and the officers had exchanged greetings, DEM reported.

"Well, Sir," he explained, "I think we pin-pointed the problem."

He dragged a young pale-faced officer forward. "This," he said triumphantly, "is the culprit. He's the new refueling officer and he used to be a supply officer, which explains everything."

"How does that explain anything?" Hannibal asked.

"Well, Sir, you know how supply officers like to hoard everything? Well, last week he was getting worried about the hay not lasting so he cut the elephants' rations way down. That elephant that gave out yesterday wasn't properly fueled."

Hannibal stepped forward and placed his hand on the trembling refueling officer's shoulder. "Is that right, son?" He said gently, "Did you cut down on the fuel loads?"

"Yes Sir, I did." The officer squeaked. "But only after I checked it out with operations and elephant control. They said it was O.K. by them."

"Did you check that out?" Hannibal asked the DEM.

The DEM squirmed. "No, Sir, I didn't think it was necessary."

"There you go with that thinking stuff again." Hannibal rasped. "Did you check any of those discrepancies on the elephant discrepancy scroll for the animal that fell yesterday?"

"No, Sir, I didn't."

"Well, tell me this. Did you look at all aspects of the problem and come up with a good sound reason for the elephant failure, or did you just jump on the first excuse you could find?"

The next man in line was the EMCO, and Hannibal turned on him. "Every one in the maintenance complex looks to you for guidance, and you're supposed to know the exact status of each and every elephant. What do you know about this reduction in fuel loads?"

Like most maintenance control officers, the EMCO started a detailed explanation of the situation based upon a rather vague personal knowledge.

"The reduction in fuel loads was based upon a protracted study of requirements and was sound and reasonable. We felt that the savings would make the politicians back home real happy. You know how they have been pushing this cost reduction bit?"

The reference to cost reduction hit a soft spot with Hannibal. The cost of campaigns was rising steadily and funding was critical. Still, letting expensive equipment sit idle because of penny savings was hardly practical.

"One thing I must insist on," Hannibal told his EMCO, "this unit must be run efficiently, but the elephant in-commission rate must be maintained at 90 per cent."

"We're trying, Sir," the EMCO said, "but you know that Carthage wasn't built in a day."

Hannibal shot a quick glance at the EMCO; that sounded an awful lot like an Hannibalism.

The discussion went on for some time, but it turned out the same as always—accusations, counter-accusations, and nothing really solved. The same thing was going on in most of the staff meetings too, Hannibal remembered. He made a mental note to look into the necessity for so many meetings.

Hannibal left the group and went

over to his number one elephant. Egras was going through a few busy little tasks, which crew chiefs have devised to impress drivers.

"Egras, get Elephant Maintenance Control on the horn."

Egras picked up his calling trumpet and yelled Control's number. A tousled head appeared at the flap of the Control tent. Egras handed Hannibal the trumpet.

"I want to know the exact status of this number one elephant." Hannibal yelled.

The reply was prompt. "In commission and ready to amble, Sir."

"You had better be right!" Hannibal said.

Hannibal mounted the ladder to the elephant's control platform and picked up the operator's check scroll. He carefully checked off each item: platform lashings for security, ears for alignment, guide spots behind ears for sensitivity, platform jettison pins, right on down the line. He then slipped down the ladder and made his walk-around inspection. He kicked the right aft gear and got a quick kick right back. He smiled his approval.

Hannibal moved around to the front of the elephant and borrowed Egras' tusk testing hammer. He gave each tusk a sharp bang and each gave off a clear ring. Both ears were checked for wax, ticks and dirt and were O.K. Hannibal handed the scroll back to Egras.

"Well, he seems O.K., Chief," he said, "but I believe I'll take him out for a test."

Egras helped his boss up the ladder and helped him strap in, then he went forward and guided Hannibal on the stroll out. Hannibal lined the elephant up on the trail and eased on the power. Walk power checked good, and amble power was O.K. but when he went into fast shuffle there was a very definite power loss. Hannibal tried a turning abort and lost control on the downhill side of the trail. Once more he had the terrible experience of gear failure and roll over. The platform jettison pin hung momentarily and Hannibal just cleared the weight of the rolling elephant. As it was, he hit his head on a rock.

Hannibal came to his senses two days later and awoke to find the Director of Elephant Maintenance leaning over his bunk.

"We found the problem, Sir," the DEM said, trying to beat Hannibal to the punch. "It was feed contamination. Quality Control let a bad bunch of fuel get through. It was half thistles and the elephants just couldn't eat it."

"You sure that was it?" Hannibal moaned.

"Yes, Sir. We got the thistles out and the elephants are well fed and in good shape. Our problems are over."

"I *hope* our problems are over," said Hannibal, but he knew that something else would go wrong before long. He wondered if other commanders and other organizations had similar problems. He knew that his campaign was like a huge puzzle and each member of his army had a piece of it which had to be placed in a certain spot at a certain time. He also knew that a misplaced or missing part of the puzzle would effect the final solution. But how could he get his men to see it?

The only thing he could think of was another Hannibalism. "You see those mountains out there?" he said to his DEM. "Well, if we all work together and everyone does his job, we can make molehills out of those mountains." ★

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UNITED STAT

1969 Safe

Secretary of the Air Force Safety Trophy

PACIFIC AIR FORCES

Best overall accident prevention program of all major commands with a military strength of 15,000 or more personnel.

PACAF's accomplishments in accident prevention were truly outstanding. Despite the constant rotation of aircrews and support personnel, around-the-clock, all-weather missions flown in a hostile environment in congested air space and from austere facilities, the command reduced its aircraft accident rate by 12 per cent while flying 1.79 million hours. Similar adverse conditions on the ground were overcome and the Command continued improvement in the ground safety categories evaluated. These accomplishments reflect strong command interest, effective safety management and a high degree of motivation among all PACAF personnel.

AIR FORCE RESERVE

Best overall accident prevention program of all major commands with a military strength of less than 15,000 personnel.

The aggressive accident prevention program of the Air Force Reserve produced an outstanding record of no aircraft accidents, major or minor, while flying 150,000 hours during 1969. The wide scope and diversity of Reserve operations, which included 1769 overwater missions to many parts of the world, direct support of SEA operations and airlift support of special exercises and Army airborne training, make the Reserve record particularly outstanding. The success of the Air Force Reserve in preventing aircraft accidents attests to the high degree of professionalism and dedication throughout the command.

Koren Kolligian, Jr., Trophy

MAJOR HENRY M. DYCHES, JR.

The Koren Kolligian, Jr., Trophy is awarded to Major Henry M. Dyches, Jr., in recognition of his outstanding feat of airmanship while flying a WC-135B at Yokota Air Base, Japan, 7 July 1969. During takeoff roll, a mechanical failure caused the flight controls to bind so that, at rotation speed, the aircraft could not be rotated to takeoff attitude. With the use of only elevator trim control, a successful takeoff was accomplished at the runway overrun. By expertly utilizing available trim, differential spoilers, and throttle control, Major Dyches executed a successful emergency landing in minimum weather conditions, averting a major catastrophe that would have taken the lives of many civilians residing near the airfield.

Maj Gen E
Memorial

AEROSPACE DEFE

A new Command lo
success rate and no
flect the outstanding
sonnel at all levels.
NORAD commander
East, ADC's accompli
dence outstanding co

S AIR FORCE

y Trophies

hief of Staff Individual Safety Trophy

l Roy J. Broughton, Jr.

olonel Broughton as Director of Safety, PACAF, produced an accident prevention ram that resulted in significant reducs to the Command's accident rates. His amic management was largely respon- for the Command attaining a record aircraft accident rate for the second ecutive year. The resultant saving of and materiel contributed substantially e combat capability of the United Air Force in Southeast Asia.

Lt Col John F. Fowler

Under Colonel Fowler's leadership for three years, the 21st Avionics Maintenance Squadron, Alaskan Air Command, maintained an accident and incident free record in missile, explosives and nuclear safety. Colonel Fowler contributed significantly to this record by applying his knowledge of missile systems to effect improved weapons system reliability and environmental safety despite the many missile handling operations in extremely adverse weather.

MSgt James A. Taylor

As Ground Safety Superintendent, Hq AFCS, Sergeant Taylor's outstanding devotion to duty and ability to initiate changes in the accident reporting and analyses procedures of AFCS resulted in substantial reductions to the command's accident rates and a savings of Air Force resources. Sergeant Taylor demonstrated an unyielding devotion to the development and implementation of safety programs within AFCS and the Air Force.

enjamin D. Foulois Award

NSE COMMAND

v aircraft accident rate, 100 per cent ejection ccidents attributed to maintenance factor re- professionalism and motivation of ADC per- Vith responsibility for providing forces to the nd its commitments in Alaska and the Far hments are particularly noteworthy and evi- nmand supervision and effectiveness.

Colombian Trophy

10TH TACTICAL RECONNAISSANCE WING

The Colombian Trophy is awarded to the 10th Tactical Reconnaissance Wing, RAF Alconbury, United Kingdom, for meritorious achievement in flight safety during 1969. The wing attained one of the most outstanding safety records in the Air Force as well as noteworthy achievements in operations and mission accomplishment. During 1969, the wing flew over 15,000 hours and 7,680 sorties in the RF-4C without experiencing an aircraft accident. This achievement is extraordinary in that it sustained a record of excellence which spanned 32 months and 43,000 hours of accident free operations in the RF-4C.

Ops topics

SHORT BURSTS FOR OPERATORS

SALT INGESTION

The HH-3E was participating in a water survival training exercise and had made an overwater pick-up of 16 students. The aircraft then hovered at an altitude of approximately 5 to 10 feet above the water for 31 minutes while the students were redeployed into the water. As the aircraft entered a hover, 30-40 feet above the water to pick up another student, there was a series of loud bangs followed by engine power failure. The pilot attempted an autorotation landing while maneuvering to avoid the student in the water. The aircraft struck the water hard enough to break the fuselage skin. This allowed water to enter the aircraft causing it to sink.

A training mission profile had been established which, based on mission requirements, warnings, and limitations in the TP 1H-3(C)C-1, contained elements of a potential accident. In fact, two weeks prior to this accident an HH-3 flying on the same mission profile had a power loss and compressor stall as a result of salt ingestion. The incident report pointed out that the heaviest salt spray ingestion occurred while students were being deployed from the helicopter into the water.

The report also stated that the operations officer was unsuccessful in negotiating a change to the mission profile, specifically to delete the low hover student redeployment. Although supervisory personnel and crewmembers had been briefed on the potential dangers associated with the mission profile, no positive action had been taken to eliminate the accident potential.

CPI INTERFERENCE

Results of a recent test to determine the extent to which a Crash Position Indicator would interfere with an emergency radio were sent to *Aerospace Safety* magazine by Lt Col Kenneth Ablett, Aircrew Standardization Officer at Hq 21st Air Force, MAC, and are passed on for your information. The test was conducted by Sgt Charles H. Hawkins, survival instructor in the 438th Air Base Group at McGuire AFB.

Sgt Hawkins and two other men removed the CPI from an aircraft and activated it. While standing within five feet of the CPI, Sgt Hawkins attempted to contact Approach Control with an RT-10 emergency radio. The two other men were stationed 50 to 75 feet away with URC-10 radios. They and Approach Control could hear Sgt Hawkins. The two men could hear Approach Control reply but Sgt Hawkins could not.

The conclusions were that reception by the emergency radio would be blocked by the CPI unless they are separated by at least 50 feet. A minimum of 100 feet is recommended.

FEATHERED FRIENDS?

A birdstrike again emphasizes the importance of keeping your visor down. During a night qualification flight in a T-38, the front seat pilot informed the IP that they had taken some birdstrikes. Engine compressor stalls and high EGT followed immediately. Since they were at 400 to 500 feet climbing after takeoff, the IP ordered ejection. The ejections were successful but the IP in the rear received facial burns from the front seat rocket catapult when the center blast screen failed. The IP did not have his visor down.

F-105 GEAR UP

After a tactical night mission, the *Thud* was passed from enroute to approach control radar. Everything progressed normally until touchdown. Configuration at landing was 650 gallons centerline, one 450-gallon fuel tank, one AGM-78A inboard, an AGM-45 on each outboard station, and GEAR UP.

After a 5000-foot slide, both crewmembers successfully evacuated the burning aircraft. Shortly thereafter, one of the missiles exploded in a low order detonation followed by some smaller explosions. During the rescue operation an H-43B's windshield was damaged by fragments from the exploding missiles.

FLIP CHANGE

Effective with the 25 June 1970 issues of U.S. FLIP Enroute Charts, the high and low altitude airway structures in the New York Terminal Area will be completely revised in accordance with the FAA Metroplex Plan. The specific charts effected are Low Altitude Charts 24, 25 and 28 and High Altitude Chart H-3. See Special Notices in FLIP IFR Supplement—U.S., 28 May 70 and FLIP Planning Section II, 25 June 70. ★

SECOND TIME AROUND

Taxiing out for takeoff, a C-123 pilot managed to rake his wingtip on a 20 foot high machine gun tower. The tower is located 34 feet from the edge of the taxiway. The incident occurred while the pilot was swinging the aircraft to the left for a right turn into the wind for run-up. He was downgraded to copilot until he demonstrates his professional qualifications. A recommendation has been made to the base commander to move the obstacle. This was the second aircraft to skin a wing tip on the same bunker. ★

REX RILEY'S CROSS COUNTRY NOTES

REX RECOMMENDS. I have received several inquiries concerning the length of time that our "Recommended" bases have remained on the select list. It is a difficult question to answer directly without reflecting unfairly upon the continued high quality of transient services provided by certain bases that have been removed through no fault of their own.

Loring AFB, awarded the Rex certificate in March 1958, has maintained its original position on the list longer than any other. The Arkansas Air National Guard Base at Little Rock held that honor until April 1964, when the new TM Standard allocations required the Guard bases to withdraw from the competition. In fact, that base and Hill AFB were the first two bases to grace this page when the program was initiated in February 1958.

To date, my files reflect a total of 91 placements and reinstatements, including 16 incumbents removed and reinstated since the program began. And, to show that perseverance pays, an even dozen of the 45 bases currently listed are on for their second time, while four have been on the list three times.

CANADIAN TRANSIENTS

Training Command of the Canadian Armed Forces has begun a transient services award program similar to our Rex Riley Transient Services program. After six months of operation, it is considered to be highly successful as indicated by response from transient aircrews.

During the first three months more than 500 comments had been received from aircrews, evaluating the service they received from transient facilities. Most comments were complimentary but some offered constructive criticism, ". . . the only kind acceptable in this program," according to the Canadians.

USAF aircrews transiting Canadian Training Command bases are invited to comment on the quality of transient services on forms available at the bases. Already some USAF crews have participated. By the time this magazine gets to the field the Commander, Training Command will have awarded commendation certificates to base sections that have received high evaluations. If you visit a Canadian base you can tell which sections have made the list by the symbol shown above.

THE

REX RILEY *Transient Services Award*

LORING AFB	Limestone, Me.
McCLELLAN AFB	Sacramento, Calif.
MAXWELL AFB	Montgomery, Ala.
HAMILTON AFB	Ignacio, Calif.
SCOTT AFB	Belleville, Ill.
RAMEY AFB	Puerto Rico
McCHORD AFB	Tacoma, Wash.
MYRTLE BEACH AFB	Myrtle Beach, S.C.
EGLIN AFB	Valparaiso, Fla.
FORBES AFB	Topeka, Kans.
MATHER AFB	Sacramento, Calif.
LAJES FIELD	Azores
SHEPPARD AFB	Wichita Falls, Tex.
MARCH AFB	Riverside, Calif.
GRISSOM AFB	Peru, Ind.
PERRIN AFB	Sherman, Tex.
CANNON AFB	Clovis, N.M.
HICKAM AFB	Hawaii
LUKE AFB	Phoenix, Ariz.
RANDOLPH AFB	San Antonio, Tex.
ROBINS AFB	Warner Robins, Ga.
TINKER AFB	Oklahoma City, Okla.
WETHERSFIELD AFB	England
HILL AFB	Ogden, Utah
YOKOTA AB	Japan
SEYMOUR JOHNSON AFB	Goldsboro, N.C.
ENGLAND AFB	Alexandria, La.
MISAWA AB	Japan
KADENA AB	Okinawa
ELMENDORF AFB	Alaska
PETERSON FIELD	Colorado Springs, Colo.
RAMSTEIN AB	Germany
SHAW AFB	Sumter, S.C.
LITTLE ROCK AFB	Jacksonville, Ark.
TORREJON AB	Spain
TYNDALL AFB	Panama City, Fla.
OFFUTT AFB	Omaha, Nebr.
ITAZUKE AB	Japan
ANDREWS AFB	Washington, D.C.
McCONNELL AFB	Wichita, Kans.
NORTON AFB	San Bernardino, Calif.
BARKSDALE AFB	Shreveport, La.
HOMESTEAD AFB	Homestead, Fla.

weather observation changes

CMSgt Sam Parrish, Hq AWS, Chief Observer

Air Weather Service has made several changes in observing procedures that will appear in teletypewriter sequences. Those of interest to aircrews are listed below.

• Unknown heights of cirriform cloud layers will no longer be reported as "/" or "U". When a reliable method of determining the height is unavailable, the height will be estimated (E), including those based on persistency (formerly "D").

• Sleet and small hail will be reported as ice pellets (IP) or ice pellet showers (IPW).

• The term "air discharge" (CA) has been added as a type of lightning. CA is defined as "streaks of lightning which pass from a cloud to the air but do not strike the ground."

• Several contractions for cloud types are changed: CBMAM (Cumulonimbus Mammatus), ACCAS (Altocumulus Castellanus), CUFRA (Cumulus Fractus), STFRA (Stratus Fractus).

• Light and variable winds are defined (speed is six knots or less and direction fluctuates by 30 degrees or more during the period of observation). When speed is greater than six knots, variable direction is reported as in the following example: WND 270V310.

• At bases which report runway visibility (RVV), the value will be based on the current high intensity runway light setting rather than the highest available.

• Peak wind gust data will no longer be reported as a part of tornado, thunderstorm and hail remarks. A separate remark will be used to report peak wind speeds observed in the preceding hour; e.g., "MAX GSTS 1723 2743" to indicate time of occurrence (1723Z) and direction and speed (270° at 43 knots).

• Estimated wind data will be reported with the "E" preceding the direction rather than following the speed.

• The peak speeds of gusts and squalls are reported in an observation for those occurring within the past 10 minutes rather than the past 15 minutes.

• To report a "Wind Shift" the wind direction must change during the last 15 minutes, by at least 45°. ★

SITE SEEING

Hy Bosch, Directorate of Aerospace Safety

Explosives Clear Zones require thorough planning

The runway on an air base is the axis of a thriving hub of activity. No one would consider constructing facilities that would block passage to or from the runway, for it is the focal point of the base's mission. Encroachment on the clear zone around the runway will reduce the base's usefulness.

A similar clear zone is required around any explosives storage area. Explosives, by nature, constitute a threat and hazard to personnel, equipment, and facilities. Thus quantity-distance tables have been established, to minimize damage from explosives to inhabited buildings and vital airbase support areas. As a minimum, the distance from explosives storage sites out to the first inhabited building (explosives clear zone) must be kept free of new construction.

Infringe on this clear zone and you unduly risk disaster in the event of an accident. An alternative would be to reduce the amount of explosives that may be stored in munitions facilities. But this would limit the base's explosives storage capacity to less than it was originally designed for. A change of mission requiring increased quantities of explosives ordnance could not be handled without costly land acquisition and construction outlays.

Surprisingly enough, although the above facts are well known, bases sometimes plan for construction within the explosives clear zone. To forestall such shortsightedness, all plans for construction of new munitions facilities, modification of existing facilities or construction of unrelated facilities within explosives clear zones must be submitted through channels for approval. These plans are closely scrutinized at all levels to insure that engineering and safety criteria are met.

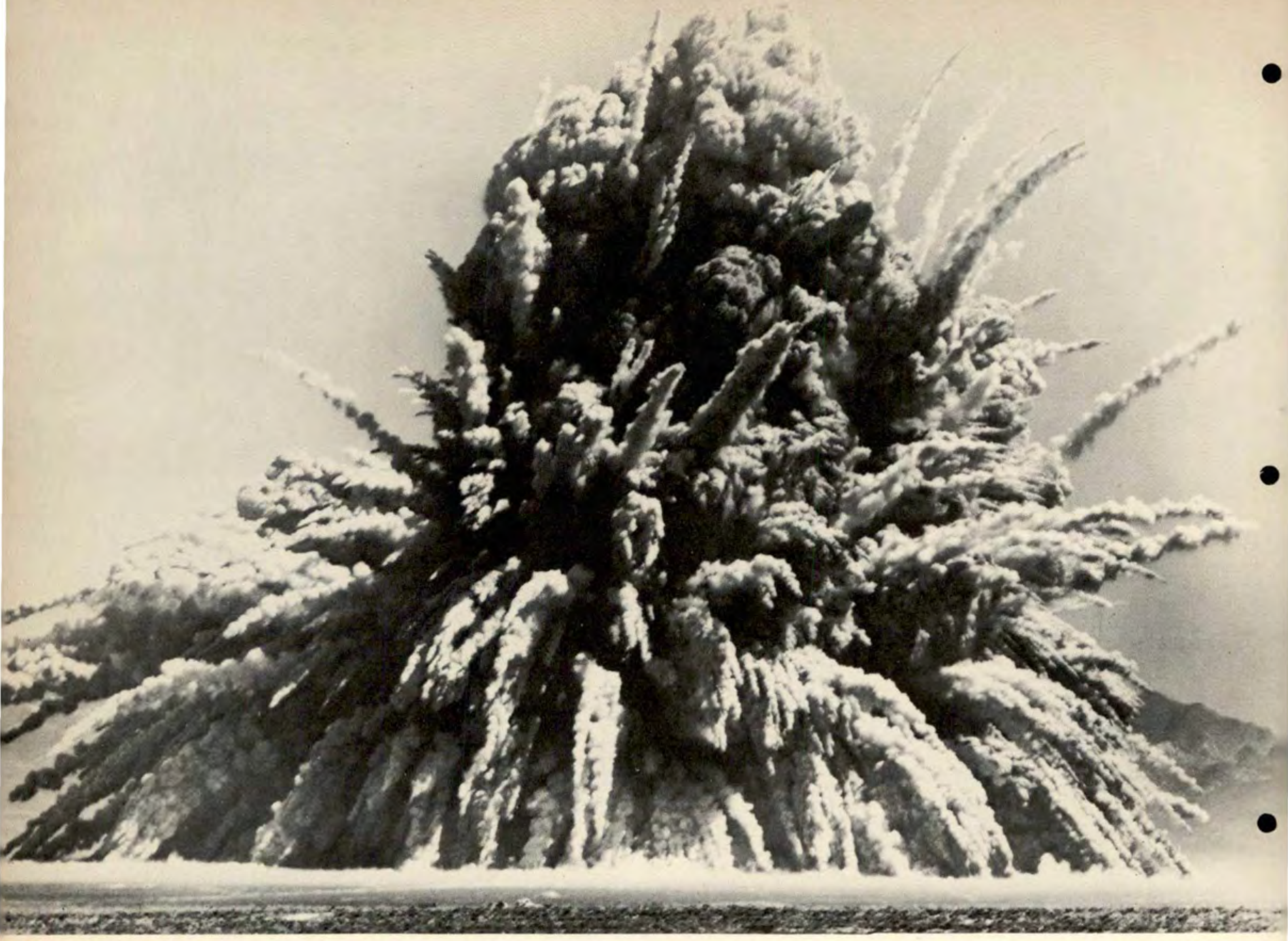
Procedures for submitting prescribed data that must accompany site plans are detailed in Chapter 8, AFM 127-100. While the established procedures are usually followed, there are still a few rugged individualists who prefer doing things their own way.

For example, a map or drawing of not less than 1":400' scale is required to properly identify the proposed location of new facilities in relation to other base facilities. Instead of this, some installations provide a 5 x 7 or 8 x 10 cutout of a map. Since explosives clear zones can extend to 5410 feet, a large area of the base could be left to the imagination.

The map must also show the base boundary and land outside the base over which restrictive easement or agreement has been obtained. This again is to insure that no unauthorized facility would be built within the clear zone. That, too, is why all buildings within the clear zone surrounding a new facility must be identified. It's amazing how many seemingly insignificant buildings within this area become habitats for boy scouts, thrift shops, hobby shops, gun clubs, golf shops and other sundry activities. Visiting areas sprout up near combat crew alert areas. Of necessity, alert force areas are in proximity to explosives loaded aircraft. Putting the crew's families in this same area is just not reasonable.

Once you've established your explosives clear zone, show it on the base master plan. Then treat that area as no-man's-land for future construction of other than explosives facilities.

Clear zone violations can be prevented at numbered Air Force or Command level during review of site plans. Some bases have seen fit not to chance this likelihood. They serenely construct the facilities without such review and then submit for post completion approval. Later, it is discovered that the munitions area fence is out of bounds for the 6th hole, or a children's slide is within a few hundred feet of a combat loaded aircraft. The alternatives then are: Abandon the unauthorized facilities; assume the risk through Command waiver action; or reduce the quantity of explosives to levels below that originally authorized. Good site planning would have obviated the necessity to face such alternatives. ★



A typical nuclear excavation test at the Nevada Test Site.

Radiation Safety *in* Underground Nuclear Testing

Capt L. G. Kline, Radiation Safety Officer, Kirtland AFB, NM

Gathering photographic, radiological and overpressure data from a thermonuclear detonation

HOW WOULD YOU HANDLE a radiological decontamination problem involving 25 aircraft and 200 personnel? Management of such unusual problems has been intensively practiced by specialized personnel at the Air Force Special Weapons Center (AFSWC) at Kirtland AFB, New Mexico. The following is an example of an operation of this kind.

PROJECT SCHOONER

Project SCHOONER, one of a series of nuclear excavation experiments, was conducted on 8 December 1968 at the Atomic Energy Commission's (AEC) Nevada Test Site (NTS), located approximately 60 miles northwest of Las Vegas, Nevada. The experiment involved the detonation of a 35KT thermonuclear device buried at a depth of 350 feet. The resulting crater was 800 feet in diameter and 270 feet deep. The dirt cloud rose to a height of 15,000 feet. The overall mission of the participating aircraft was to obtain photographic, radiological and overpressure data concerning the detonation and the cloud.

The Continental Test Division of the Directorate of Nuclear Field Operations, Headquarters, AFSWC, worked closely with the AEC and the Lawrence Radiation Laboratory (LRL) in planning for the required air support. As Radiological Safety (Rad-Safe) Officer for the Continental Test Division, the author planned for and supervised the Rad-Safe operations for the Air Force. Due to the nature of the test, radiological safety was of prime concern. Much activity on and off the NTS was dedicated to ensuring that personnel, animals and crops were not unnecessarily exposed to the hazards of radiation. Radiological safety procedures were spelled out in the Safety Annex of the Air Force Systems Command Operations Plan 15-66, "Air Force Continental Nuclear Test Support." Personnel and materiel support came from the Reynolds Engineering and Electrical Company (REECo), the AEC contractor at the NTS; Nellis AFB, Nevada; Indian Springs Air Force Auxiliary Field (ISAFAF), Nevada; and Kirtland AFB, New Mexico.

Although several Air Force commands participated, the RB-57C and 57F cloud-sampling aircraft of the 58th Weather Reconnaissance Squadron, Kirtland AFB, were the heart of the support. Their mission was to penetrate the dirt cloud in order to obtain particulate and gaseous samples. In line with good health physics practices and in order to insure that crews would not exceed the permissible occupational radiation exposure limit, they wore anticontamination clothing and used

CREW RECOVERY. The crew of an RB-57C is shown climbing into a forklift-mounted box. Care is taken not to touch the contaminated aircraft exterior.

Radiation Safety *in* Underground Nuclear Testing CONTINUED

100 per cent oxygen during the mission. Aircraft ventilation systems were shut off prior to cloud entry and remainder of the mission. The maximum exposure received by the aircrews was 290mR, well within the limits. Radiation was from sources of such short half-life that it presented no danger to the surrounding area.

Other aircraft which participated in the support mission were:

- An EC-121 used for airborne aircraft control;
- RC-130 and RC-118s used for photography;
- C-130s for sample package drops;
- UH-1Fs which performed security sweeps, search and recovery missions; and,
- A U-3B which performed the U.S. Public Health Service cloud tracking mission. None of their missions required cloud penetration; therefore, the following discussion will focus on the cloud-sampling aircraft recovery operations.

Seventy persons worked to recover the RB-57 cloud-sampling aircraft. Some personnel performed such tasks as crew, aircraft and sample recovery. Others assisted in monitoring, decontaminating and processing all personnel through the "hot line" at the personnel decontamination facility.

Equipment for Rad-Safe activities, mostly obtained through REECo, included E-500B and PAC-3G radiac instruments, film badges, pocket dosimeters, and anticontamination clothing, respiratory masks, general cleaning equipment, decontamination trucks, restraining devices to mark off the decontamination areas and walkie-talkies for communications.

SAMPLE RECOVERY. Two members of the Sample Recovery Team pull the sample "flimsy" from the wing-tip sampling tank. Note the use of long-handled tools to keep the individual at a distance from the radioactive source.

Once the participating personnel and aircraft were present at ISAF-AF, Rad-Safe procedure briefings were held. Two full-scale mission rehearsals were held prior to the actual test.

After several delays due to weather, the final countdown proceeded normally. Soon the giant dust cloud was seen over the intervening mountains. Last-minute checks were made to insure that all equipment was ready, and recovery personnel were properly film badged and dressed in anticontamination clothing.

AS THE FIRST OF THE RB-57S taxied to a stop inside Decontamination Area 1, the Aircraft Recovery Team pinned and chocked the wheels of the aircraft, engines were shut down and the Crew Recovery Team removed both crew members and transported them to the personnel decontamination facility.

Meanwhile a monitor team spot-checked the aircraft to determine the levels of radioactivity present. Special attention was given to the wing leading edges and the wing-tip sample tanks. Readings of 500 to $1000m^{R}$/hr (beta gamma) were obtained on these surfaces. These readings were radioed to the Rad-Safe Control Center. From the control center, the Rad-Safe Officer coordinated the activities of the various recovery teams within the controlled areas.

The Sample Recovery Team removed the particulate samples from the wing-tip tanks and the gas-sample bottles from the modified wing gun bays.

The particulate samples were collected on a special filter paper held inside the sampling tank by a "flimsy" metal screen. After removing each paper from the sampling tank, with its "flimsy," it was placed inside a three-inch thick lead "cave," where the "flimsy" was opened and the paper rolled into a lead "pig." The "pigs" were then crated and shipped to the laboratory, but they did not require special handling preparations.

Eight RB-57 aircraft and their samples were recovered throughout the day. Recovery of each required approximately 30 minutes after each landing.

After the C-130 package-drop aircraft had taxied to a halt in Decontamination Area 3, a pickup truck transported the crews to the decontamination facility while a monitor team checked the aircraft for radiation levels and radioed the information to the Rad-Safe Control Center.

As the aircrews arrived at the decontamination facility they were monitored and decontaminated, as necessary. A standard "hot line" was used for monitoring—showers were available. Only seven of the 200 personnel in the operation required decontamination. These cases were minor ones which involved only the hands and hair. Use of anticontamination clothing and good health physics' practices accounted for the low incidence of contamination.

Most of the aircraft recovered throughout the day showed no traces of radioactivity and were released from the decontamination areas within an hour after recovery. The contaminated RB-57 aircraft were not released immediately, but were allowed to undergo natural radioactive decay. Readings taken on the day after the test were approximately one-fourth of those taken the day before. This natural decay rate was a great help in subsequent decontamination operations.

Cleaning procedures outlined in Technical Order 1-1-1, "Cleaning of Aerospace Equipment," were used. Personnel wore anticontamination clothing and respiratory protection equipment and adhered to strict hygienic practices.

Decontamination of the RB-57 aircraft began early in the morning following the test. The aircraft were towed to the decontamination pad where personnel and equipment were all readied and in position. Two teams of 10 men each were assigned to wash each aircraft, thus permitting continuous operation of the wash pad during the day. A full day's work was required to wash the aircraft. The area was decontaminated before it was opened to unrestricted access. Within two weeks the decay rate had reduced the radioactivity to background. Laboratory checks of the sewage effluent and the surrounding terrain were made to insure that the maximum permissible concentration levels were not exceeded.

The situation was controlled much like a Disaster Preparedness Team controls a BROKEN ARROW. A control center directed all activity within the restricted area. Entry to, and exit from, the area was strictly controlled. Each aircraft, regardless of its airborne mission, was treated as a real radiation hazard until thorough monitoring proved otherwise. Only after the area was completely free from radiation hazards, was it open to unrestricted access.

The Project SCHOONER Rad-Safe operation was completed efficiently and without any major incidents. From its inception, planning had proceeded under the assumption that the worst possible situation could develop. ★

DECONTAMINATION. The most effective means of decontamination is the use of soapy water. Solvent is used to cut through grease and oil deposits.

UNITED STATES AIR FORCE WELL DONE AWARD

Presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Accident Prevention Program.

Standing (l to r)

Major Harold K. Sacane
Navigator

TSgt Bruce P. Huff
Flight Engineer

TSgt Billy R. Hales
Loadmaster

Kneeling (l to r)

Captain Donald R. Miller
Pilot

Major Thomas J. Lewin
Aircraft Commander

17th Tactical Airlift Sq, APO Seattle 98742

On 27 May 1969, Major Lewin and his C-130 crew were enroute to Sondrestrom Air Base after completing a resupply mission to a radar site on the Greenland Ice Cap. Captain Miller, the pilot occupying the left seat, leveled the ski-equipped C-130D at 16,000 feet and began accelerating to cruise airspeed. As the airspeed passed 200 knots, the crew heard three rapid explosions and the aircraft began vibrating violently. Cabin pressurization was lost and indicated airspeed decreased rapidly. TSgt Huff, the flight engineer, reported failure of Nr 1 and Nr 2 engines just as TSgt Hales, the loadmaster, reported Nr 2 propeller had torn a hole in the left side of the fuselage. The two engines were shut down, and with both pilots on the flight controls, a descent was begun. Maximum power on Nr 3 and Nr 4 engines was necessary to maintain control of the aircraft.

Sgt Huff reported Nr 1 and Nr 2 propellers had separated, one was embedded in the leading edge of the wing, and there was a large hole in the left side of the fuselage.

The crew quickly analyzed the situation and decided they would attempt a forced landing on the ice cap. Major Sacane, the navigator, computed their exact position then, using the radio altimeter, began calling off the absolute altitude above the snow as Captain Miller continued the descent. Major Lewin lowered the gear and skis and Captain Miller accomplished a smooth touchdown on the right main ski and gently lowered the left ski to the snow. However, the ski and gear assembly had been damaged and collapsed as the aircraft decelerated. Captain Miller kept the aircraft from ground looping by skillful control of Nr 3 and 4 engines.

The outstanding ability, composure, and coordination demonstrated by Major Lewin and crew during their handling of this extreme emergency prevented injury and the loss of a valuable USAF aircraft.
WELL DONE! ★

Toots

is interested in your problems. She spends her time researching questions about Tech Orders and directives. Write her c/o Editor (AFIAS-E1), Dep IG for Insp & Safety, Norton AFB CA 92409

Dear Toots

Major Johnson's Foreign Object Removal Program has the type of ideas that we are looking for in the Foreign Object Damage program (February Aerospace Maintenance Safety). Hope your readers can furnish similarly good ideas to their base and major command representatives. As a matter of interest, the "piece of junk" that Major Johnson referred to was worth about $11,000 during CY 69 ($13,531,600 repair dollars ÷ 1220 engine removals). Pretty expensive junk, not to mention some "stark terror moments" which make the flying game pretty sporty at times.

Lt Col. John P. Raymer
HQ USAF (AFSMEMS)

Dear Toots

As a maintenance technician I find your magazine very helpful.

Is there any way I can get a copy before it has passed through 14 sets of grubby, greasy hands?

A1C Endoftheline

Dear Endof

Thanks for the nice words; it's sure good to feel wanted!

About those grubby hands, I hope that each copy of the magazine reaches ten people. So there should be only ***nine*** *sets of grubby, greasy hands on it before you see it. If 14 fellas have handled one copy when it gets to you, maybe too many copies are being shortstopped before they get to the greasy-hand group. Why not show this to your local Safety Person—tell him I asked that he take another look at the distribution.*

Toots

Dear Toots

We have recently been ordered to remove the safety pins from the pintle hooks installed on all Aerospace Ground Equipment assigned to our organization. The reason given was that AGE does not meet the definition of vehicles as referred to in TO 36-1-44. We maintain that the safety pin should be on all pintle hooks installed for the purpose of towing.

We have also been ordered to remove the inventory labels attached to all AGE on our account. This is contrary to AFM 67-1, Vol II, Part II, Chapter 12, para 48B. May we have your comments, please?

FRUSTRATED SHOP

Dear Frus

From what I read in TO 36-1-44, you are right—the pin is required in all pintle hooks. I called the OPR, Warner-Robins AMA, and they agree; pintle hooks are supposed to have a pin for additional safety, regardless of what the pintle hook is installed on.

Regarding the inventory labels, possibly your supervisors are having the labels removed because they have a tendency to peel off. Removal of the labels is legal so long as AFM 67-1, Vol II, Part II, Chapter 12, para 52E is followed. Since there appears to be some misunderstanding, why don't you talk to your supervisor again?

Toots

Tech topics

BRIEFS FOR MAINTENANCE TECHS

doctor/detective

MAINTENANCE BOO-BOOS quickly get a lot of attention, whereas the hard work and effort of the boo-boo fixer is pretty much taken for granted. And fixing some of the things that go wrong with airplanes isn't easy. We sometimes think a good troubleshooter has to be a hybrid of about 50 per cent technician and 50 per cent Sherlock Holmes. To wit: An A-7 pilot got a compressor stall on takeoff just as the gear was retracting. He turned to downwind and dumped wing fuel, then tried to increase power. Another compressor stall. At 80 per cent the engine ran smoothly and an uneventful landing followed. Then the troubleshooters went to work. They removed the engine, borescoped it, ran it on a test stand. No results. Next morning they ran it again, simulating as closely as possible the conditions that prevailed when the compressor stall occurred. Mild to heavy stalls between 85 and 89 per cent. Further inspection and the inlet guide vane stop was found out of limits. The stop was set and the engine ran normally on the stand and during an FCF. Just another job well done by the maintenance crew. ★

unhooked hundred

ON POST STRIKE inspection, Flight Lead saw that his wingman's left main gear door was missing. Wingie had reached about 500 knots during the strike and pulled 5.5G on the pullout. After landing, QC determined that the gear fairing roller had been contacting the fairing door up-lock near the point of the hook.

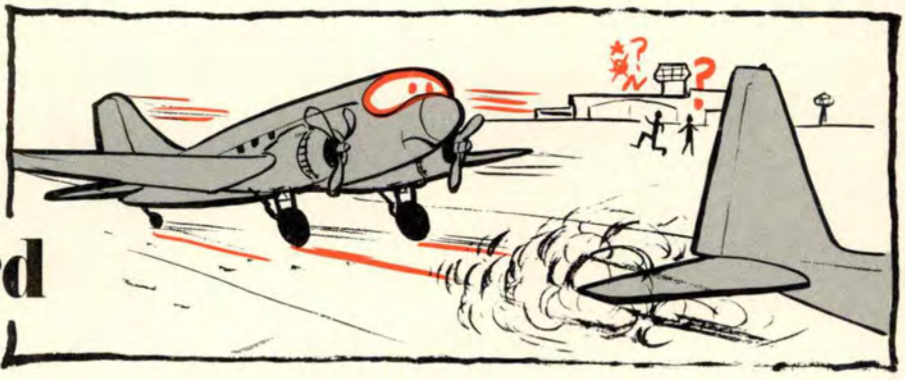
A peek at the back surface of the hook revealed that the hook had closed without catching the roller. In other words, the outer fairing door was out of adjustment. Watch those paint marks on the fairing door up-lock hooks on preflight. ★

Daedalian trophy winner

FOR MAINTENANCE Excellence in 1969, the 4780th Air Defense Wing, Perrin AFB, Texas, is the winner of the Major General Clements McMullen Weapon System Maintenance Trophy awarded by the Order of Daedalians. Presentation was made during the Daedalians' annual meeting at Lackland AFB, Texas.

Receiving the trophy from Gen Jack Merrell, R, are Chief MSgt George Beleele, Col Jimmie Nichols and Col Vermont Garrison, Commander of the 4780 ADW. ★

blowhard



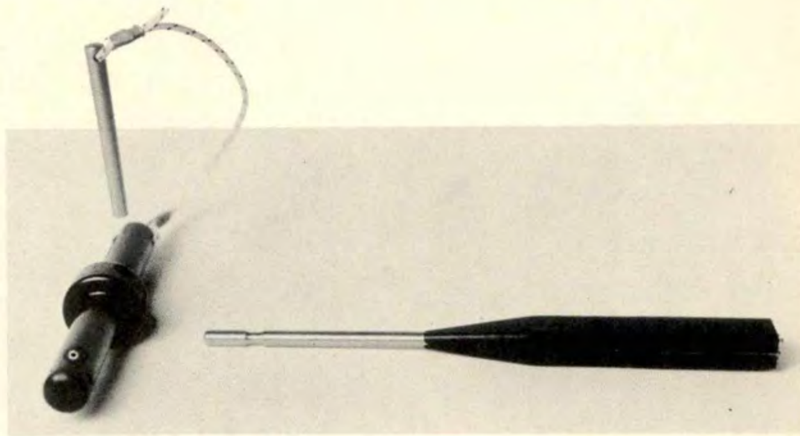
A C-47 WAS BLOWN almost 1000 feet across the ramp, striking two RB-57s in its travel. The tie-down rope on one wing broke and the tie-down attach point was pulled out of the other wing which allowed the aircraft to start its unscheduled movement.

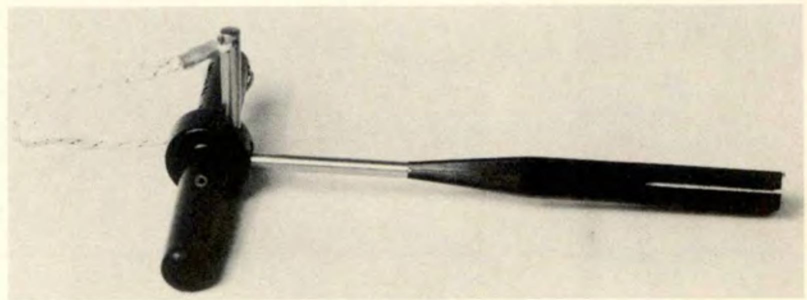
This minor non-flight accident occurred when the engines of a C-130 were being run at full power 230 yards ahead of the C-47. The propeller wake combined with 20 knot winds caused the C-47 to break from its moorings and roll backwards across the ramp, striking the two B-57s. ★

Maj John P. Garbe
Directorate of Aerospace Safety

Tech topics

CONTINUED





handy tool for p.e.

TOOL USED FOR INSERTING communication cord in the smoke mask. Tool can also be used for inserting cable guides in oxygen masks. OCAMA has procured 1000 of these tools (P/N 520-615, FSN 5120-NDO-29044HTP) for issue of one to each P. E. shop. On receipt, the tool should be placed in the field repair kit (mask, oxygen breathing) P/N 450-50, FSN 1660-672-3945.

F-105 loose connector

A RECENT F-105D incident brought to attention the fact that an unsafe right gear indication can be caused by a loose Bendix quick disconnect electrical connector plug, J326, located in the right main landing gear well. Of perhaps greater significance, however, is the fact that this connector also carries anti-skid and landing flap position indicating circuits. Therefore, all F-105 pilots should know that with an unsafe right gear indication, the anti-skid system and flap indicators may be inoperative. Said connector plug being loose, unsecured or improperly mated may also require the use of the override switch to raise the gear. *Maintenance and preflight personnel must assure proper locking of J326 quick disconnect electrical plug in right wheel well.* ★

(Submitted by AFLC)

AIM-4D damage

AN F-4E WAS BEING set up on alert with AIM-7s and 4Ds. The crew chief had connected a ground wire, with an alligator clamp attached, to a grounding point on the main gear. This allows the ground wire to disconnect on scramble. Then he yanked the ground plug from the aircraft ground point located on the right side about 3-4 feet from the exposed AIM-4 missile dome.

Result—broken dome. Now, nobody can work on alert aircraft without covers on the AIM-4 domes. ★

MIKE FOD

THE NOT-SO-CUTE FELLOW shown above represents micron-sized contaminants in aircraft hydraulic systems. "Mike" has been with us for a long time so maybe it is appropriate to formally introduce him. The idea for "Mike" came from the Canadian Forces who were more than glad to let us borrow him. He thrives on poor housekeeping and poor procedures, and the short cut is his breeding ground. Since 40 microns is about the smallest particle the eye can see, "Mike" is indeed a formidable adversary.

What is the size of this problem we are talking about? Control actuators and pumps of high performance aircraft have clearances as small as .0005 in. Aircraft hydraulic system filters are generally rated 25 micron minimal—15 micron absolute. Which means the filter is only about 95 per cent effective down to 15 microns—.0006 in. Several particles this size won't cause a system to fail but if too many accumulate they will cause a valve to stick or they might clog an orifice resulting in a very sick bird or worse.

"Mike" can be controlled, and the hydraulic shop is a good place to start. Super clean is the word.

Use dust caps on open hydraulic lines and disconnects.

Don't store hydraulic fluid in open cans or service directly from the can.

"Mike" can be controlled and the supervisor is the key to controlling him. Be sure your hydraulic system procedures reflect the discipline required. ★

SEMICONDUCTOR DO'S & DONT'S

Murvel Borth, Naval Aviation Engineering Service Unit

If semiconductors, vital to the operation of electronics equipment, are not to be damaged, they must be handled with care. Careful handling, use and servicing will prevent the incidence and severity of physical, mechanical and electrical abuses such as overheating, shock, lead-bending, damaging effects of ultrasonic cleaning, improper use of measuring equipment and improper handling. These abuses and ways of avoiding them are discussed in the following sections.

OVERHEATING

Because a transistor being serviced may be destroyed if its maximum junction temperature is exceeded, maintenance personnel must know this temperature and the melting points of other materials with which it may be used. For instance, the melting point of 60/40 solder (see table, Page 40) is 372 degrees F and that of the germanium transistor junction 212 degrees F. If the maximum junction temperature of the germanium transistor is exceeded during soldering, overheating may cause a shorted transistor junction, open lead connections, and the possible breaking of the hermetic seal (a result of uneven expansion between the header and the package).

To prevent damage to semiconductors, some of the precautionary maintenance steps that must be considered and taken are:

• DO remove the transistor from the socket to which heat is being applied, if possible. Heat can quickly travel from connecting wires being serviced to produce negative effects on neighboring circuitry.

• DO use an adequate soldering iron — one that will supply only enough heat to get the job done. (Most work can be accomplished by use of an iron in the 20- to 50-watt range.)

• DON'T use higher-temperature-rated soldering irons unless an emergency exists. Their use increases the risk of damage to the device.

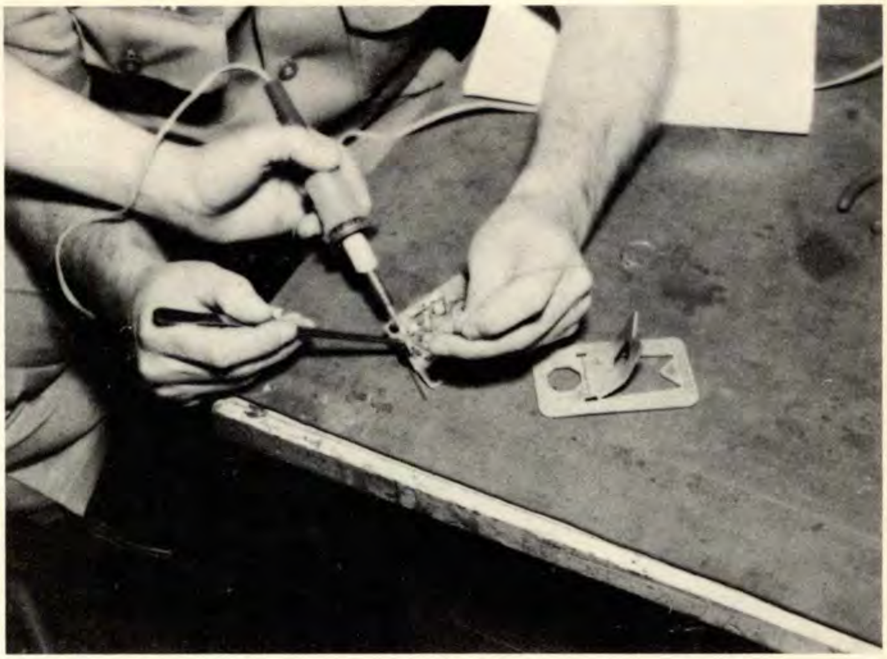
• DO use heat shunts (clips, pliers) to isolate the transistor from the heat source.

• DO clean all surfaces to be soldered, and solder all wires cleanly and quickly.

• DO remove any flux residue on lead connections with alcohol or other approved noncorrosive solvent.

SHOCK

Since semiconductor materials are hard, brittle, and sensitive to physical vibrations, personnel handling them improperly can cause mechanical damage resulting from heat-impact shock. Therefore—



Three hands are not an absolute necessity but it makes soldering with a shunt much easier.

• DON'T drop a transistor onto a wooden work bench.

• DON'T shock-abuse vital and sensitive transistors in handling.

LEAD-BENDING

Most maintenance personnel know that sharply bending wire leads back and forth in conventional circuitry results in a break, or at least a fracture. This is especially true of transistor wire leads, which are located at the entrance of the header area. If bent during testing their service life is considerably shortened and cracks may be produced at the header through which moisture may enter and contaminate the device. To insure against the foregoing:

• DO remember to allow at least one-eighth of an inch clearance between the header and the start of the band to the lead of the transistor.

• DO avoid sharp bends and preserve future components for readiness of equipment operation.

ULTRASONIC CLEANING

Semiconductors should not be cleaned by ultrasonic means. Therefore—

• DON'T place transistors and diodes in an ultrasonic cleaner. Although some semiconductors can withstand the level of vibration encountered in such a cleaning unit, many will be damaged. Avoiding the use of this type of cleaner wil! decrease the risk of damage. To clean printed-circuit boards, simply apply an acceptable solvent with a stiff brush.

OHMMETERS

Some transistors with emitter-base reverse breakdown voltage, usually from one to five volts, can easily be damaged by an ohmmeter that contains an internal battery with a potential up to 22½ volts dc. Voltage "spikes" can cause a buildup of impurities in the collector and emitter junctions. As a result of this accumulation, an internal short from

Multi-wired cannon plugs require the right soldering iron and a steady hand.

Photos courtesy of 63d Avionics Maint. Sq.

collector to emitter can develop. Also, in the case of ohmmeters, excessive current (on the low-resistance ranges particularly) can burn out transistor junctions. Vacuum-tube voltmeters sometimes have on the leads a-c voltage potentials that are high enough to damage the more sensitive transistors.

POWER-SUPPLY POLARITY

Because semiconductors are polarity- and voltage-sensitive devices, power-supply polarities must be considered when the resistances of the circuits of modular assemblies containing transistors or other semiconductors are measured. Reversing the plate-voltage polarity of a conventional triode vacuum tube will keep the stage from operating but generally will not injure the tube; in the case of a transistor or other semiconductor, however, reversal of the collector-voltage polarity will ruin it, instantly and permanently. It is also good maintenance practice to have the power supply disconnected whenever a transistor or any one of its leads must be removed. In short,

- DO know and apply your test equipment properly, and

- DO use extreme care when mating connector leads. Insure that they have the proper polarity.

SPECIAL HANDLING

Great care should be taken during receipt and shipment of the insulated-gate type of transistor. To protect this type of component in shipment, some manufacturers either solder all the leads together or wrap them in fine wire on conductive foil. Maintenance personnel should experience no trouble in handling these transistors if the following safety precautions are taken:

- DON'T unpack the device until it is ready for use. If the leads are soldered or wrapped, they should not be separated until the device is to be installed.

- DO wrap a fine wire around all the leads at the point where they enter the casing, and then proceed to separate them.

- DO attach a ground to the tip of the soldering iron prior to use.

- DON'T use a soldering gun.

- DO provide a heat sink for each lead between transistor and iron before soldering.

- DO remove the shorting wire from the leads after all of them have been connected.

CONCLUSION

This article highlights the most common causes of damage to semiconductors through improper servicing and testing and emphasizes some of the safety practices to be applied to prevent obvious types of abuse. Once a maintenance technician knows the physical and chemical limitations of semiconductors, his own common sense should dictate proper handling and servicing. Accordingly,

- DO use your head and apply the proper tools to do a good maintenance job that will insure equipment readiness.

(Reprinted from U. S. Naval Aviation Weapons Systems DIGEST) ★

Melting Temperatures of Transistors and Associated Materials

MATERIAL	TEMPERATURE	
	°F	°C
60/40 LEAD/TIN SOLDER	372	189
SILVER SOLDER	1377	747
ALUMINUM	1220	660
SOLDERING IRON TIPS (minimum)	500	260
SILICON TRANSISTOR JUNCTION (maximum)	392	200
GERMANIUM TRANSISTOR JUNCTION (maximum)	212	151
MIL-E-5400-J — CLASS 1 AVIONICS EQUIPMENT	131	55
MIL-E-5400-J — CLASS 4 AVIONICS EQUIPMENT	257	125
MIL-E-5400-J — ALL CLASSES	65	54

☆ U.S. GOVERNMENT PRINTING OFFICE 1970 391-400/11

"FROM INSTRUMENT TO CONTACT"

. . . Allow me to add a specific problem area to Maj Carmack's excellent article "From Instrument to Contact" in the April *Aerospace Safety* magazine. If an approach under low visibility conditions is accompanied by a strong crosswind component, the pilot's first view of the runway environment will be at an acute angle to the fore-and-aft axis of the aircraft. The instinctive reaction is to turn the aircraft so as to align it with the runway. Obviously, this will cause the aircraft to drift to the downwind edge of the extended runway or, perhaps, completely out of the runway confines. The pilot now has nine or ten seconds to get back within the runway limits, establish the crab/wing-down landing attitude, and hopefully land safely. The situation is usually accompanied by a slippery runway, so the possibilities for trouble are limitless. The solution, of course, is to plan ahead. If you have been holding a large correction down the glideslope, it is pretty obvious the runway is not going to appear directly ahead of the nose of the aircraft....

Maj Robert Downs, MAPMAC
Scott AFB IL

"MINIMUM" VS "EMERGENCY"

In your March 1970 issue, the article on minimum fuel failed to stress one point that might save an aircraft and a lot of explaining some day.

My point is the difference between declaring "minimum fuel" and "emergency fuel" and what they mean to all air traffic controllers (see FLIP Planning for the latest definition). It is my contention that there are still a lot of old pilots flying around who expect priority treatment when they declare "minimum fuel."

Maj Robert L. Russell
Seymour Johnson AFB, NC

We said "minimum" instead of "emergency" fuel because that should be the point where your problem is identified—and action begins. Even though you don't get priority per se when you call minimum fuel, you have alerted the controller and started his planning.

About the old pilots flying around who haven't kept up with the times—let's hope not!

UR EXHIBITS

The article which you printed in *Aerospace Maintenance Safety* dated June 1969 on identifying UR exhibits with AFTO Form 114 has proven to be very effective. There have been no reports of receiving UR exhibits improperly identified since your June 1969 publication. Thank you for your fine cooperation. However, there is another problem.

UR exhibits for U-3 aircraft components are being received here which have no exhibit value. Approximately 90 per cent of the (proposed) exhibits have been partially disassembled and/or had components replaced. These conditions destroy the effectiveness of a comprehensive technical investigation. Comply with procedures as outlined in Section V of TO 00-35D-54 for effectively processing UR exhibits.

Real exhibits get Real results.

D. O. BOWLAN
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Safety Awards 1969

FLIGHT

AAA	17th Tactical Airlift Squadron, Elmendorf AFB
ADC	48th Fighter Interceptor Squadron, Langley AFB
	78th Fighter Wing, Hamilton AFB
AFLC	Air Procurement Region Far East, Tachikawa AB
AFRES	934th Tactical Airlift Group, Minn-St Paul Intl Aprt
AFSC	Air Force Eastern Test Range, Patrick AFB
ANG	140th Tactical Fighter Group, Buckley ANGB
ATC	3560th Pilot Training Squadron, Webb AFB
	3645th Pilot Training Squadron, Laughlin AFB
	3515th Pilot Training Squadron, Randolph AFB
AU	3800th Air Base Wing, Maxwell AFB
MAC	89th Military Airlift Wing, Andrews AFB
	40th Aerospace Rescue & Recovery Wing, Ramstein AB
	61st Military Airlift Wing, Hickam AFB
PACAF	463rd Tactical Airlift Wing, Clark AB
	315th Tactical Airlift Wing, RVN
	356th Tactical Fighter Squadron, Takhli RTAFB
SAC	28th Bombardment Wing, Ellsworth AFB
	319th Bombardment Wing, Grand Forks AFB
	92d Strategic Aerospace Wing, Fairchild AFB
TAC	311th Tactical Fighter Training Squadron, Luke AFB
	426th Tactical Fighter Training Squadron, Luke AFB
	464th Tactical Airlift Wing, Pope AFB
USAFE	10th Tactical Reconnaissance Wing, RAF Alconbury
	7101st Air Base Wing, Weisbaden AB

MISSILE

CATEGORY I (Air-Launched Missiles)

AAC	21st Avionics Maintenance Squadron, Elmendorf AFB
ADC	Air Defense Weapons Center, Tyndall AFB
	78th Fighter Wing, Hamilton AFB
ANG	115th Fighter Group, Truax Field, Madison
PACAF	355th Tactical Fighter Wing, Takhli RTAFB
	12th Tactical Fighter Wing, Cam Ranh Bay
SAC	42d Bomb Wing, Loring AFB
	100th Airborne Missile Maint Sq, Davis-Monthan AFB
TAC	57th Fighter Weapons Wing, Nellis AFB
	33d Tactical Fighter Wing, Eglin AFB

CATEGORY II (Ground-Launched Missiles)

ADC	46th Air Defense Missile Sq, McGuire AFB
SAC	321st Strategic Missile Wg, Grand Forks AFB
	381st Strategic Missile Wg, McConnell AFB

CATEGORY III (Units Launching Missiles—Test and Research)

ADC	Aerospace Defense Group, Vandenberg AFB
AFSC	6555 Aerospace Test Wg, Patrick AFB

CATEGORY IV (Ranges, AFSC Divisions and AMAs)

AFSC	Air Force Eastern Test Range, Patrick AFB