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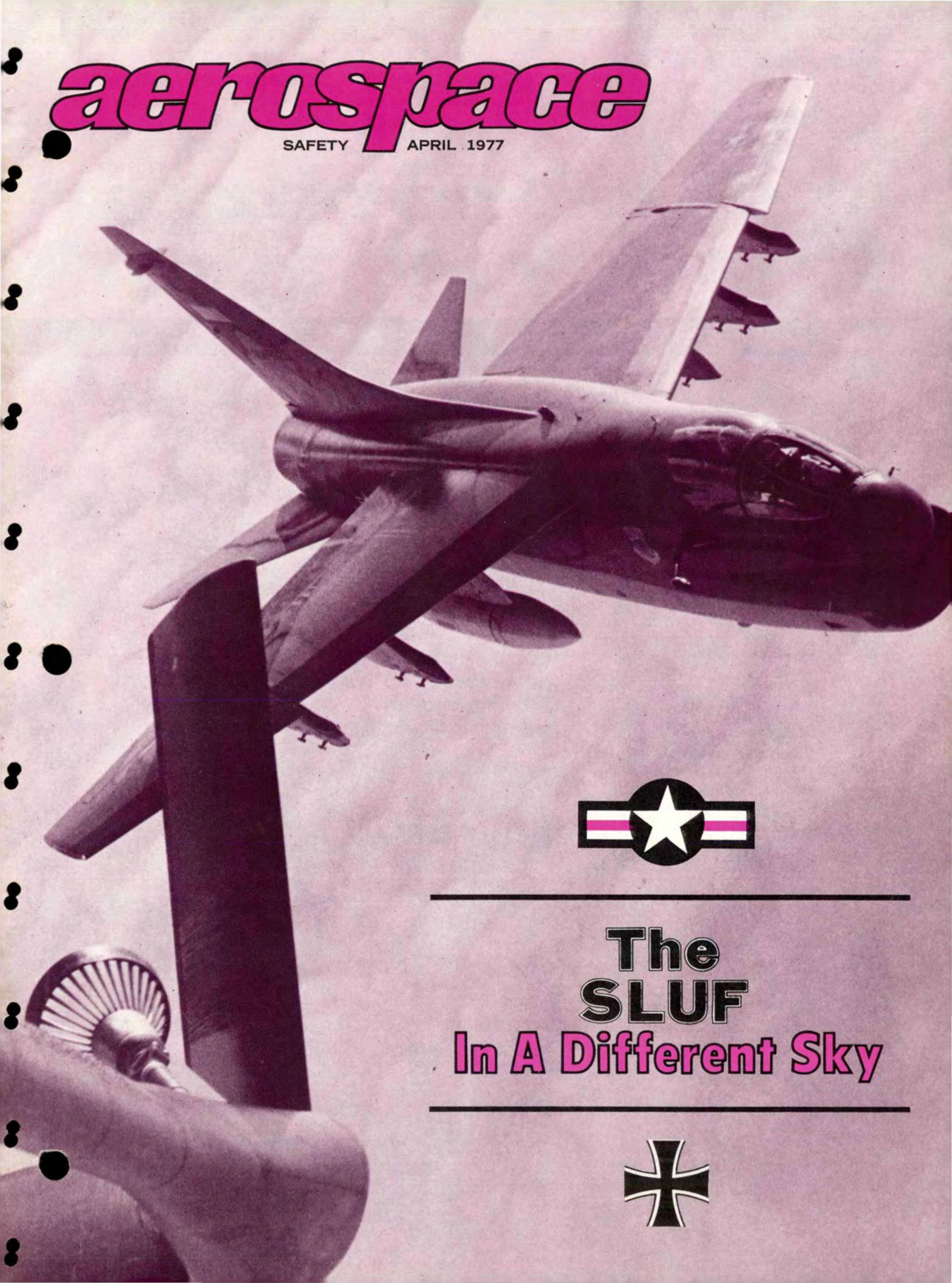
SAFETY APRIL 1977



The SLUF In A Different Sky

UNITED STATES AIR FORCE APRIL 1977

aerospace SAFETY

THE MISSION - - - - - - SAFELY!

SPECIAL FEATURES

REGULAR FEATURES

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NAME THAT PLANE ANSWER

These are two (one pusher and later a tractor) versions of the first flying wing. The aircraft was designed with two cockpits offset from the centerline engine. The aircraft was usually flown from the left cockpit, while the starboard opening was faired over. The landing gear by the way was a reversed tricycle type. The pictures and information for Name That Plane courtesy Northrop Corp Aircraft Div.

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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APRIL 1977 AFRP 127-2 VOLUME 33 NUMBER 4

STANDARDS

CAPTAIN GARY A. VOELLGER
523 TFS
CANNON AFB, NM

During my eight years in TAC I've heard much said and seen a great deal written about what a fighter pilot is. In general, the theme has been that a "fighter pilot" is more an attitude than an occupation; a proposition I can readily endorse. I would further propose that the single most essential element of attitude that distinguishes the "fighter pilot" from the "shoe clerk" is his standards.

As members of the Air Force, each of us is familiar with the standards that are imposed by directives. They are not, however, the topic of this discussion. I am more concerned with those standards that each of us —F-15 pilot, crew chief, or supply officer—must individually define for ourselves and jointly define in our associations. We've all heard the wag discussing the individual who consistently sets low standards and fails to meet them. While the witticism is entertaining, it also contains an element of sagicity. Low, easily attained standards have an inherent debility. They breed contempt. Standards held in such disdain receive little attention, which often results in the deterioration of existing performance. Reciprocally, the individual who sets high standards is stimulated to greater levels of performance by the challenge of those elevated standards. The obvious contrast in these two philosophies is in performance. The striver is ever improving, whether he attains his goal or not. The individual satisfied by mediocrity, remains static or even regresses.

This distinction in the setting of standards applies to groups as well as individuals. The establishment of high group standards brings in another dimension, though. The individual working toward elevated standards can accept falling short of his goal, consoled by the fact that he is improving all the time. My experience has shown that it is much more difficult for individuals to react to group standards with the same assurance, no matter how demanding the standards. As a result, groups tend to set standards that even the poorest performer can attain. The biggest contributor to this tendency is the misconception that we are helping each other. I say misconception because the lowering of group standards, like individual standards, more often than not has a negative impact on performance. And that helps no one.

Countering this tendency is a three-step process. First, we must be willing to set high standards, particularly as supervisors. Second, we must communicate that our expectations are high. Third, we must recognize that the benefit of such standards is derived more from the striving to meet such elevated goals than from their actual attainment.

As an example of this type of thinking, I should like to illustrate two philosophies of grading patterns at mobile. On one hand we have the wing where everyone gets a Q. Anything less would highlight the individual, and we wouldn't want to do that. In contrast is the wing where only those patterns proficiently flown receive a Q grade. All others receive a Q− with proper annotation of the deviation. Supervisors in the second example must communicate their standards are high and be aware that deviations from such standards are inherent.

Frequent deviations from the standards, rather than reflecting negatively upon the individual(s), would indicate areas for increased training emphasis.

I would propose without hesitation, that the proficiency of the air crews in the second wing would far exceed those of the first.

The philosophy of setting high standards described above can apply to any job, not just grading landing patterns. The challenge is yours, both individually and as a supervisor. What will your standards be? What standards will you impose upon your subordinates? Can you accept setting standards demanding enough that not everyone will always attain them? What will be your reaction if everyone doesn't meet elevated standards, If you can meet these challenges, you've got everything to gain. ★

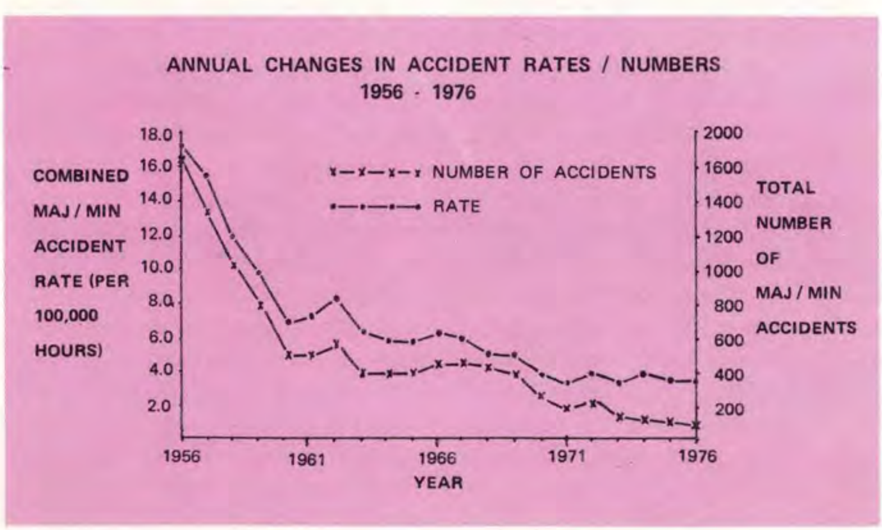
Safety's Track Record

. . . A 20 YEAR LOOK

MAJOR THOMAS R. ALLOCCA
Directorate of Aerospace Safety

". . . We had 108 accidents last year . . . 108 . . . that's about one every 3 days . . . boy, we had a bad year." This discussion conceivably could have taken place in the Squadron briefing room, or the maintenance hangar or the Officer's Club. We in safety like to think that you "out there" care about how the Air Force is doing—safety-wise. And how are we doing? Was 1976 a bummer? More importantly, what has our track record been? Has all of this "Safety comes first" business reaped any benefits? Let's turn to history for an answer.

In 1956 USAF experienced 1679 major and minor flight accidents. This translated into a combined rate of 17.0 and an average dollar loss of approximately $350,000 per mishap. Ten years later, in 1966, we experienced 440 major and minor accidents, the combined rate was 6.3 and the average accident dollar loss was about $810,000. A decade later we had 108 major and minor accidents, a combined rate of 3.5 and an average dollar loss per accident of 1.95 million. Graphically, the numbers and rates are portrayed below:



The graph dramatically illustrates the improvement in our record made through the implementation of a vigorous safety program. The fact that the combined rate has decreased by almost 80 percent shows that we have flown the mission more safely. And while the record is encouraging, perhaps the following question should be answered to provide a better assessment of safety's advances: "How do these reduced rates and numbers translate into dollar savings?" Perhaps this question can best be answered by a review of destroyed aircraft numbers and rates.

In 1956, 739 aircraft were destroyed at a rate of 7.5. By 1976, this number had been reduced to 68 aircraft destroyed for an annual rate of 2.2. If USAF had made no improvement in this very crucial safety statistic, the 1976 rate would have equaled that experienced in 1956—7.5. Since USAF flew a fleet total of 3.1 million hours in 1976, this rate translates into a *no improvement* figure of 233 aircraft destroyed. The average cost of a 1976 destroyed aircraft was 3.0 million dollars; therefore, the *no improvement* destroyed aircraft dollar loss is computed to be 233 x 3.0 million dollars, which equals 699 million

dollars. The actual 1976 destroyed aircraft dollar loss experienced was approximately 201 million dollars, a difference of 498 million dollars. *This amount represents the dollar loss savings and, more significantly, the preservation of our combat capability, realized through a 20-year improvement in USAF's safety statistics.*

Who get's the lion's share of the credit for this savings? No one individual, agency or unit. Rather, the effort has been achieved by that heterogeneous grouping known as the aviation community. This grouping includes the aerospace industry —which "engineers" safety into our aircraft; Air Force's development agencies—which ensure that our fleet is developed, procured and tested with safety foremost; USAF's operational and maintenance communities—they ensure that our fleet effectively, but safely, accomplishes the mission; and the safety agencies —which seek to ensure, throughout a weapon system's life cycle, that safety requirements are afforded uppermost consideration.

So our ability to fly the mission more safely has reaped benefits—to the tune of hundreds of millions of dollars over the past two decades. Can we improve? And what kind of a payoff will USAF realize if we do improve?

The answer to the first question is an emphatic yes! USAF's accident experiences include "lessons learned," accident board recommendations and system safety improvements which—if implemented —will enable the Air Force to continue to enhance the record achieved to date. To best answer the second question, we should compare like time intervals and our most recent accident experience.

The average combined dollar loss (in millions) for the 1967 to 1971 time interval was 358.0 million dollars per year; for the 1972 to '76 period the average figure decreased to 275.9 millions. This 23 percent decrease was realized because of the vigorous safety programs pursued Air Force-wide. If we register a similar decrease in the next five years, the average annual combined dollar loss figure will be approximately 212.4 millions. If we show no improvement—and history seems to indicate otherwise—USAF will experience a 275.9 million dollar average annual loss. The difference between the two projections is depicted below:

YEARLY INTERVAL '77-'81
IMPROVEMENT: 212.4
NO IMPROVEMENT: 275.9

The total projected dollar loss is computed as:

YEARLY INTERVAL '77-81
IMPROVEMENT: 212.4 x 5= 1.06 BILLIONS
NO IMPROVEMENT: 275.9 x 5 =1.38 BILLION

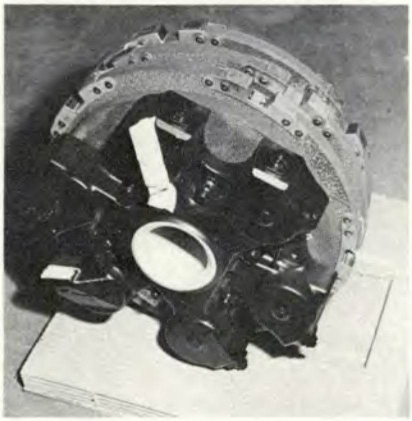
The difference between the two projections is 320 million dollars—the price we will pay if we fail to register an improvement in our safety record in the next five years.

Safety does not come cheaply: building redundancy into the flight control system of a new fighter aircraft; outfitting the fleet with a less flammable hydraulic fluid; procuring training devices which offer the best chance of producing an accident-free aircrew — these are expensive undertakings. But because USAF has undertaken similar programs in the past, we've compiled the safety record documented in this article. If we want to realize the 320 million dollar savings mentioned above, and—more importantly—if we want to conserve a fleet "second to none," we'll have to pursue those programs which offer the best chance of building upon our record. Will we? History says yes! ★

New "Whoa" Power

CAPTAIN ROBERT M. CARNES, HQ USAF/LGYYC, Washington, DC

Lightweight carbon brake installation on the F16. New fibers added to the carbon discs have allowed smaller size and retention of braking power when water soaked.



The major points of discussion about new aircraft tend to highlight powerful engines, sophisticated avionics, responsiveness of the flight controls and the total performance characteristics. Articles about military aircraft usually point out those new and superior systems that enable the machine to fly and fight better than aircraft of the adversary.

Seldom does the discussion lead to ground performance but all modern aircraft have two things in common while moving across the surface of terra-firma: a propulsion system for "Go" power and a braking system for "Whoa" power. On the ground, "whoa" is more important than go.

Military aircraft brakes have undergone an evolutionary process just as have all other systems. Brakes have progressed from none at all, in the days of the bi-wing, sticks-n-wire tail draggers, to the mechanical drum and shoe configuration. Then fluid under pressure came to the foreground as hydraulic cylinders were applied to the drum and shoe arrangement. Next came the hydraulic expandable tube brakes, then the rotating disc with hydraulic spot clincher and then the top of the evolutionary chain was supposedly reached with the stopping power of the multiple rotor-stator steel brake disc. This configuration has survived but not sufficed for many years. One characteristic of all is that they lose effectiveness when they overheat or become water soaked.

Brakes have had a quiet and rarely noticed evolution. It has been something no one talks about but that many people are presently doing something about. Imagine having total brake failure at 10 mph in a 30-ton aircraft and having to do the old "leg over the rail and boot on the ramp" trick to stop that big machine! The boot would get scorching hot very rapidly, not to mention the wear and distortion.

This heating effect is what braking is all about, for brakes must convert moving energy of the aircraft into heat energy and dissipate the heat to the surrounding air. The more energy a brake system can absorb and convert to heat over a given period of time, the more efficient it is in halting a moving object. This is all well and good, but like the sole of the boot, heat and friction cause wear and destruction. In these days of austere funding and low spare replacement buys, the cost of owning a weapon system becomes of prime importance, even in replacing worn and warped steel brake discs.

Well, the evolution story of brakes is not over yet. In 1966, Goodyear Aerospace Corp. initiated development of brake discs made of carbon. That's right, carbon, the kin sister to the diamond. Rayon cloth was heated to extreme temperatures and converted to carbon sheets. These were trimmed to size, stacked in desired layers and saturated with a special resin or gas. They were cured to a hard material and then baked at temperatures from 3300 to 5500 degrees Fahrenheit until the resin or gas was also converted to carbon. After machining, a brake disc of strong black carbon was ready for use.

In 1970, Goodyear received a contract award for the F-15 brakes and testing started at Edwards AFB in 1972. Test results were highly successful and all prototype and production F-15s are now fitted with carbon brakes. In late 1972 a contract was awarded Goodyear for the YF-16 brakes. Presently flight testing is in progress with carbon brakes on the B-1 bomber and F-16 fighter.

Evolution has not stood still but has had quantum leaps with the carbon brakes. A new fiber, polyacrylonitrile, referred to as PAN has been added to the disc and when converted to carbon provides a 10-15% denser disc. The denser the material, the more energy it will absorb and thus the smaller the disc has to be to provide the same "whoa" power. Another additive was infiltrated in the carbon material to prevent loss of braking power when water soaked.

What is so great about carbon? How is it superior to the steel rotor-static brake disc? The answer, from a technical point, goes back to heat. Carbon can absorb more than twice the amount of heat per pound than can steel, thus carbon brakes can be made ⅓ to ½ lighter and still do a much superior job to steel. Carbon does not melt, warp or fracture under high temperatures, thus brake failures are not a problem. Carbon has a low thermal expansion rate, 1/5 that of steel, thus brake lock-up and welding does not occur. It is highly resistant to thermal shock and can go from sub-zero temperatures to extremely high temperatures and return to cold temperatures without internal embrittlement failures. Carbon is also an excellent heat sink and can quickly move heat away from the disc surfaces to allow higher energy absorption, which equates to stopping power.

What does all this add up to, you say? Plenty! It means more safe landings between brake changes. The newest production F-15 brakes are getting about 160 landings between changes and with the new spacers to compensate for wear, this figure is approaching 450. A new carbon disc presently under development is expected to boost the figure to over 1200 landings with the use of spacers. It has meant a weight savings of 130 pounds for brakes on the F-15. For every pound saved in the brake system, this saves three more pounds in fuel and basic aircraft/landing gear structure. This is all important in our high thrust-to-weight ratio fighter aircraft. It means less "sweat" in making those maximum high energy emergency stops because of its good heat properties.

The B-1 has eight brake stacks for a total brake weight of only 512 pounds. With the bomber's weight at 360,000 pounds, a maximum energy stop requires the carbon disc to dissipate 413 million foot pounds of energy. Steel brakes trying to provide the same service would have to weigh in excess of 1600 pounds and would still be completely destroyed.

OK, you say, what about this sis-

One of eight new carbon brake stocks used on the B-1. Combined weight of all stocks is only 512 lbs.

ter to the diamond, is the cost just as prohibitive? When first developed, the cost per landing of a carbon brake disc was nine times greater than that of a steel disc. The present production version is about 1.4 times greater and a new disc under development is expected to be only .4 times greater in cost. With the use of brake disc wear spacers, our cost per landing to use carbon brakes will soon be equal to that of steel.

There are other cost savings associated with using carbon discs that are not readily visible but that quickly offset the higher cost per landing when compared to steel. The cost of maintenance manpower is not cheap. The high rate of steel brake changes, transportation to the nondestructive inspection (NDI) shop, the de-grease process, the zyglo or magnaflux check, machine shop warp check, cold press straightening, another trip to the NDI shop and installation on an aircraft all equate to manpower and supplies expenditures and dollars. Carbon eliminates all these functions with the exception of remove and replace, and that is not very often.

Well, that is what is so great about carbon for the maintenance people but what is so great about it for the pilot? It would only take one ground abort at almost liftoff speed and the performance of a maximum energy stop on a rain soaked runway to answer that question. To the pilot—carbon is worth its weight in diamonds. ★

THE IFC APPROACH

This month's article contains some of the questions most often asked concerning the material contained in the newly revised AFM 51-37. All page, figure, and paragraph references are made to AFM 51-37, dated 1 December 1976.

Q. Why have ADF procedures been omitted?

A. ADF equipment description and procedural steps for tuning were removed because of the numerous different types of receivers currently installed in operational aircraft. The individual aircraft flight manual should contain specific information on tuning and equipment description. Procedures to fly ADF approaches are still included, although not under a separate chapter. ADF information is located as follows:
Description: pg 1-24
Tuning: pg 2-17
Homing: pg 2-18
Proceeding Direct: pg 2-19
Inbound (RMI only): pg 2-22
Outbound After Station Passage (RMI only): pg 2-26
Outbound (RMI only): pg 2-30
Maintaining Course: pg 2-33
Station Passage: pg 2-33
Final Approach: pg 6-13

Q. The "NOTE" under paragraph 2-17 states that once established in the holding pattern, the first definite move by the bearing pointer 45 degrees either side of the holding course may be used as station passage indication for holding timing. Does this apply to VOR, TACAN and ADF holding?

A. No. The note only applies to ADF holding and should not be used in a VOR or TACAN holding pattern. Additionally, AFM 55-9, US Standard for Terminal Instrument Approaches, states that the use of TACAN station passage as a fix is NOT acceptable for holding fixes.

Q. Paragraph 5-5a(3) states that holding pattern teardrop offset may be up to 45 degrees. Is this a misprint?

A. No. Many pilots discovered that under certain airspeed and/or wind conditions, especially in short TACAN holding patterns, it was impossible to arrive at an inbound position from which a turn inbound would place the aircraft on-course when limited to a 30 degree teardrop offset. Consequently, the teardrop offset was increased to a maximum of 45 degrees to allow the pilot more flexibility. The following situation illustrates the rationale behind the change: An aircraft flying at 300 KTAS, under no wind conditions, will fly approximately 7½ NM outbound in 1½ minutes. At 300 KTAS, the turn diameter is approximately 4½ NM at 30 degrees of bank (reference: Figure 7-14). Since the distance between each radial is 1 NM at 60 NM, at 7½ NM, each radial is ⅛ of NM wide. 30 radials at 7½ NM are 3¾ NM wide, (30 × ⅛ = 3¾). Since the turn diameter at 300 KTAS is 4½ NM, the aircraft will overshoot the inbound course by ¾ NM, as shown in Figure 1. A 36 degree teardrop, as shown in Figure 2, will allow the aircraft to arrive on-course inbound

FIGURE 1

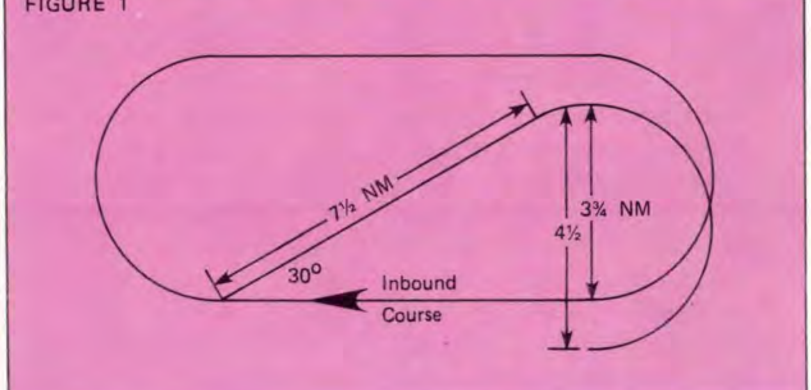
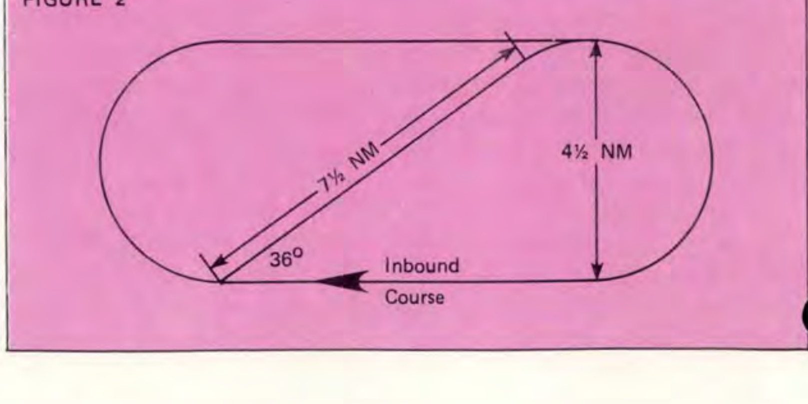


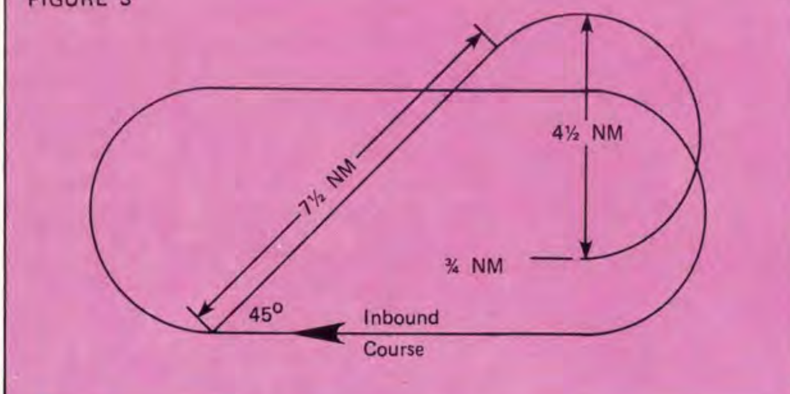
FIGURE 2



By the USAF Instrument Flight Center
Randolph AFB, Texas 78148

Aircrews should be cautioned that in certain situations 45 degrees of offset may result in an undershoot in the same situation as Figure 3 illustrates.

FIGURE 3



The intent of this change is to encourage crew members to precompute teardrop offsets for their particular aircraft operations. The turning performance chart on page 7-15 is easy to use and since crews do most of their holding at nearly the same altitude and airspeed for any particular aircraft, one or two pre-computations should cover most situations. The 45-degree offset should allow aircraft enough flexibility for almost any TAS/wind situation, while assuring the aircraft will not exceed holding air space.

Q. Paragraph 6-5a states that upon arrival at the Initial Approach Fix (IAF) for a non-DME teardrop penetration at an altitude below that published, maintain that altitude and proceed outbound 15 seconds for each 1000 feet below the published altitude before starting descent. Does this procedure apply equally to recommended minimum and mandatory IAF altitudes?

A. Yes. The purpose of the non-DME teardrop penetration is to permit an aircraft to reverse direction and lose considerable altitude within reasonably limited airspace. If a pilot begins penetration from the IAF at an altitude below the published IAF altitude (mandatory, minimum or recommended), he may not have enough time to safely intercept the final approach course, descend to Final Approach Fix altitude, configure the aircraft, and slow to final approach airspeed.

Q. Why were "vertical S" maneuvers removed from the manual?

A. Most major commands indicated that the vertical S descriptions were not being used operationally.

Q. When the guidance contained in AFM 51-37 conflicts with other directives, such as the Dash One or command directives, which directive should be followed?

A. You should comply with Dash One procedures and/or command directives. The information contained in AFM 51-37 provides general guidance.

Q. What is the purpose of the numbers at the top center of each page?

A. These refer to paragraphs found on that page. The index only refers to paragraphs. Therefore, this new feature was included in the new manual to facilitate locating the referenced paragraphs.

Q. Who is required to have a copy of AFM 51-37?

A. Distribution is determined locally. Commanders may deem it unnecessary to issue a copy to every aircrew member.

Q. How can a copy of AFM 51-37 be obtained?

A. Copies can be requested through unit publication distribution office (PDO) account representatives. AFM 51-37 is also for sale through the Superintendent of Documents, US Government Printing Office, Washington DC 20402. The subscription price is $11.00 domestic or $13.75 foreign.

CORRECTION

The February 1977 "The IFC Approach" article, which outlines the significant changes to the revised AFM 51-37, describes, in error, a 2½ degree tolerance for determining "on-course" during descents. It is not intended for this 2½ degrees to be used for descent purposes on any approach except when the aircraft is being radar vectored. This 2½ degrees is intended to give pilots on radar vectors guidance as to when they can consider themselves "on a segment of the published routing/instrument approach procedure" so they may depart their "last assigned altitude." ★

FOR WANT OF A NAIL

MAJOR PAUL TILEY
Directorate of Aerospace Safety

The open 781 write-up read something like this: "AOA probe heater heats up all the time with power on aircraft. Circuit breaker pulled for ground operation." If you as an aircrew member were to see this write-up, it should at least cause you to ask some questions about what troubleshooting was done to clear the write-up. Every aircrew member should realize that pulling a circuit breaker does NOT constitute a proper corrective action, and that circuit breakers are NOT meant to be switches.

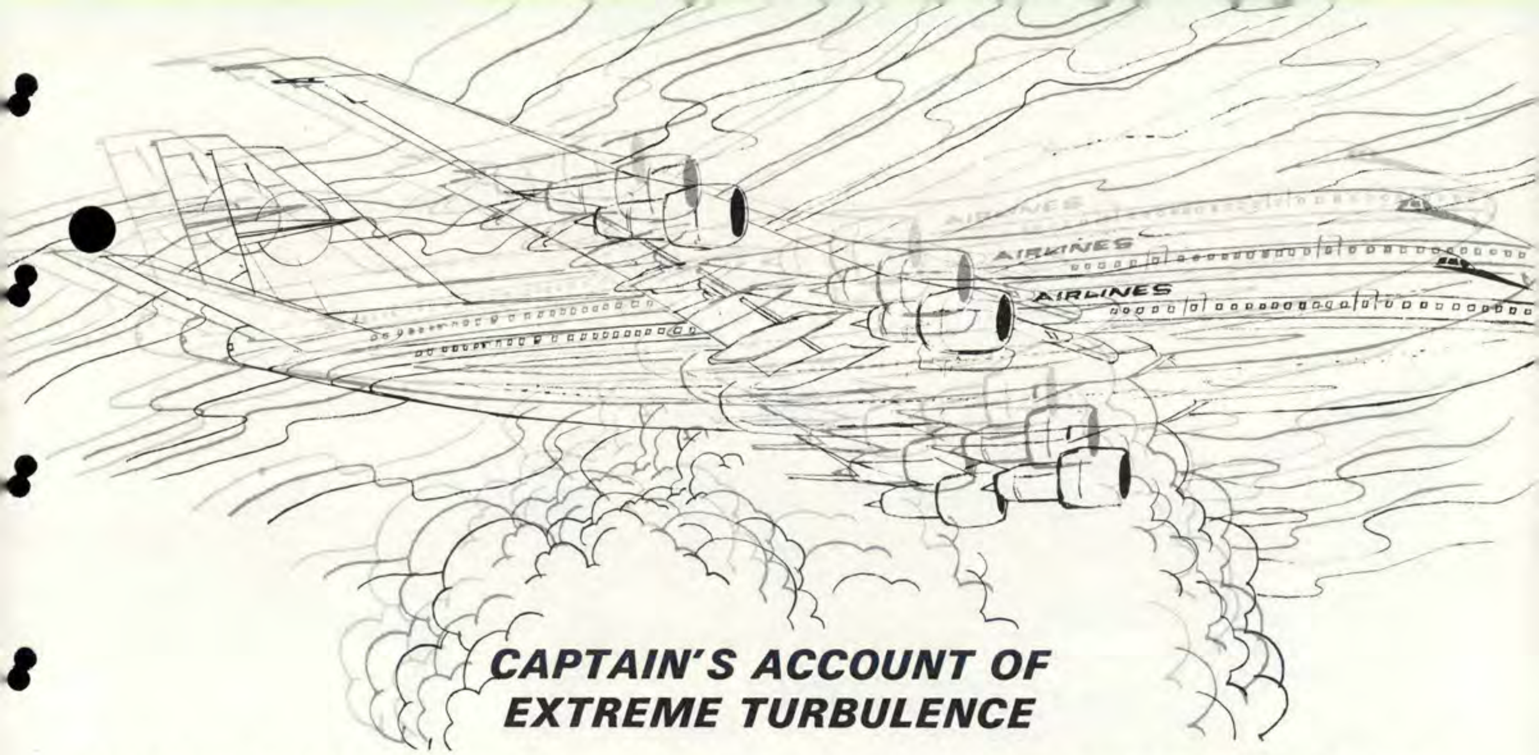
The aircrew accepted the aircraft with this open write-up apparently without inquiring any further into the cause of the write-up. This was the "nail" that *twice* nearly caused them to have an accident.

On landing at an enroute airfield, the aircrew discovered that they had NO nosewheel steering and NO normal braking below approximately 40 knots. The antiskid was turned off and the emergency brakes activated with NO apparent effect. At a very low speed, normal braking was regained and the aircrew managed to stop on the runway without further incident. Sometime during the troubleshooting, the AOA circuit breaker, which had been reset after takeoff, was pulled because of the open write-up. You guessed it, all of the problems CND'ed. No work was done on the AOA write-up, so it was still open. The aircrew decided to press on to their destination.

On landing roll at their destination, they again experienced a loss of nosewheel steering and normal braking below approximately 40 knots. This time the aircraft started to drift over to the edge of the runway. Again the antiskid was turned off and the emergency brakes applied. There was no response from the emergency brakes and the aircraft departed the runway. Fortunately, there was no damage to the aircraft. As you might guess, the AOA probe heater circuit breaker had been reset in the air again.

This time everybody agreed there was something wrong with the aircraft. Troubleshooting revealed that the scissor switch on the main landing gear was stuck in the "airborne" position. With the scissor switch stuck in this position and the AOA probe heater circuit breaker IN, the aircraft would NOT have nosewheel steering or normal braking below approximately 40 knots. The aircrew did not discover this sooner because the circuit breaker had always been reset after takeoff. Additionally, with the brake valves that are presently in this aircraft, the emergency brakes will not work if normal utility hydraulic pressure is available.

The failure of maintenance personnel to properly troubleshoot the AOA probe heater write-up was the basic cause, but the aircrew almost bought the accident *twice*. Scissor switches and circuit breakers may have many functions. A "simple" solution like pulling a circuit breaker can be the "nail" that sets you up for an accident. Know your aircraft.



CAPTAIN'S ACCOUNT OF EXTREME TURBULENCE

This airline captain's account of an encounter with extreme clear air turbulence appeared in the Jan 77 issue of Crosscheck, *Pan Am's flight safety publication. The aircraft was a Boeing 747.*

At approximately 1614Z, near 66N 41W, FL 350, G.W. 600,000 pounds, the flight encountered turbulence which caused me to be concerned with the structural integrity of the aircraft.

Due to previous light chop, passengers had been warned to keep belts fastened at all times. The seat belt sign was off at the time of the encounter. Fortunately no injuries were sustained.

OAT −53C wind 180/110 air smooth, M.84. With no warning all hell broke loose. Put A/P to "turb" mode, seat belt and no smoke on. Rapid oscillations in roll and yaw, very little in pitch. I don't believe a human could have controlled the aircraft manually—oscillations too rapid. My main concern was the possibility of shedding engine pods. As near as I could determine, excursions approaching 40° in the roll axis occurred, mainly to the right. Speed indication was difficult to determine due to rapid fluctuation. I saw one indication of .87 at the highest and .80 at the lowest. Engine rpm was kept in vicinity of 91 to 93 percent N1. Caution panel lights blinked on and off—mainly engine oil pressure.

I believe both high and low speed buffet were felt. The airstream noise variation is difficult to describe—approaching thunder on the high DB side and eerie silence on the low.

First officer read OAT and wind indications. Highest OAT read −41° lowest wind readout 084 /58 kt. At 1615 I attempted to warn other aircraft in the area, freq 129.7, no reply. Transmitted on 121.5 blind our position and situation. At approximately 1630 turbulence became moderate and I was able to communicate with the cabin to ascertain no injuries or damage sustained (except for galley chaos).

OAT stabilized at −48°, wind 110/90. During the turbulence the aircraft had been allowed to settle to 34,600 feet. After assessing our situation in smooth air, we climbed back to 35,000 and continued enroute. ★

SAFETY RECORD

The 103 TAC Fighter Group, Connecticut ANG, has compiled an excellent record of 10 years and 50,000 accident-free flying hours. Most of this time (40,000 hours) was logged in single engine F-100 and F-102 aircraft. This 10-year record encompassed two airframe conversions and a shift of mission from ADCOM to TAC. In the picture above, Lt Col Peter Cascio, Commander of the 118th TFS, helps celebrate the milestone with 1Lt Bill Kirkland after Kirkland completed the final flight last September that marked the 10-year record.

Hot Refueling

. . . a term used for refueling an aircraft with one or more engines running. Combat tested in Vietnam, this refueling procedure increases readiness by reducing ground turnaround time, increases sortie surge and optimizes the efficiency of manpower and equipment.

SMSGT OWEN G. BERNHARDT, HQ USAF/LGYF

Hot refueling system, unique to most of the Air Force, has been under design and construction in US Air Forces Europe (USAFE) since 1970. The USAFE hot refueling system is not the same as the hot refueling operation that was used in Vietnam. The USAFE operation is a sophisticated, advanced system, designed with safety as well as mission capability in mind. Designed primarily for the F-4, the "Hot Pits" have many new safety devices and automatic controls not required in conventional refueling systems. The best way to describe this new refueling method is to start at the aircraft and trace the system back to the storage tank.

At the skin of the aircraft is an improved single-point refueling nozzle to which a newly-developed "dry-break" coupler is attached. The coupler is designed with an automatic shut-off valve to stop fuel flow when it is disconnected from the refueling nozzle. This feature provides an added measure of safety to the pilot and ground crews in an emergency situation.

Next is a reinforced hard rubber hose, approximately six inches in diameter and six feet long, attached to an aluminum swing arm pantograph. This replaces the 50 foot collapsible rubber hose presently being used for refueling operations.

CONTROL PIT

The fuel control pit is located about 50 feet from the aircraft, and is controlled by a pneumatic rather than an electrical system. Air pressure must flow through a "dead man" control switch, which must be hand-held and depressed to be in the "on" position before fuel flows into the aircraft. This system eliminates all electrica connections at the hot pad, which can be a potential source of sparks and ignition.

If excess fuel flow (surge) or any hazardous situation develops, a flow control valve instantaneously stops the fuel flow. The flow control valve is set at a maximum flow rate of 570 gpm. If the fuel line or nozzle should rupture or disconnect, fuel flow would momentarily increase and exceed the 570 gpm limit. When this occurs, an activated valve automatically shuts down the fuel flow.

Next in line to the fuel control pit is the filter separator house, where control fuel line pressure gauges are installed. These sensing devices control the two independent 600-gpm fuel pumps, based on the fuel demand or fuel pressures. When the system is not in use, the fuel is kept under static pressure; but as the flow valve is opened by the pneumatic control valve to start the fueling operation, the fuel pressure drops, which automatically turns on the first fuel pump. If a second aircraft is refueled simultaneously, the pressure will drop again, turning on the second pump. Fuel pumps are automatically turned off as the demand for fuel decreases and the fuel pressure increases.

CONTAMINATION MONITOR

Before the fuel enters the pumps, it passes through a constant fuel contamination monitor, which shuts down the fuel flow if water, rust or sediment is detected in the fuel. However, this situation is not likely to occur since the fuel goes through filter/water separators as it enters and leaves the fuel storage tank. The filter/water separator extracts water from the fuel, and drains it into a "waste" collection tank where it can be disposed of. As an added quality control feature, all internal piping is constructed of high-pressure, corrosion-resistant aluminum.

As an added safeguard the storage tank is designed to be self-cleaning. The epoxy-coated interior has a five-degree sloped bottom to allow water and sediment to collect in a sump at the bottom of the tank. This residue is then pumped into the waste collection tank for further disposition or reclamation.

Emergency shut-off switches are located throughout the system. These added safety devices are easily activated, but require a special key to be disengaged. In this way, the system cannot be accidentally overridden and placed back into service after a safety discrepancy is detected.

SYSTEM SAFETY ENGINEERING ANALYSIS

The final step required to place this system in operational status is to have a system safety engineering analysis conducted on the system, the aircraft, and the aircraft and system coupled together under actual fuel flow hot refueling conditions. Fuels experts at Air Force Headquarters tasked the Air Forcce Logistics Command (AFLC) to perform the system safety analysis. AFLC assembled a team from AFLC, Air Force Systems Command (AFSC), the Pentagon and an on-site evaluation was conducted at Ramstein AB, Germany. The main thrust of the analysis was to evaluate procedures and the hardware for possible error or failure which could result in a hazardous operation. Even though the analysis identified some procedures that needed strengthening, and a couple of hardware redesigns, the refueling system truly represents a significant "state-of-the-art" improvement over other fueling systems.

When the USAFE hot refueling analysis was completed, Pacific Air Forces (PACAF) requested that a system safety engineering analysis be conducted to determine the feasibility of hot refueling with mobile refueling and air transportable hydrant refueling systems. Again AFLC was tasked to conduct the analysis for PACAF. The team traveled to OSAN AB, Korea for the on-site evaluation and analysis. After several days of reviewing procedures and hardware, they found that the hardware would not permit recommending hot refueling. The major weaknesses were the single-point fueling nozzle, the coupler, the fuel hose and the marriage between each of these components.

The team did envision the use of an aluminum swing arm pantograph similar to the USAFE fueling system. Once back in the States, they pursued this idea and funds were made available for the development of two prototype pantographs. Two were constructed and a feasibility demonstration was conducted at McDill AFB, Florida. The results of this test revealed that the pantograph provides a safe environment for hot refueling when coupled to mobile, permanent hydrant or air transportable hydrant fueling systems.

It is anticipated that as a result of this feasibility demonstration, a requirement for two district pantograph systems will be developed; (1) A pantograph system configured for use in bare base deployment situations, and (2) a pantograph system to modernize existing hydrant systems. Air Force fuels experts believe the pantograph will provide a viable and safe means to hot refuel from any fuel source. ★

The SLUF In A Different Sky

LT COL DOUGLAS W. STOCKTON
Commander, 356 TFS, Myrtle Beach AFB, SC

The deployment of TAC fighter squadrons to Europe for participation in NATO exercises has been a matter of routine for many years. For a group of A-7D pilots of the 354th Tactical Fighter Wing at Myrtle Beach it was to be a first and very rewarding experience. They would be participants in Coronet Redcoat, the deployment of 18 A-7D aircraft to Lechfeld Air Base in Bavaria where they would fly close air support missions in exercises Cold Fire and Reforger.

The support rendered by our Luftwaffe hosts was nothing short of magnificent. Jagdbombergeschwader 32 (Fighter Bomber Wing 32) welcomed the squadron as one of its own, alongside their two F-104 squadrons, and met or exceeded virtually every housekeeping or operational requirement at

first mention. Thus, the feasibility of operating the A-7D from a German base was, for all practical purposes, readily proven.

Of greater interest, however, to those who will be making similar journeys in the future are some of the problems we encountered in transitioning from admittedly crowded airspace in the CONUS to an environment of eye-watering proportions in Europe. Congested airspace, weather, ground controller terminology, and differences in flight rules all dictated thorough planning and preparation before entering the exercise arena.

Homework began two months in advance of deployment. We first ran everyone through the flight simulator to practice each instrument approach to primary and alternate bases at least twice. A glance at the European letdown plates will show that, for the most part, the approaches are extremely busy and challenging, as a result of airspace limitations, and that no amount of study and practice can be considered excessive. This was particularly true of standard instrument departures (SID) which were unavailable to us prior to deployment.

The SID, surprisingly, turned out to be a part of the routing out of the exercise areas. Air traffic control facilities became saturated in marginal weather conditions and were thus unable in all cases to provide the luxury of enroute climbs, descents and radar vectors. Hence, the flight plan would normally take us to a NAVAID near the exercise area where we would penetrate and transition to VMC. Upon departure, we would proceed back to the NAVAID and climb out via a SID. This usually created a great flurry of paper in the cockpit, once the SID was announced.

We also devoted a great deal of time to the study of Lechfeld and its environs. According to an earlier safety survey, approach end cable engagements, should they become necessary, would have to be made against traffic and with ten minutes prior notice, since the real approach end cable was disconnected for F-104 operations. The runway width was 98 feet which meant that single ship takeoffs and landings were the order of the day. Departure and arrival traffic patterns were doglegged in the interest of noise abatement, a crucial requirement in heavily populated West Germany.

To prepare us psychologically, USAFE headquarters and the 52d

The support we received from our German allies was superb. Everything we could have asked for was provided as though we were one of their own squadrons.

Tactical Fighter Wing at Spangdahlem sent a briefing team to Myrtle Beach to clue us in on European flying and to test us on buffer zone procedures. The more memorable aspects of this briefing were time lapse photography of meganumerous arrivals and departures on a London radar scope and selected recordings of air-to-ground radio transmissions, which were marked by an abundance of clutter and strange accents. Mentioned also were the gliders, hot air balloons, and light aircraft which we might have occasion to dodge on low level nav routes. We, therefore, departed CONUS with an above average, yet healthy, degree of apprehension about European flying.

Our apprehensiveness was greatly reduced upon arrival, however. A full day of briefings by our GAF and USAFE counterparts in operations, air traffic control, weather, flight safety and stan eval covered all aspects of both normal and exercise flying which we could anticipate in the next three weeks. The briefings were followed by local area orientation flights for our IPs and flight leads on the wing or in the back seat of F-104s. There was widespread agreement that we could not have asked for a more thorough and professional indoctrination.

Now began the process of verifying all of our planning and all that we had been told in the past couple of months. It was all true and then some!

Flight planning could have had all the symptoms of a migraine headache had it not been for a stan eval rep from the 52d Tactical Fighter Wing at Spangdahlem who was at our side for the entire stay. Flight plans and their content arrangement were not your standard 175 or ICAO layout. Additionally, USAFE rules governing weather alternates, for example were more stringent. In some cases, two alternates were required and this meant A-7 bingo fuels on the order of 5000 pounds for remote exercise areas. (That's a lot of gas for a miserly turbofan!). However, with the help of our man from Spangdahlem, stereo flight plans and low level routes were quickly developed and de-conflicted, enabling flight leads to simply state their intentions to Lechfeld Base Operations and they were on their maximum IFR way. This provided more time for briefing the more critical aspects of the exercise scenario and employment tactics.

The weather was good by European standards for September but not what we were accustomed to at home. Fronts had the habit of stalling at the Alps, producing tw to three day stretches of fog and low stratus in the mornings followed by a lot of puffies in the afternoons. More than once we encountered steady ceiling and visibility deterioration as we progressed along low level routes toward the exercise objective. When completely boxed in, the GAF last ditch procedure called for a 7700 squawk and a rapid climb to VMC. This procedure held little appeal due to the amount of aluminum up above, and flight leads, therefore, tended to make their low level abort decisions a lot earlier.

Air traffic was heavy as advertised, especially in the exercise areas and along low level routes. Balloons, gliders, and light aircraft were out in great numbers, especially on weekends, but were accurately forecast through NOTAM's on our GAF provided teletype machine. (This machine also provided up to the minute weather information.) The heavy traffic, coupled with routes and working areas in or near the buffer zone, required wingmen to be especially vigilant and to pull more than their usual share of the navigational chores. "Checking six" naturally suffered as a result.

Traffic Control on the IFR segments of our missions was superb, considering the volume of civil and military air handled. Accents and terminology were quickly adjusted to and misunderstandings virtually eliminated after two or three flights. We found on frequent occasions, however, that it paid to repeat instructions back if there was any doubt. Terminal air traffic control, particularly during GCAs, was unbelievably precise, despite what we considered to be nonstandard terminology. It was not uncommon for GAF controllers at Lechfeld to have been there at the same job for more than ten years. That kind of tenure combined with

Despite all our study before leaving Myrtle Beach, there was a great deal to learn once we arrived at Lechfeld. But, the professional thorough indoctrination from our GAF and USAFE counterparts took away much of the apprehension.

numerous saves in bad weather undoubtedly contributed to their high degree of precision and competence.

A major problem in the opinion of many pilots was the congestion on radio frequencies in the exercise areas. With the large number of agencies and nationalities involved in a confined area, it was not uncommon to run through as many as five frequency changes to find one that was workable. Memorization of several backups proved to be the answer, especially in the heat of battle.

Overall, one would have to say that the trip was extremely profitable and educational in all respects. Thorough preparation, beginning well in advance of deployment and sprinkled with liberal amounts of flexibility during the employment phase, proved once again to be the big key to success.

And if you're wondering about the cable engagements against traffic—we had two of them. Both were successful and in both cases the GAF crash and rescue personnel had the runway open again in less than ten minutes. Scarcely 100 feet from the edge of the runway on both occasions was a large cheering section of our German pilot friends who rarely get an opportunity to observe such feats. Perhaps that had a lot to do with the way things turned out. ★

BIOGRAPHY

Lt Col Douglas W. Stockton

A 1957 graduate of the US Military Academy, he has served as an ATC instructor pilot, advisor to the Royal Thai Air Force and as airmanship instructor at the Air Force Academy. Following a combat tour in A-37s in Vietnam, he was assigned to Operations Plans, HQ PACAF, and later served as executive to the Vice CINC. He was assigned to Myrtle Beach AFB in 1974 and has been squadron commander of the 356th Tactical Fighter Squadron since February 1976.

SOS

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Signals of one type or another are used by everyone, everyday. Pilots get a thumbs-up from a crew chief when a particular part of a pre-takeoff check is complete; navigators give a verbal signal to the aircraft commander when all of their systems check out; jump-masters signal their jumpers when to hook up, jump, etc; and, of course, there is the obvious—SOS—a call for help that is recognized around the world.

We use the verbal or audio means of communication whenever possible, but when that medium is removed, we resort to the visual, in a wide variety of design and complexity. Visual signals are the topic of this month's issue of Survival.

In a survival situation, several instances may preclude success in using your radio or beacon. First, those pieces of gear may not work. They are designed so that they can survive a lot of punishment, but, like any piece of equipment, they may fail. Enemy activity, inability to talk, transmissions at times when friendlies aren't around—all will impact on the ability to get your message across. So it's important that you be at least knowledgeable in the use of surface-to-air signaling devices.

The signal mirror, strobe light, whistle, MK-13 flare, and pen gun or gyro-jet are all designed to make your position known to a potential rescuer. They're good signals, but we've discussed them at length in past articles. Next to the radio, they are probably still your best means of getting your message across. However, they are all active devices, requiring some action on your part to activate them. The signal that you lay out on the ground has the advantage of being passive. It works continuously and doesn't require you to stand around and fire it off. But, I'm getting the cart before the horse. Let's discuss some of the principles of these signals.

PASSIVE GROUND SIGNALS

Three considerations are important. First, the size of your signal is vital to its success or failure. Make sure you make it big enough to be seen, but not so big that you spend all day building it. Obviously, the quantity of materials and the amount of space available will dictate how large you can make it. Naturally, some folks go to extremes. One fellow who was stationed in the Canadian wilderness, to maintain a piece of electronic equipment got bored, and, having nothing else to do, decided to "signal" the jet liners overhead. Since he had a large tractor and snowplow at his disposal, and unlimited acres of snow, he built a 4-letter word that was big enough to be clearly visible from 35,000 feet. It also adequately passed on his feelings of frustration. But what you say doesn't really matter since any signal will draw attention. When building strip signals out of panels of parachute material, use the six to one ratio; i.e., make each panel 18 feet long by 3 feet wide, or any other multiple of 6:1. (Note: The 18 x 3 dimensions are considered the minimum to be effective.) Again, this principle says make it big enough.

The second principle concerns form. Straight lines or geometric designs do not exist on a large scale in nature. So, make your signals so that they do not look like they naturally belong in that area. Take advantage of natural features however. For example, if you are in a valley, make your signal run across the valley and not parallel to the drainage. Also, look for an area that will give maximum visibility or exposure to your signal. This may even require that you travel to an area that affords better exposure for your efforts. However, 97 percent of our crews are rescued within four hours, at the site of their emergency, so that decision should be made only under extreme circumstances. The point to remember is, if you don't know what's ahead, you may be leaving the best signaling area for miles around. Consider all factors before striking out.

The third important principle applies to contrast. Green material put out in a nice green meadow obviously won't work, unless there is a definite color contrast. So accentuate the color differences. Using orange parachute material on a snow-covered area or the white in the dirt will provide good contrast. If you can't spare any canopy material, consider using overturned sod, stamping in the snow, piling brush in a design, or even clearing brush from an area. Any means to make your signal contrast with the surroundings should be used. Use your imagination. A pond dyed fluorescent green with sea marker dye stands out like a sore thumb—even from 35,000.

You no doubt have heard that American Indians used smoke signals to pass on a message. It worked very well, and for that matter still will. Smoke signals can show your location very effectively, provided you have the necessary materials. White smoke against a blue sky shows up well whereas black smoke is most effective on an overcast day. The white variety can be made using dry wood, wet or green grasses, pine boughs, etc. Black smoke will be produced by fires from aircraft parts such as electrical insulation or tires and from the fuel or oil. Some woody plants found in desert areas such as creosote bush, sagebrush, or some junipers will produce a dense black smoke when burned. This is caused by the high creosote content of those plants.

You are probably aware that a triangle of fires, signals, etc., is an international distress signal. If you have the fuel, time, and terrain to build a triangle of fires, have at it. But make sure each fire is far enough away from its neighbor to keep the smoke columns from blending together. Better yet, build one big fire and don't try to race from one to another keeping three going, or worse, trying to get three started as the search aircraft drones off over the ridgeline. Also, if you tie your MK-13 flare to a stick and allow the orange smoke to be drawn into the smoke column of your fire, you can end up with a very large cloud of orange smoke.

Several notes of caution apply directly to the use of fires. First, a big bright fire at night will be an effective signal to aircraft—especially if it covers about 5000 acres. Be careful—15 smoke jumpers putting you out with axes and shovels should rate high on your "must miss" list for today. Consider the area, terrain, and how dry the forest is before you begin to build a signal fire. Another note pertains to maintenance—you have to keep feeding a fire, for best results. Have sufficient fuel available to keep it going. Take care of your other signals too. Go back daily and improve or repair them. Wind, snow, rain will all affect the quality of your signal and will require that you work at keeping it up to speed.

Surface-to-air signals aren't complicated if you keep the principles in mind. Remember size, form and contrast, and don't try to write your life history—keep it simple.

If you have questions or comments concerning the information contained in this article, please call or write to:

3636 CCTW/DOTO
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Crew Coordination

...you, your crew, and your responsibility

Your emotions and those of your crewmembers have an important effect on how well you do your job. You are not supposed to be a psychologist, but you do need some familiarity with the effects which changes in the personal lives of your crewmembers may have on their performance.

CAPTAIN
LAWRENCE R. CHALMER
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One of the most easily overlooked aspects of aircrew coordination on a multi-seat aircraft is that of crew ambience—the tone, the environment of the particular crew. That's abvious, you say? You know how everybody's feeling today, how you'll work together. Do you really know?

Let's look at a six man B-52 crew as our first example. What's bothering the copilot? He's slow on checklist. The AC snaps at him. The nav is concerned about something and misses a timing call. The radar nav hasn't said anything all day. The EW omits replacing his seat pins and the gunner mutters as he reminds him.

What's going on with this crew? More important, what is happening on your crew? How have *you* been working lately? What do you and the other people on your crew carry onto the aircraft with you besides your equipment? I'm suggesting that you take a good look at the personalities on your crew (or crews, if you're their supervisor), in addition to their crew specialties. What might they have on their minds, and you on yours, in addition to professional duties? Are you naive in thinking that there is no room on the airplane for personal problems? Perhaps not. But there *will* be personal problems and concerns on board. The more important the problem to the individual, the more it will affect his work. Unrealistic? Think back. How well did you perform the day your wife delivered, when she was hospitalized, when a loved one died? How well did you work as a crew after you returned from leave?

Too many questions? Let's consider four of the most obvious areas of individual concern as they interrelate and affect your performance: Your family, your (and their) health, your finances, and your job.

FAMILY

How does your flying or alert schedule affect your family? Do you and your wife have the blues the day before you start alert/TDY? Are you able to adequately explain to your children what keeps you from home? There are no model answers to these questions. Your schedule affects the lives and the personalities of others. Accept that and realize that what happens at home is carried onto the job, the airborne job. If you've had a family fight, do you take it out on your crew, or vice versa? Has your bachelor pilot or nav been having social problems that keep him preoccupied?

How you relate to your crew in response to family joys, pressures, or problems is important. A degree of introspection may naturally be difficult, yet "knowing thyself" creates a more aware person, an individual

who functions more easily in the airborne role.

HEALTH

Few problems carry the immediacy of medical ones. It is extremely difficult, if not impossible, to divorce ourselves from thinking of loved ones in pain or physical discomfort. Emergency leave, you say? Have you spent an alert tour or been overseas with a man whose family was hospitalized? Have you been that man? Emergency leave may not always be possible. But understanding and acceptance of the individial is *always* possible. If a crewmember is concerned with his own health or the health of someone close to him, *you* may see his performance change. Be aware that it will change and be ready for it. If *you* are that person, be more watchful of the routine portions of your crew duties, the areas you may neglect first through preoccupation.

FINANCIAL

Money. Few of us have too much of it; therefore, our concerns lie with making and distributing it. The distribution process involves problems that not only are compounded quarterly, but that must be documented yearly. The financial headaches of a crewmember are as easily carried to work as any other. They may be felt to be as pressing as medical problems and may be even more difficult to alleviate. Buying a new home or trying to arrange base housing? Your crew duties are time consuming enough even when your finances are stable. If you and your crew can recognize each other's feelings and financial worries, you might prevent inadvertent errors on the job.

YOUR JOB

Any major changes in an individual's working conditions will affect the way he sees himself and others. Have you changed crew seats through upgrading? Are you now at a new base in a new airplane? As your roles and their expectations change, your behavior will consequently change. Your peers will naturally sense these changes, and it is equally important that you realize them. "He's new on the job" means little during an in-flight emergency at 480 knots.

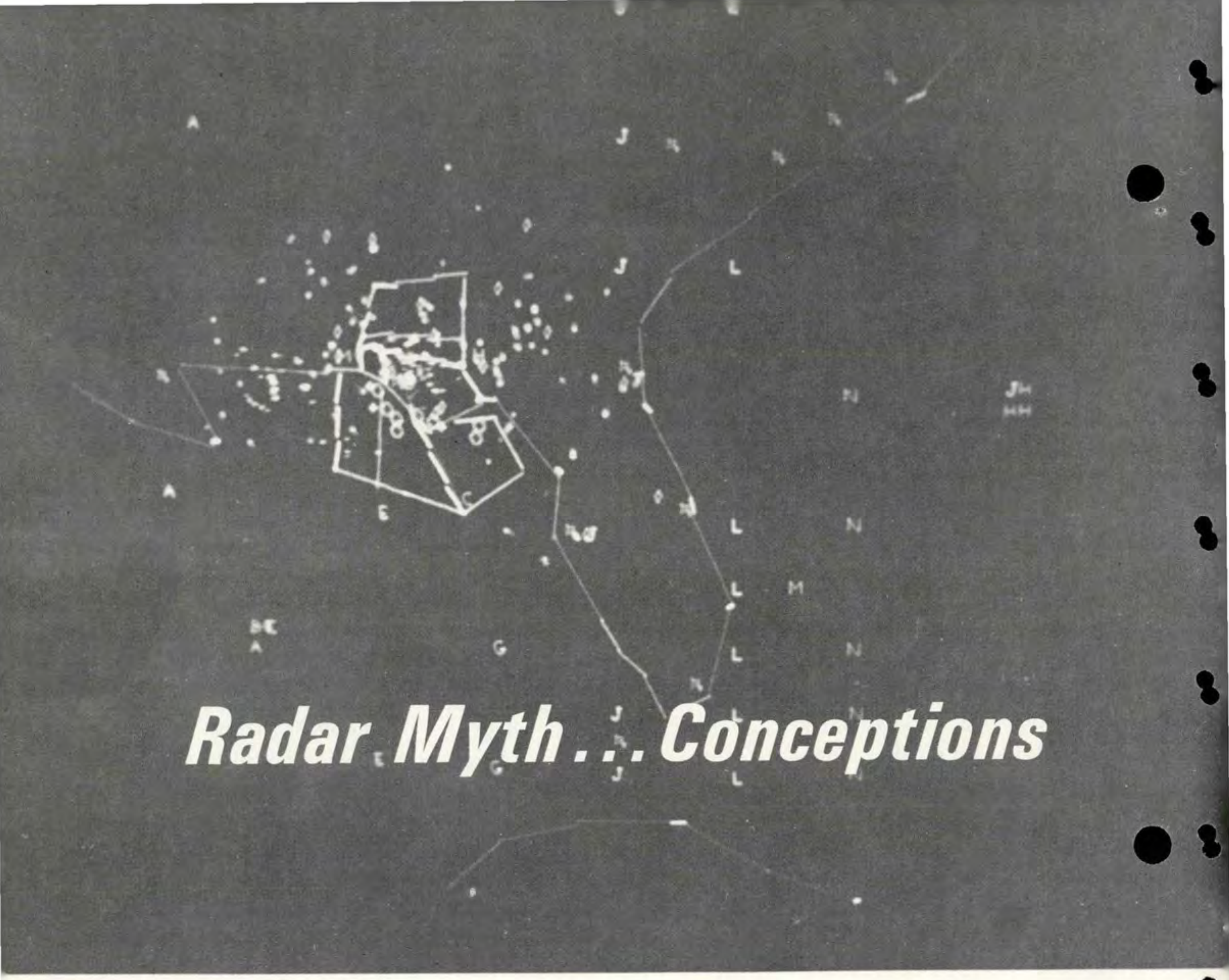
A second working condition responsible for major behavioral change is the PCS. Here the crewmember's entire environment is disrupted. His family, health, wealth, and professional roles may all be changed. His self concept may change radically, and with it his inflight behavior. A man new to a base or position, for example, may work within a closed environment until he feels secure in his new job or environment.

Equate the above areas of concern with your flights of the last year. What was on your mind? Have you descended early, missed an altitude, overshot an airspeed? Has your mission plansing been detailed or hurriedly completed—"I've flown this mission many times before. . . ."

I'm offering no pat solutions for *you*. The path to that solution begins with self-awareness. You—as rated professional, crewmember, supervisor—are an individual subject to change. What affects you at home will affect you at work. Cognizance of your own and others' behavior in response to familial, medical, financial, or occupational variations will allow you to better prepare for your operational duties. Expecting crucial personal matters to produce changes in proficiency permits us to recognize and possibly avert problems in crew coordination and safety. ★

ABOUT THE AUTHOR

Captain Chalmer is an FB-111 navigator in the 393d Bombardment Sqdn, at Pease AFB, NH. His military career includes service as a B-52 navigator and Air Staff Training Officer. Captain Chalmer has attended Squadron Officer School, Air Command and Staff College (correspondence) and has an M.A. in counseling from Central Michigan University.



Radar Myth . . . Conceptions

Although written for general aviation, this article from FAA's General Aviation News *tells how it is in the radar environment. We recommend it for USAF crews for their information as to the kind of protection traffic control provides for both them and for the general aviation pilot who may lack sophisticated IFR equipment.*

It is one of those ideal weather, built-for-flying afternoons. You are cruising along VFR, no clouds, no worries . . . then in an instant, the unthinkable: Aluminum overcast for a millisecond—a wing, a blur of numbers, another pilot's face flashes by, mirroring your horror. Then he is gone as quickly as he came, leaving stillness and empty blue skies in his place.

You have come face to face with a pilot's nightmare, a near midair collision, and you will never be the same again. It is frightening. You are weak, you are scared, your hands are trembling. Then you feel angry and keep getting angrier—you grumble: They spend millions on exotic ATC radar, everyone knows, but there was no warning, none of the "advisory service" advertised. They can program computers to read an aircraft's altitude and flight number without a word being spoken. But they didn't warn you—or the other guy, presumably, that you were dead on target for an aerial smashup. What's wrong with this elaborate, expensive system, anyway?

The answer is that nothing is wrong with the modern air traffic control radar system, except possibly the airman's conception of it, what it can and cannot do. The continuing development of more sophisticated and automated equipment has given rise to the notion among some pilots that controllers are watching their every move enroute, and will always be able to warn other aircraft—particularly those flying IFR—of their presence. This is the misconception that can kill you.

The adoption of radar into air triffic control brought with it a series of increased capabilities which have continued over its 20 year history. From the earliest days, when radio operators had to guess at locations, times and speeds of aircraft, we have gone through "raw" radar to transponders to modern computer-augmented machinery that can spit out a wealth of information on command, right on the controller's scope.

These new radar/computer capabilities have unquestionably enriched the capabilities of the airway system and brought us closer to the much desired day when collision avoidance for virtually all aircraft will be practical. But the glowing wonders of each new radar or its added capabilities encourages some of us to overlook the fact that current radar is not all-encompassing in its coverage, does not pick up all aircraft at all times, and is primarily concerned with the separation of IFR traffic.

Originally developed during World War II, radar (Radio Detection and Ranging) had as its initial purpose not the separation of aircraft, but detection of enemy aircraft. (See "The Big Eye," FAA GENERAL AVIATION NEWS, August 1975). Later developments resulted in radar being used for the positioning of aircraft. Fighters were joined up with the bombers they protected in this way, and many other uses were found for radar. Most of the research aimed at improving the outer range, ignoring the "ground clutter" —the undesirable returns from nearby trees, fences, etc., which covered the center of the scope.

After the war ended and radar found its way into air traffic control, ground clutter became an increasingly serious problem for terminal radar. Some of today's most sophisticated black box circuitry is aimed at reducing this phenomenon. Modern radar does a magnificent job compared to the old days, but clutter is still there. One way of reducing it to a minimum results in weakening radar's sensitivity to certain distant aircraft targets. The person affected in this trade-off is the pilot flying an airplane whose radar-reflecting properties are weakest. This group includes many small general aviation airplanes flying VFR without active transponders. In some situations these aircraft are not "painted" on the radarscope, even though they are within range of the transmitter.

The new capabilities of radar/computer assisted air traffic control means much better collision avoidance, but it is still not all-encompassing.

Some pilots think of IFR as a kind of security blanket. They say to themselves, "I'm on an IFR flight plan; therefore the air traffic service is going to tell me about all the traffic I might encounter." So they settle back in their seat in imagined safety.

WHO IS RESPONSIBLE

The fact is that when operating in VFR conditions, regardless of flight plan, responsibility for seeing and avoiding other traffic rests with the pilot, not the controller. Civilian radar was developed primarily for the separation of IFR traffic from other IFR traffic. That is still the controller's prime responsibility, although he will also assist VFR traffic as much as time and facilities permit, calling the pilot's attention to any known potential problem or immediate hazard. Radar advisory service for aircraft is specifically designated as a duty that follows the priorities of separation, safety advisories, and other required controller actions, to be performed on a workload permitting basis only. Furthermore, at any given time the controller may not be getting any return from your aircraft —or from your potential traffic.

But, you ask, what about that VFR day when you were level at 4,500—certainly high enough to be in coverage—and Center missed telling you about the T-38 that nearly skewered you? Traffic was light, so you know the controller should have had time to help you.

Believe it or not, there are days when the weather is "good" for flying, but maybe not so good as far as radar is concerned. Wind, temperatures aloft (particularly when inversions are present), dew point spread, and clouds can all have effects on radar that produce clutter, or reduce radar efficiency often right where you or your traffic are. In addition, the angle at which the radar antenna is tilted can result in some traffic not being seen at certain altitudes. Statistics show that the bulk of IFR traffic—the kind Center radar is primarily interested in, remember—spends most of its time at relatively high altitudes while en route, so that is what the en route radar is designed to see.

In terminal areas, the heavy traffic areas are within 30 miles of the airport at altitudes varying with the location; again, the radar is focused

RADAR MYTH—CONCEPTIONS
continued

for the area of greatest use. At 40 miles out you are in all likelihood within range of the radar signals, but the controller's scope may only be displaying targets closer in. Another factor to keep in mind is that there is virtually always a cone of non-coverage directly overhead the radar antenna. All these things leave some rather wide open air spaces where there is no VFR radar coverage at many altitudes.

Certain kinds of general aviation aircraft are detected by radar with more difficulty than are others. Smaller airplanes; those made in great part of materials other than metal; aircraft without propellers; and slow moving craft all have less reflecting ability than others, resultting in less return of energy to the radar antenna. Consequently, the primary targets they produce are weak or often non-existent. An airplane also presents less of a target to the controller when it is flying directly toward, or directly away from, the radar antenna.

WEATHER RADAR

The airman's oldest adversary—weather—often enters the picture. One of the current uses of radar, other than air traffic control, is in weather observation and forecasting, and weather returns tend to blot out aircraft. True, controllers can lessen to some extent the strength of weather returns, but this ability is not absolute and often it is desirable to display weather for use when pilots ask to be vectored around rough areas or storm cells. Other aircraft may be "wiped off the scope" by this display.

In short, the concept of 100 percent radar coverage has to be understood in terms of stated goals, present and future. Questions put to FAA "Listening Sessions" reveal that some pilots believe any time they hear "Radar Contact" the controller has taken over all separation responsibilities. At the very least, these pilots believe all air traffic in the area is shown on the controller's scope. This assumption can be a fatal error —for any of the reasons given earlier. Radar does not protect from unidentified aircraft or those which may not be showing up clearly on the radar scope, such as VFR traffic that has entered into an IFR environment.

Radar advisories are an infinitely useful aid in helping the VFR pilot maintain his own separation, but they are not to be regarded as evidence that a controller has taken over responsibility for such separation.

What can the pilot do to increase the protection available from radar?

• Much of the problem could be solved by the acquisition and use of a transponder. If you have never visited an air traffic facility with radar, do so and see the difference on the scope between a transponder reply and the blip from a non-equipped light aircraft. The contrast could surprise you—the typical transponder ident "slash" is many times the size of the small dot that represents the non-equipped airplane. Transponders make the size of the airplane irrelevant; transponder replies are the same size for a 747 and for a Cherokee.

• If you have a transponder, particularly w/mode c alt. reporting use it. Many pilots turn the transponder off when leaving terminal areas to "save" it or lengthen its operating life. There are two dangers in this practice: One is the weaker reply enroute that makes you less visible on the controller's scope, and the other is the possibility of forgetting to turn it back on at your destination area. By the time the destination controller asks if you can "squawk," it is long past the time that you should have been using the extra help of a transponder to show all your progress and altitude through busy airspace. It is true that you might not be sending a signal en route if you get out of an area of radar coverage, but what is wrong with leaving the set turned on to get you back on the scope as soon as you again enter coverage? Another advantage is that the target generated by the transponder does not easily get lost in clutter, between antenna sweeps or precipitation returns.

• You can help the radar controller help you by not adding to his workload unnecessarily when he is in the process of identifying your target. Remember that he may be looking at many unidentified blips on his scope. Knowing where you are at all times simplifies the task of establishing radar contact—and shortens the time when you are present as an "unknown." ★

(From material presented by Charles Douglas, FAA Central Region.)

—Courtesy FAA General Aviation News/*January 1977.*

Know Your Local Barrier... ...eh...cable...net...or whatever!

MAJOR LAWRENCE E. WAGY
Directorate of Aerospace Safety

What do you know about your local aircraft arresting system? If you work in the tower/approach control, base operations, wing flying safety, crash rescue, or base facilities, your job security may depend on your knowledge of the local aircraft arresting systems. If you're a pilot, your life may depend on your knowledge of all aircraft arresting systems.

The following self-test may point out some areas for further study. Be honest! Cover the answers until you've committed yourself.

1. Question: Aircraft arresting systems are designed only for emergency arrestment of aircraft.

A. True

B. False

Answer: This one is easy and was entered only to encourage you. The answer is obviously false. At some bases, certain aircraft (for example, the F-4) routinely make operational arrestments under certain adverse weather and runway conditions. Consequently, the Air Force has reviewed its policy on the use of arresting systems to allow for both operational and emergency arrestments. If your answer was A, a good review of AFR 55-42 is in order.

2. Question: The term used to describe a device used to engage hook-equipped aircraft to absorb the kinetic energy of a landing or aborted takeoff aircraft is:

A. Barrier

B. Cable

C. Big Bertha

Answer: Cable. If you answered Barrier, you obviously were not briefed on the contents of ALSAFECOM 008-76 in 1976. A pilot of an F-111 on an emergency recovery was informed by tower personnel that there were no barriers on the assigned landing runway. The pilot elected to land on a shorter runway that did have a barrier. The tower was correct; the original runway had no barriers. It did have two arresting cables which were what the pilot wanted. For those of you who answered Big Bertha, you are partially correct. It could certainly absorb the kinetic energy and reduce the landing roll if strategically placed on the runway.

3. Question: An aircraft plans to make an approach end cable arrestment on a runway equipped on both ends with a BAK-12 in conjunction with a BAK-14. What should he tell the tower?

A. Raise cable.

B. Barrier, barrier, barrier.

C. Raise cable on approach end.

D. Nothing, the cable is always in place.

Answer: The BAK-14 is a hook cable support system that provides a means to lower the cable below the runway surface to avoid interference with traffic not requiring or capable of using the hook cable.

A pilot request to "raise cable" will mean to raise the departure end cable. An approach end cable must be specifically requested. For those who answered B, go back to Question 2.

4. Question: You are a pilot of a hook-equipped aircraft just short of rotation speed on takeoff roll on RY 32L, Moffett Field CA, when you elect to abort for utility hydraulic failure. The IFR supplement depicts the A-gear thus:

Rwy 14R E5-1→ ←E5-1——
E5-1→ RW 32L
(1435') (2545') (1520')

What arresting system(s) can you expect?

A. Two hook-cable arresters, no sweat!

B. A bi-directional BAK-12 type arresting system.

C. A single usable hook-cable arrester 2545 feet short of the departure end.

D. I'm not a dummy. I would continue the takeoff and make an approach end engagement on RW 32L.

Answer: The E5-1 is a Navy unidirectional chain type arresting gear. Answer A is close except for the "no sweat." Only the cable 2545 feet from the departure end is usable on takeoff from RW 32L. If you answered B, study the IFR supplement legend which shows Navy/Air Force equivalent A-gear. Those who answered D may be "smart" to continue the takeoff and make an approach end engagement. However, RW 32L has no approach end arresting system. Answer C is most correct. After deciding to abort, you had best get that tail hook down fast, your only usable barrier is a nominal 5600 feet from the takeoff position.

5. Question: A C-9 is "nordo" on final to a runway with retractable barriers. The barriers should be:

A. In accordance with a le[tter] of agreement.

B. Left retracted

C. Raised

Answer: A is almost correct. Barriers and/or hook cables should be raised for a landing military jet with a known or suspected radio failure or anytime there is doubt regarding the ability of an aircraft to engage the system. Exceptions, however, are authorized for specific aircraft which cannot engage an arresting system such as the B-57, T-37 and large cargo type aircraft, C-9, C141, C-5, etc., if covered by a letter of agreement.

6. Question: What are "Dead-Man Anchors?"

A. Big Bertha used as an arresting system.

B. A device used to anchor a BAK-13 to the earth for expediti[on]ary installations.

C. Chains which are used with MA-1A barriers to absorb the kinetic energy.

Answer: B The BAK-13 arresting system provides operational, rapid cycle recovery of hook-equipped aircraft in an austere forward area environment. It is designed as an air transportable expeditionary system that can be quickly installed for operational use.

7. Question: You are a flight leader of a four-ship flight recovering on a runway with a BAK-9 arresting system. The runway is icy so you decide to utilize the barrier. What would be the minimum time from the first engagement to the last. (Hint, the nominal rewind time for a BAK-9 is 3.5 minut[es])

A. 14 min

B. 10.5 min

C. The time required is so long you should go to your alternate.

Answer: Those who answered A get a big "A" for multiplication and a big "hiss" for logic. Those who answered B get an "A" for logic and a "hiss" for falling for the hint. While the hint is true, the BAK-9 arresting system operational recycle time must be limited to approximately 20 minutes due to inspection and cooling requirements.

8. Question: You are approaching to land at Plattsburgh AFB in a hook-equipped aircraft. You request the dual BAK-12 be in the single mode. Which of the following is appropriate?

A. The dual BAK-12 in the single mode configuration is identical to a regular BAK-12 arresting system.

B. All BAK-12's are dual capable.

C. Present Dash One engagement speeds apply, but the engagement should be made slightly off center.

Answer: The dual BAK-12 system consists of two single B-12 energy absorbers installed on each side of the runway connected to a single cross runway arresting cable. The system was designed to arrest the heavier hook-equipped aircraft. The system can be converted to a single mode where present Dash One engagement speeds apply. However, in the dual BAK-12 single mode configuration hook loads are a bit higher than a regular BAK-12. Therefore, the engagement should be made slightly off center which produces hook loads similar to a regular BAK-12 system.

9. Question: A fighter pilot diverting to a USN airfield notes that the IFR Supplement shows E-28 arresting systems. How can he find out what that system is?

A. Why worry? If it's Navy it's got to be good.

B. Call the tower.

C. Look in the IFR Supplement Aerodrome/Facility Directory Legend.

Answer: The IFR Supplement Aerodrome/Facility Directory Legend lists the E-28 as similar to the BAK-13. In an emergency this is probably the easiest way to identify the type arresting system, assuming the pilot knows what a BAK-13 is. At any rate he can determine that the E-28 is a hook/cable bi-directional system. Although the directory lists the B-13 as similar to the E-28, a more thorough investigation would reveal some differences in gross weight/airspeed limitations.

10. Question: Airfield managers should concentrate on ensuring that new barrier installations meet appropriate standards; established installations are obviously correct.

A. True

B. False

Answer: If the question was true, how would I make a safety plug. A review of accidents dating back to 1972 revealed that three accidents were attributed to improper barrier installations, and two accidents were attributed to improper maintenance. All barrier installations should receive periodic safety surveillance.

* * * *

OK, let's check the score. If you were correct on all questions, it's obvious you didn't cover the answers. If you didn't score 100%, there may be more about aircraft arresting systems that you could bone up on. Some good sources are:

Aircraft flight manuals

Arresting system technical orders

FLIP documents

AF Regulation 55-42 (Management and Use of Aircraft Arresting Systems)

ALSAFECOM 008/76

FAA Handbook 7110.65

AFISC Accident/Incident data. ★

OPS TOPICS

SHALLOW APPROACH

Two pilots were making an approach to a local municipal airport in a T-38. Shortly before the aircraft touched down, the rear seat pilot felt a thump and saw an approach light fixture flying away from the aircraft. The aircraft returned to home base where the left brake was found damaged. A call to the muni showed that two approach lights were broken off at ground level. The aircraft did not touch down in the overrun, but because the pilot flew such a shallow approach, the main gear struck the light. This unit has instructed their pilots to shift their aim point from the approach end overrun to the runway threshold, to ensure that the main gear will clear the elevated approach lighting.

THANKS TO AN ALERT CONTROLLER

An F-106 had a total electrical failure while airborne. The pilot was able to remain in VMC and return to his departure base. The Center controller involved observed the loss of the aircraft's IFF/SIF and loss of radio contact and notified the tower of the electrical failure inbound. This allowed tower to coordinate the recovery and have emergency vehicles standing by. The F-106 landed uneventfully, thanks to the controller for his alert response.

IT'S NESTING TIME

While preparing to launch a KC-135, the crew chief saw a bird disappear into the wing. When the crew investigated further, they found a large bird nest complete with eggs in the outboard aileron control actuator. Birds have also taken up residence in propeller hubs, engine bays and other interesting places. This is the time of year to check carefully during preflight.

AILERON ICE

After a night of heavy rain, the pilot arrived at his A-10 for an early morning departure. During preflight the rain had decreased to a light drizzle. After takeoff the A-10 climbed to FL 240 and cruised at FL 240 for the next 2 hours. Then the pilot noticed that the stick was becoming stiff. Although he saw no ice, the pilot suspected ice in the ailerons. It took 20 minutes of selecting alternate controls and movement to free the ailerons. Although maintenance inspectors could find no mechanical problems or water after landing, the most probable cause was water in the flight controls from the heavy rains.

TAXIING ISN'T GOING ALONG FOR THE RIDE!

A cargo aircraft landed and was taxiing at a non-USAF facility. The marshaller's instructions weren't clearly understood by the crew. The crew was concerned that the left wing tip wouldn't clear a parked truck. No sweat! After missing the truck, the crew again tried to follow the marshaller's directions. Nobody noticed the other obstruction approaching the left wing. Tower transmitted a warning on guard, but the crew didn't acknowledge. DENT, SCRAPE, OUCH! The left wing tip was damaged, and needless to say, the crew was very embarrassed. The moral—obvious—if you're not absolutely sure of your wing tip clearance—STOP! Old Chinese saying—careful taxi driver never wreck airplane. —Captain Michael T. Farson, Directorate of Aerospace Safety.

OPS TOPICS

A LITTLE MISTRUST IS A GOOD THING

—The approach controller gave the aircrew a vector that would have headed them straight for terrain. When the crew questioned the heading, they got a vector that lined them up with the runway.

—A GCA final controller confused two aircraft on final approach, and was giving instructions to the wrong aircraft. The crew realized what had happened and took corrective action.

Both of these *actual* occurrences would have ended in disaster if the crew had blindly followed the controller's instructions. A questioning heads up attitude can help an aviator reach a ripe old age. Remember, the guy on the ground is human, and he can have bad days too. Just make sure *you* don't make the error of letting the other guy's mistake kill you. —Captain Michael T. Farson, Directorate of Aerospace Safety.

NOT A HANDGRIP

While flying in a US Army OH-58, a technical observer in the copilot's seat wished to shift position. The aircraft was at a hover at the time. Looking for a handhold, the observer inadvertently grabbed the copilot's collective stick and pushed it down. The pilot was unable to recover before a hard landing occurred. In any aircraft when non-qualified personnel occupy crew positions, the aircraft commander must be absolutely sure these persons understand which controls are not to be touched. This was only a minor incident. It could have been much worse.

CROSSCHECK

While returning from an ATC mission during which the altimeter performed normally, the pilot of an F-15 leveled at what he thought was 5,000 feet. Actually, as pointed out by his wingman, he was at 15,000 feet. The wingman took the lead and they flew a formation approach to landing. Maintenance reported the altimeter malfunction could have gone the other way—a 10,000 feet high indication. This was a daylight mission. What if the altimeter had failed the other way—at night? It has happened many times. Crosscheck is the name of the game. The standby altimeter was functioning properly.

LIGHTNING

McDonnell Douglas Corporation has been involved in lightning research for many years. Included in an article in Vol 24 of MAC's *Product Support Digest*, "The Eagle Looks at Lightning," were some figures and facts that will be of interest and value to USAF aircrews. Here are some selected items. All apply to the Phantom.

- 43 percent of lightning strikes occurred in clouds, 57 percent while adjacent to clouds.
- 83 percent of reported strikes occurred during rainy conditions.
- 36 percent involved F-4's at altitudes up to 5,000 feet, the other 64 percent scattered out at 10 to 20 percent increments up to 25,000 feet.
- Damage ranged from negligible skin pits to the loss of an entire rudder, release of bombs and loss of external tanks. Canopy strikes caused flash blindness of up to 30 seconds.

The months of March through July are the busiest lightning months. ★

mail call

Send your comments and questions to:
Editor, Aerospace Safety Magazine
AFISC/SEDA
Norton AFB, CA 92409

REVISION OF "IFC APPROACH" ARTICLES

1. We compliment you for the professionalism of "The IFC Approach" articles. Your sustained accuracy makes this column the standard technical authority for instrument flight.

2. There were two errors in the January 1977 column, however, which I believe should be brought to your attention. "Post 20, DESCEND NOW TO . . ." should read, "Post 20, DESCEND AND MAINTAIN . . ." and "ADVISE YOU CLIMB TO (ALTITUDE) IMMEDIATELY.", should read, "ADVISE YOU CLIMB AND MAINTAIN (ALTITUDE) IMMEDIATELY."

3. As a rule of thumb, pilots should not expect to hear the word, "TO", followed by numerals. The words "TO" and "TWO" can cause confusion. The only exception is, "DESCEND/CLIMB TO REACH (ALTITUDE)."

BRINSON N. LEAPTROT, Colonel, USAF
DCS/Air Traffic Services
HQ Northern Communications Area (AFCS)
Griffiss AFB, NY

ERROR IN RSC AND RCR ARTICLE, JAN 77

1. First of all I want to say that I was very pleased to see my article RSC and RCR published in the January 1977 issue of **Aerospase Safety.** The pictures you added to the article were very appropriate and contributed significantly to the value of the article.

2. Secondly, I would like to point out one error that appeared in the article. The example "SLR16P—Dry slush on . . ." was in error. It should have read "SLR16P DRY—Slush on . . .". This small mistake changes the true meaning of the RSC/RCR report and, if possible, a correction should be published.

DAVID L. BUZARD, SMSgt, USAF
Mgr AWS Surface Observing Program
Field Support Dir, DCS/Operations
Scott AFB IL

U-2 PILOT OPENINGS

There are current manning requirements for highly motivated, mature and experienced pilots for entry into the U-2 Program. This is a special duty assignment as stated in AFR 36-20. The aircraft is flown to absolute limits in a pressure suit environment, demanding very highly skilled and dedicated pilots. Minimum requirements are:

a. 1500 hours total flying time, of which 1000 hours are jet.

b. Diversification to include pilot in command experience in two or more types of military aircraft.

c. Medically qualified to fly the U-2.

d. Others as stated in AFR 36-20, Chapter 8.

If you qualify and are interested, please contact a U-2 Manning Project Officer, AUTOVON 368-2927/2156.

MAKE STATISTICS A TOOL—NOT A RULE

Several years ago, the Directorate of Aerospace Safety hired a group of people to analyze and predict where the mishaps would occur. The early test results were quite good—too accurate in fact—so in 1977 they've let us all in on the forecast.

1977 Mishap Forecast*	
Control Loss (Pilot)	8
Collision with Ground (Nonrange)	8
Collision with Ground (Range)	6
Midair Collision	6
Landing (Pilot)	12
Takeoff (Pilot)	3
Locally Preventable	43

*Includes all class A, but only class B mishaps with losses greater than $50,000.

Your local safety officer has detailed information on the forecast. Ask him to help you develop your own prevention program.

We're out to prove the forecasters wrong and you'll see a lot of activity in this area—movies, video-tapes, magazine articles, safety officer training, etc.

The stakes are high—lives, equipment and combat capability—but now that we know, we should be able to do something about it.

Make everyone happy—prevent a mishap.

NAME THAT PLANE

This forerunner to a famous class of aircraft first flew at Muroc Dry Lake CA in the 1929-1930 period.

☆U.S. GOVERNMENT PRINTING OFFICE 1977 789/855/44

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.

SQUADRON LEADER

Malcolm Gleave ROYAL AIR FORCE

319th Fighter Interceptor Training Squadron
Tyndall Air Force Base, Florida

On 2 June 1976 Squadron Leader Gleave, an F-106 flight instructor and Captain Laszlo J. Bakonyi, a weapons controller, departed Tyndall Air Force Base in an F-106B on a tactics development test flight. The mission proceeded normally until the last intercept which required a final turn at a 60 degree angle of bank with afterburner selected. As the afterburner ignited, the crew heard a thump and noted the gear unsafe light had illuminated. Sq Ldr Gleave immediately reduced airspeed and requested the target aircraft (GP-24) join up and visually check for any damage. GP-24 reported that part of the left main gear door was missing, but that the left landing gear itself appeared normal and no other damage to the air frame was visible. Sq Ldr Gleave declared an emergency and began an RTB with GP-24 in formation. At approximately 10 NM from base, when normal landing gear extension was attempted, only the nose gear extended. Using the emergency extension system, Sq Ldr Gleave was able to lower the left main gear, but the right main remained retracted. A closer check by GP-24 revealed that the right main door was open several inches. Attempts to lower the gear by yawing and rolling the aircraft with rapidly applied positive G loading to about 3½ Gs produced no results. After all attempts to lower the gear proved futile, Sq Ldr Gleave decided on a midfield arrestment on runway 13 Left. It was foamed, beginning 500 feet prior to and extending 2500 feet beyond the barrier. In an effort to maintain airspeed and directional control, to prevent the right wing and external fuel tank from contacting the runway, he did not deploy the drag chute. The cable was engaged on centerline at approximately 130 knots with the nose gear and right wing barely in the air. Immediately after cable engagement, the nose came down, breaking the nose gear strut and crushing the right drop tank. At approximately 500 feet runout, the cable broke and the aircraft veered sharply to the right, finally exiting the runway 1500 feet after cable engagement. The aircraft entered the soft soil at the runway edge and came to a stop approximately 90 degrees to the runway heading. Both crewmen egressed safely. Despite the adverse conditions, Sq Ldr Gleave's superior judgment, decisive action and exceptional pilot skills were responsible for successfully recovering an irreplaceable aircraft with only minor damage. WELL DONE! ★

"Radar contact" may not mean what you think it does. Radar Myth — Conceptions can cause you real trouble (Page 20).