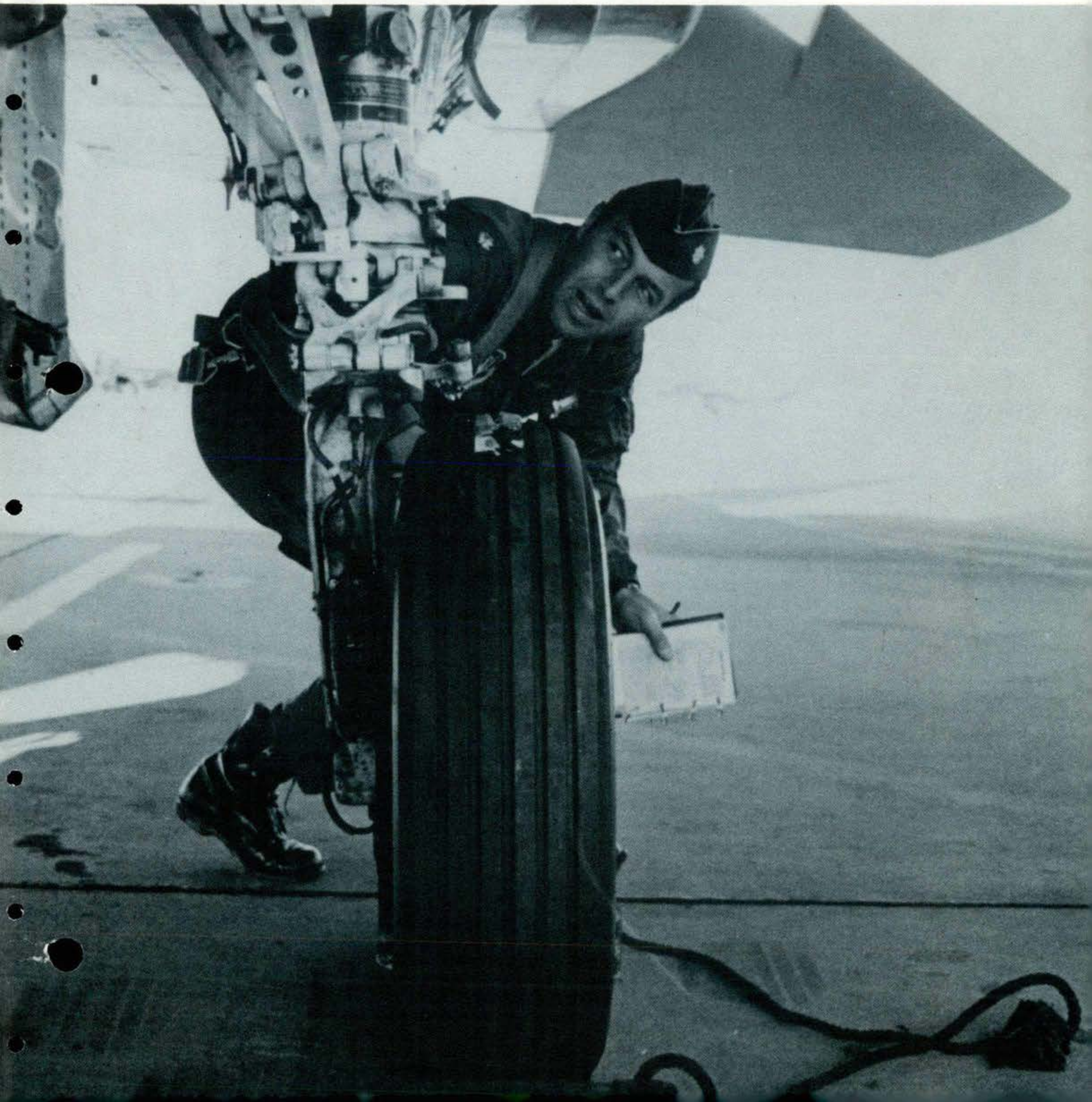
AEROSPACE

SAFETY • MAGAZINE FOR AIRCREWS

JUNE 1979



THE MISSION—SAFELY

MAJOR MICHAEL D. BLANCHARD • Directorate of Aerospace Safety

■ It's that age old problem again—mission accomplishment versus safety considerations. I think we can safely assume that all dedicated Air Force crew members have a strong sense of mission accomplishment. The problem arises when this desire to accomplish the mission interferes with the crew member's judgment in the area of safety. Very few crewmen would willingly jeopardize safety of flight during peacetime conditions. However, questionable decisions in combination with unforeseen events can lead to a dangerous situation.

Consider the case of a B-52 on a normal training mission. During climbout the aircraft lost nr 1 hydraulic pack, and just after level-off the right aft alternator shut itself down. Neither of these problems calls for any critical action, although the Dash One says consideration should be given to terminating the flight if one alternator has become inoperative. The decision was made by the AC to continue the mission. About 2 hours later the aircraft lost another alternator. The Dash One states the loss of two alternators requires that the mission be terminated as soon as practicable. The mission profile was continued, and on the last leg home a third alternator was lost leaving only one alternator to supply electrical power to the entire aircraft. Nonessential systems were shut down, and the aircraft recovered with no further difficulties.

Usually a serious aircraft mishap is caused by a chain of events; if you violate procedures or circumvent established safeguards, you may be providing all the links of the chain but the final one.

The crew was lucky in this case; the press on attitude did not cause a mishap, but the potential was there. Usually a serious aircraft mishap is caused by a chain of events; if you violate procedures or circumvent established safeguards, you may be providing all the links of the chain but the final one. In essence, you have relegated a redundant safety system to a single failure, catastrophic consequence, system.

A positive example of mission dedication integrated with safety awareness was emphasized in another B-52 mishap report. During preflight, the tail gunner determined his oxygen system was inoperable. He, therefore, had the turret stowed and came up to the forward compartment. This decision soon proved very wise since the aircraft lost pressurization at high altitude and had to descend with the crew on oxygen. Had the gunner elected to press on without a properly operating oxygen system on the premise that the compartment was pressurized, and he could remain in his compartment and complete his mission requirements, he would have had a very serious problem.

Again, the point is that procedure and requirements are not established to prevent a crew from accomplishing a mission, but rather to ensure the safe accomplishment of that mission.

Compliance with established directives and procedures in conjunction with sound judgment is essential in preventing the completion of an accident chain. ■

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SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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MAJOR JAMES GILLESPIE, CF
Directorate of Aerospace Safety

The Bird Nemesis

■ In 1911, a man called Cal Rogers flew across the Continental United States from New York to California. It took him 49 days, 30 landings and 19 crashes. In the spring of 1912, while still a hero, he collided with a gull in California, his plane crashed, and he was killed. Thus, he became the first bird-related flight statistic. Aviation has come a long way since 1912, but aircraft birdstrikes continue to be frequent, costly and hazardous. Progress is being made in reducing this hazard, but the problem is still with us and your appreciation of the bird situation is very important.

In January 1978, AFR 127-15, The Birdstrike Hazard Reduction Program, came into effect which requires that all birdstrikes now be reported using AF Form 441, Birdstrike Report. Previously only those encounters of a kind causing aircraft damage as specified under AFR 127-4, Investigating and Reporting U.S. Air Force Mishaps, were reported. This provided an incomplete picture, without adequate feedback, and did not place the bird problem in proper perspective.

Records show that during CY 1977/1978, there were 506 birdstrikes to USAF aircraft, which resulted in $3.7 million in damage. During this same period, two aircraft losses were attributed to birds: an F-111 ingested a bird and the aircrew ejected too late; an A-10 pilot attempted to avoid hitting a bird at low altitude, lost control and successfully ejected. It is estimated that for each damage birdstrike reported, five additional strikes occurred without damage. Statistics for CY 1978, the first year of AFR 127-15, show that 1,187 birdstrikes were reported. Sixty-one percent occurred during takeoff and landing, 31 percent happened below 3,000 feet AGL, including low level navigation routes, and 5 percent occurred during range operations. The remaining 3 percent were in the area above 3,000 feet AGL. A disproportionate 19 percent of all these occurred at night.

These figures are not exactly a revelation but follow a generally understood trend. It can readily be seen that two areas deserve immediate attention: that area in and around airports and the low level navigation area.

Additionally, it can be seen that flights to and from ranges should be at or above 3,000 feet AGL to minimize the bird hazard, especially during the morning and evening hours when bird flocks are moving to and from their feeding areas.

To further expand on the two most serious areas of bird hazard, they will briefly be discussed separately. Each base with a flying mission has a Birdstrike Hazard Plan which your reports will influence. The majority of birdstrikes occurs at or near airports, but because the takeoff and landing are at relatively low speed, very little airframe damage results. Don't let this lull you into a false sense of security. A bit more thought will reveal that this is a hazardous regime where the engines are operating at high power settings and thus are very susceptible to damage from bird ingestion.

There are numerous airfield maintenance programs aimed at reducing the local bird population. Essentially, the denial of water, food, shelter and security makes airfields a less desirable bird habitat. In addition to bird scaring devices such as Falconry, shell crackers, distress transmitters, flashing lights and trapping, experiments are underway with chemicals aimed at repelling birds from within airfield perimeters. Identification of local and transitory bird species will determine the type of top cover and vegetation growth to cultivate on the infield. By your accurate reporting of all bird encounters, the magnitude of the problem will be understood and countermeasures more easily supported.

The majority of birdstrikes occurs at or near airports, but because the takeoff and landing are at relatively low speed, very little airframe damage results. Don't let this lull you into a false sense of security.

The second and more serious area of concern, as it pertains to aircraft damage and loss, is the birdstrike hazard to low level jet operations. An awareness of the hazard, coupled with conscientious flight planning, will result in reduced risk. For example, airspeeds should be reduced during periods of increased bird activity. Shore lines and other areas of gull activity should be avoided. Aircrew should wear helmets with visors down, both day and night, and if practical, keep landing lights on and the windscreen heated. Knowing where primary migration routes are located, when they are active and where waterfowl or gull concentrations exist, will facilitate low level route planning. Accelerated climb to above 3,000 feet AGL, bird information passed over ATIS and included with weather forecasts are additional methods of countering the bird threat. With the introduction of the A-10 and the increased emphasis on TAC low level operations, the birdstrike hazard has taken a quantum jump.

The cost of modern jet aircraft and increased nap of the earth missions combine to produce a situation of mounting concern. Nations throughout the world are engaged in birdstrike countermeasures. We can mutually benefit from shared experience but the resolution of any problem must start with a basic understanding and thorough awareness of its magnitude. Do not underestimate the ability of a bird to spoil your day. ■

A Hole That Is Not A Hole

Airborne Weather Radar Interpretation

CAPTAIN THOMAS E. SIELAND
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Scott AFB, IL

■ On 4 April 1977, Southern Airways Flight 242 crashed near Rome, GA, killing 72 people. The National Transportation Safety Board concluded the following factors contributed to the accident: The severe weather encountered by Flight 242 near Rome, GA, the extent of the flight crew's knowledge of the severe weather conditions before the encounter, and the information provided the crew concerning those conditions. Survivors of the crash verified that both engines surged, stalled and then quit while the aircraft was penetrating a thunderstorm with heavy rain. In addition to the testimony of survivors, the cockpit voice recorder indicated the crew flew the aircraft through what they thought was a hole in the line of thunderstorms; however, it is possible that they misinterpreted what they saw on their radar. This article summarizes what might have happened, and more importantly, what could happen to you under similar circumstances.

Mr. Jim Metcalf of Georgia Tech University analyzed radar data from the National Weather Service's (NWS) 10 cm storm detection radar at Athens, GA, and produced Figure 1. It was at this time that the captain and first officer were discussing the hole in the storm. As you can see, this is an extremely intense thunderstorm with maximum reflectivity in excess of 50dBZ. Generally, at this time of the year and in this geographical area, we consider storms with maximum reflectivities greater than 50-55dBZ as severe storms. How could the crew see a hole in such a large storm and then attempt to fly through it? Read on.

Heavy precipitation (areas of high reflectivity in Figure 1) will absorb and scatter transmitted electromagnetic energy. We call this *precipitation attenuation* and it varies according to the wavelength of the radar. A 10 cm radar, such as the NWS radar at Athens, GA, will not experience much attenuation. However, a 3 cm radar, like the airborne weather radar on-board Southern 242, can experience severe attenuation. To demonstrate, Mr. Metcalf calculated the probable attenuation values for a 3 cm radar, applied them to the values in Figure 1 and developed a synthetic display of 3 cm radar data (Figure 2). Note how attenuation makes the storm appear narrower across the strongest part of the echo.

In addition, iso-echo circuitry was apparently being used by the crew of Southern 242. Iso-echo circuitry is meant to aid the radar operator/interpreter by identifying areas of *high* reflectivity. When the returned signal exceeds a preset threshold, iso-echo reverses the signal and displays it as if there were no signal. As a result, the most intense portion of a storm appears on the scope as a "hole" in the echo. In reality, these holes are heavy rain and/or hail shafts in a thunderstorm; areas that pilots should definitely avoid. Therefore, one might be fooled by returns that combine the effects of iso-echo and losses due to precipitation attenuation. This may be what happened to Southern 242.

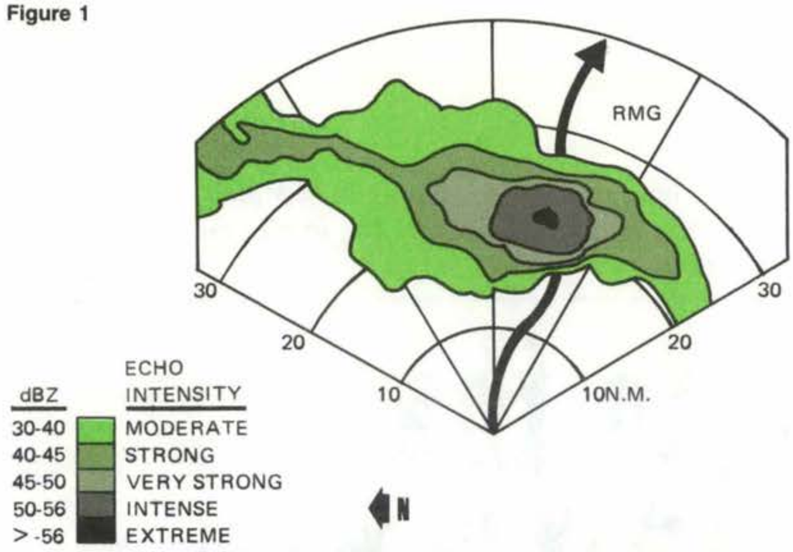
Figure 3 shows what the on-board radar would look like if the data in Figure 2 are representative. As you can see, the aircraft track goes right through the iso-echo hole in what appears to be the narrowest portion of the storm. When you compare Figures 2 and 3 with Figure 1, you can see how the combined effects of attenuation and iso-echo circuitry can be misleading.

In later correspondence, Mr. Metcalf also states: "The principal qualitative conclusion . . . is that the crew was using their radar for a purpose beyond its intended capabilities. The X-band (3 cm) weather radar is a weather *avoidance* radar, and, if used for anything more than that, should be used with great care and maximum data input from ground stations." If possible, pilots should use Pilot-to-Metro-Service (PMSV) to contact an Air Weather Service unit having a storm detection radar. Discuss the magnitude and extent of thunderstorm activity before making any decisions about circumnavigating thunderstorms, or you may find yourself penetrating a thunderstorm like Flight 242 did.

Another incident that points out the problems that can arise from use of iso-echo circuitry occurred on a weather reconnaissance mission. While they were penetrating a typhoon and using airborne radar, the copilot told the AC that there was a hole in a storm cell, and they should head for it. The weatherman on the crew overheard the conversation and realized that iso-echo was on. He asked the naviga[tor] to flick off the iso-echo so the copilot could see that there really wasn't a hole in the large storm cell. It only appeared to have a hole because *iso-echo circuitry cancelled out the heaviest portion of the cell.*

We don't know for sure what really happened on 4 April 1977, and there is, of necessity, some speculation. For one thing, we don't know the configuration or operational status of the on-board radar. However, the study does illustrate what could happen if you are not careful. Evidently the Southern Airways' crew misinterpreted what they saw on their radar. Maybe they forgot that iso-echo was on or even worse may not have completely understood what iso-echo does. Don't let this happen to you. ■

Figure 1



This drawing shows aircraft track through worst part of storm. Compare this figure and Figure 2, below, with true configuration of the storm in Figure 1.

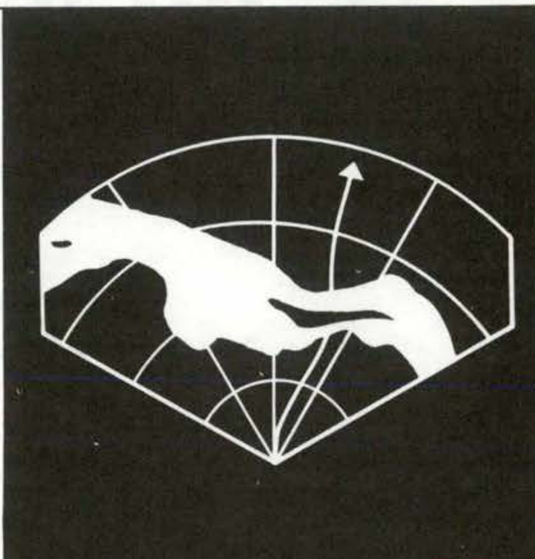
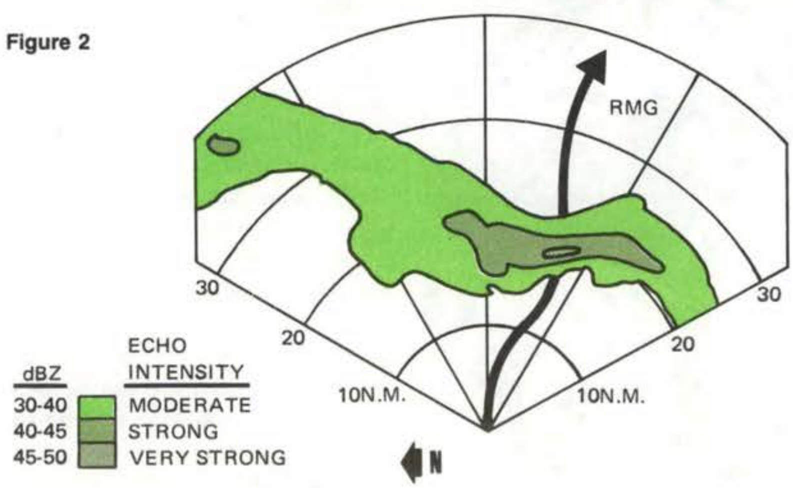


Figure 3

Figure 2



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ABOUT THE AUTHOR

Captain Thomas E. Sieland is the Assistant Chief, Requirements Division, DCS/Systems, HQ Air Weather Service, Scott AFB, IL. He enlisted in the Air Force in January 1960 and received a B.S. in meteorology from Florida State University under the Airman Education and Commissioning Program in 1967. Captain Sieland was commissioned through OTS in 1968. His weather officer assignments include Ft Rucker, AL, Tan San Nhut AB, Vietnam, and Scott AFB, IL. In addition, Captain Sieland has received his M.S. in meteorology from the University of Michigan in 1971, and a PhD in meteorology from Texas A&M in 1977, all under the auspices of Air Force Institute of Technology graduate programs.

This is the final of three installments of Major Weir's article about helicopter flying in all kinds of conditions.

Ride the WILD horse

Conclusion

MAJOR CHARLES O. WEIR

Landing Site Selection

■ When selecting a landing site, weigh the advantages of different type areas, i.e., ridges, hilltops, saddles, knolls, valleys and canyons. The velocity of the wind will be one of the first and most important factors to consider. If the wind is relatively calm, it is usually best to select a hill or knoll for landing, where full advantage of the wind effect may be realized. Extreme care must be exercised when light winds exist (0-5 knots) because they are usually variable, difficult to evaluate, and may be very detrimental if a downwind condition is encountered during the takeoff or approach.

Whenever possible, approaches to ridges should be planned along the ridge or at a slight angle rather than perpendicularly. This procedure will help avoid downdrafts during the final phase of the approach and provide a better abort route, should an abort become necessary.

In planning the approach, consideration must be given to a number of factors. Wind must be evaluated to the best advantage. Consider obstacles in selecting the best approach route. *Weigh and consider all factors carefully*. Keep the top of the landing area in view at all times during the approach.

Landing Site Evaluation

A complete landing site evaluation must be made to assure a safe operation from unfamiliar or unprepared sites.

In performing a landing site evaluation, execute as many fly-bys as necessary to obtain all the information required. Make at least one high reconnaissance and one low reconnaissance before conducting operations into a strange landing area.

High Reconnaissance

Prior to the first landing in a strange area, the pilot should circle the area to determine the general terrain characteristics. The high reconnaissance should be flown at an altitude of approximately 300 feet above the ground to permit observation of the intended landing area and all possible approach and takeoff routes. On the high reconnaissance, thoroughly evaluate the wind for direction and velocity. Movement of trees, smoke, bushes, etc., will assist the pilot in making the wind evaluations.

To determine drift, a rectangular pattern flown around the intended landing area should be sufficient to determine drift and wind direction. Drift and estimated wind velocity may also be determined by flying at a constant airspeed over the landing area on each of the four cardinal headings.

Throughout the entire landing site evaluation process, note the location and intensity of turbulence in the immediate area. Carefully observe the obstacles in the vicinity of the landing area. Note their estimated height and location with reference to best approach and departure route.

Consider the landing area. Check for suitability of landing. Such items as slope, rocks, stumps, undergrowth and marsh land must be taken into consideration to determine if the helicopter can be landed at the selected area.

Check the pressure altitude to determine whether it is the same as that used for flight planning. (To accomplish this, set 29.92" hg in the window of the altimeter and read pressure altitude directly from the instrument.) Check free air temperature. Determine if power lines, cables or similar obstacles are in the immediate landing area or near the selected approach route.

. . . never select a landing site for convenience only, but consider all relevant factors in the determination.

Power lines are very difficult to see from the air and a thorough search for supporting towers or poles should be made. Should evidence of power lines be found, proceed with the utmost caution until positive location is established. Select the most desirable approach and takeoff routes. Such routes should have the fewest obstacles yet be consistent with the wind direction and velocity.

Ensure that landing areas are of sufficient size to permit safe landing and takeoff under the prevailing operating conditions. In determining size of landing area, consideration must be given to operating weight, wind direction and velocity, obstacles, temperature, and other variables which influence helicopter performance. *Remember, never select a landing site for convenience only, but consider all relevant factors in the determination.* Prior to descending for the low reconnaissance, determine the maximum power available. This will provide the pilot with an expected performance capability of the helicopter should any unusual or unexpected conditions occur during the low reconnaissance.

Low Reconnaissance

The low reconnaissance is flown in the direction determined to be the best route during the high reconnaissance. Accomplish the following during the low reconnaissance. If terrain, weather, and all other factors are favorable, fly a rectangular pattern at approximately 50 to 100 feet above all obstacles and at an airspeed commensurate with flying safety for the existing conditions. Recheck the size, slope and obstructions in or surrounding the landing area. Recheck the wind for the intended landing area. This recheck is necessary in order that any changes in direction or velocity may be noted subsequent to the high reconnaissance.

Power Check

The importance of the power check cannot be overemphasized. The power differential determined in this check is the final factor for consideration in the pilot's analysis as to whether a safe approach and landing can be made. A power available check should be performed any time a remote area operation or hoist recovery is anticipated. When not prescribed in the flight manual the power available check should be accomplished as follows: using maximum rpm, first establish the preselected condition, i.e., airspeed, altitude and OAT for which power has been precomputed, then increase collective to ensure that precomputed power is available within existing engine or transmission limitations. Maintain rotor speed as prescribed by the flight manual during the check. The power available/allowable check should be performed as near as possible to the same pressure altitude and OAT conditions as that of the landing or recovery site. This power available check may be performed either en route to or at the recovery site. Should precomputed power not be available, engine topping may be required. Compare the power available against that computed for hover to ensure that there is sufficient power available to complete the landing or recovery.

It should be remembered that the power check is only a guide to be used by the pilot to supplement and cross-check his flight plan and assist him in the determination of whether

Ride the WILD horse *continued*

a safe landing can be made.

Hovering and Landing (Operational)

Bring the helicopter smoothly to a one- to two-foot hover. Low hover requires a minimum of power, reducing the possibility of rpm loss and subsequent settling. Should settling occur, the helicopter will touch down more gently from the low hover. Land as soon as possible. Decrease the collective pitch slowly while maintaining maximum rpm until the entire weight of the helicopter is supported by the landing gear. Maximum rpm should always be maintained until it has been determined that the surface will support the helicopter.

Consider the rotor diameter and be constantly alert to ensure adequate rotor clearance. The angle of descent over an obstacle must be sufficiently high to ensure rotor clearance. Exercise extreme caution when hovering in confined areas to avoid swinging the aft or tail rotor into obstructions.

The importance of preflight planning for any helicopter flight and particularly operational helicopter flights cannot be overemphasized. Prior to any helicopter departure for a remote area or site, power required and power available upon arrival must be computed. Such items as weather upon arrival, direction and velocity of the wind, en route turbulence, and adequacy of landing site must be carefully analyzed before departure. Refer to the appropriate Flight Manuals for complete details in preflight planning and proper use of performance charts.

Turbulent air is encountered at low altitudes in the vicinity of irregular or mountainous terrain. The degree of severity is directly related to three main factors – thermal effect, wind velocity, and the contour of the terrain. The general effects of a strong wind over a mountain barrier are an accelerated wind speed and reduced pressure over the crest, with turbulence and relatively low pressure on the lee side. The increase in wind velocity over a crest is likely to be greater when the wind is at a right angle to the ridge. Isolated peaks tend to create severe turbulence by wind swirl effect rather than increased wind velocity.

The importance of the power check cannot be overemphasized. The power differential determined in this check is the final factor for consideration in the pilot's analysis as to whether a safe approach and landing can be made.

With a wind velocity over a mountain barrier, downslope wind usually occurs in the lower altitudes on or near the lee slope. Contour has a definite effect on lee flow pattern. The lee flow of air over a gentle contour provides the simplest pattern and the least turbulence, although downdrafts are often severe on the lee side of the crest during periods of high wind velocity.

In winds of approximately 10 knots and higher, turbulence will usually be found near the ground on the downwind side of trees, buildings or hills. The turbulent area is always relative to the size of the obstacle and the velocity of the wind. You can also expect it close to, and on the upwind side of a barrier, such as trees, buildings or hills.

Turbulence can be encountered on bright sunny days over the border of two dissimilar terrain features, such as a ramp bordered by sod. The primary cause of this type of turbulence is the vertical air currents produced by the heating effect of the sun.

General procedures and precautions are recommended when flying in high winds and/or turbulent conditions. You should make frequent checks of direction and estimated wind velocity during flight. If severe turbulence is encountered, reduce airspeed and land as soon as possible. Crossing mountain peaks and ridges at low altitude under windy or turbulent conditions can be very dangerous. The safest crossing can be made by flying downwind. This will ensure that downdrafts will be encountered after ridge crests have been crossed. If this is not practical, altitude should be increased proportionately before crossing such areas.

The minimum altitude for flying over a high ridge depends on the wind velocity, type of terrain, and the degree of slope. In strong winds over steep slopes, severe turbulence may always be expected. Plan your flight to take advantage of the updrafts on the windward slope and wherever possible avoid the downdrafts prevalent on the lee side. In high winds it is possible to encounter downdrafts of sufficient intensity to render full power inadequate to prevent extreme loss of altitude.

You should always exercise extreme caution when flying in canyons and valleys; assure adequate terrain clearance before entering such an area; always maintain an "out"; plan ahead, and at all times know which way to turn in event of an emergency. Fly the upwind slope whenever possible to take advantage of updrafts, and in the event of a forced landing, always be in a position to autorotate downhill and into the wind.

Winds below 35 knots can normally be used to an advantage during takeoff or approach, but in higher winds turbulence may cancel out any wind advantage.

Watch for rpm surges during turbulent conditions. Strong updrafts cause the rpm to increase, whereas downdrafts cause the rpm to decrease. Usually the surges are small and the rpm will correct itself; however, if the rpm begins to approach the maximum limits, corrective action must be taken.

Fly as smoothly as possible and maintain attitude control. Prevent excessive airspeed build-up to avoid the possibility of blade stall.

Avoid flight in or near thunderstorms. Dangers to be encountered in thunderstorms include hail, freezing rain, lightning, swirling winds and vertical air currents which have been known to be strong enough to exceed the structural limitations of the helicopter. If thunderstorms cannot be avoided, land as soon as possible and await passage. Use extreme caution during helicopter shutdown if gusty or high winds exist.

Constant study, planning, maintaining top physical and mental alertness— remembering the hazards— coping successfully because you are prepared will certainly enhance longevity.

Providing all of these procedures are used, takeoffs as defined in the appropriate Dash Ones can be utilized to effect safe departure from any of these areas. When possible, a power to hover check should be made prior to any particular type of takeoff.

Conclusion

Only through study of these factors and joining them into our daily practice can we attain the skills necessary to arrive at a "go or no go" situation. A reading file should be maintained in each Helicopter Operations Section so that pilots can familiarize themselves with factors governing their daily flying duties. Your Dash Ones have a wealth of information. Talk with your base weatherman frequently; he can fill you in on a lot that normally doesn't come out during your routine weather briefing on your '175. Study as you fly – develop the habit – it can save your neck. It's up to you. Constant study, planning, maintaining top physical and mental alertness – remembering the hazards – coping successfully because you are prepared will certainly enhance longevity.

The successful mountain pilot is a product, like a gem that is polished to a shining finish. He will sparkle in his difficult task. It takes work, supervision, study, planning and sound application of all these to attain the razor edge of sharpness. Would you supervisors settle for anything less when it comes to dispatching your helicopter to a landing area the size of a postage stamp at 10,000 feet? Do we want to "Ride the Wild Horse" or shall we tame him – with knowledge?

It is our choice. ■

X-COUNTRY NOTES

■ Bad guys are traveling! The weather Gods and broken airplane gremlins didn't get to us the last trip and we were able to evaluate 13 different facilities. Before listing the good guys, we'd like to pass out some items which popped up frequently during the trip.

INFORMATION

IFR Supplement—This book is the bible that throttle-benders use to decide if your facility is suitable for their machine. The intent of the Supp is to list available equipment and facilities, but also to pass on information necessary for the aircrew to safely arrive and depart the airdrome. As we roamed the CONUS, we noticed a tendency to stuff more and more info into the book. Sure, much of it is necessary, but some is not! Our only point is that maybe it's a good time for airfield management folks to take a hard look at their advertisement in the IFR Supplement. Is everything a required item? Are hours of operation versus transient hours versus other hours confusing? Sometimes the disparity is unavoidable but on occasion, a slight time shuffle will line up operating hours to prevent confusion. May be worth looking into! Like we said, take a look at your entry and empathize with the crew member who has to digest it all in only a minute.

Transients versus transients—At several places we stopped, the people really had their act together until we played devil's advocate and said "O.K., you took good care of us, but now let's say we're a broken C-130 and we have five or six enlisted crew members with us. Show us where they can get a meal and adequate crew rest before we blast out of here tomorrow." At times we were disappointed in the services and facilities that we were shown. POINT—crew members come in all different sizes, shapes, colors, ranks and sexes! If you're looking at your own house to see if it's in order for providing good service to transients, remember that the service needs to be good for *all* crew members. Often, a loadmaster or flight mech needs a good crew rest facility much more than the pilot or nav since they may have spent extra hours working cargo or fixin' a sick bird. Take care to provide good transient service across the board.

Retained Awards

HILL AFB, UT

Check the IFR Supp for the note about runway winds! High altitude, high terrain and mucho traffic make Hill AFB a place to approach and depart with caution. Base Ops' facelift is turning out a top-notch facility and personnel are anxious to provide good service! Keep up the good work!

KIRTLAND AFB, NM

Same kind of terrain and traffic problems as Hill but add joint-use airfield cautions (airlines and lots of little airplane folks). Kirtland TA folks and Base Ops do a fine job. Leave yourself some extra time to get to and from billeting because it's on Kirtland East and can be a 20-25 minute ride each way. All facilities super.

RANDOLPH AFB, TX

Take some extra gas because you may get an early descent and some low altitude vectoring on the way in. Randolph continues to provide super service and facilities.

for transients. Call ahead for reservations!

BARKSDALE AFB, LA.

Only one runway has caused some arrival delays at times. Super turn makes it a good east-west enroute gas and food stop!

SHEPPARD AFB, TX

Lots of local and student traffic make Sheppard a heads-up place! Contract TA does an outstanding job and facilities are super. Good stopover or RON!

BUCKLEY ANGB, CO

Another high altitude and terrain place. The Denver traffic also needs watching. Buckley TA and Ops folks still bend over backwards to provide the best possible service whether you're staying or pressin' on. It's always been a pleasure to visit—wish there were more places that. . . . Nuff said!

LAUGHLIN AFB, TX

Not on the beaten path, but you can expect a good turn from the Del Rio folks. Laughlin service and facilities continue to be some of the best.

New Additions

ALTUS AFB, OK

Probably the hardest trying outfit I've seen, Altus has a brand new Base Ops and is obviously anxious to serve. Now that RG has drawn down, maybe Altus will pick up the reputation for a good X-C stopping place. Glad to have you!

WURTSMITH AFB, MI

We landed in a snowstorm with sub-zero temps and still received super service. TA and Ops folks will take good care of you and the RON facilities are good. A long way to an alternate, but next time you might try the northern route!

WILLIAMS AFB, AZ

UPT and the Phoenix area traffic require the moving eyeballs to be used in and outbound. Willy has a somewhat limited transient ramp so if you have a many-motor or a flock of machines, you may want to call ahead. Other than that, the personnel at Willy will take super care of you. Welcome to the list!

That wraps up the latest trip! Keep the feedback coming 'cause we use aircrew comments as an indication of where we need to schedule to. Write Rex Riley, AFISC/SEDAK, Norton AFB, CA 92409. FLY SMART! ■

THE

REX RILEY

Transient Services Award

LORING AFB	Limestone, ME
McCLELLAN AFB	Sacramento, CA
MAXWELL AFB	Montgomery, AL
SCOTT AFB	Belleville, IL
McCHORD AFB	Tacoma, WA
MYRTLE BEACH AFB	Myrtle Beach, SC
MATHER AFB	Sacramento, CA
LAJES FIELD	Azores
SHEPPARD AFB	Wichita Falls, TX
MARCH AFB	Riverside, CA
GRISSOM AFB	Peru, IN
CANNON AFB	Clovis, NM
LUKE AFB	Phoenix, AZ
RANDOLPH AFB	San Antonio, TX
ROBINS AFB	Warner Robins, GA
HILL AFB	Ogden, UT
YOKOTA AB	Japan
SEYMOUR JOHNSON AFB	Goldsboro, NC
KADENA AB	Okinawa
ELMENDORF AFB	Anchorage, AK
PETERSON AFB	Colorado Springs, CO
RAMSTEIN AB	Germany
SHAW AFB	Sumter, SC
LITTLE ROCK AFB	Jacksonville, AR
TORREJON AB	Spain
TYNDALL AFB	Panama City, FL
OFFUTT AFB	Omaha, NE
NORTON AFB	San Bernardino, CA
BARKSDALE AFB	Shreveport, LA
KIRTLAND AFB	Albuquerque, NM
BUCKLEY ANG BASE	Aurora, CO
RAF MILDENHALL	UK
WRIGHT-PATTERSON AFB	Fairborn, OH
CARSWELL AFB	Ft. Worth, TX
HOMESTEAD AFB	Homestead, FL
POPE AFB	Fayeteville, NC
TINKER AFB	Oklahoma City, OK
DOVER AFB	Dover, DE
GRIFFISS AFB	Rome, NY
KI SAWYER AFB	Gwinn, MI
REESE AFB	Lubbock, TX
VANCE AFB	Enid, OK
LAUGHLIN AFB	Del Rio, TX
FAIRCHILD AFB	Spokane, WA
MINOT AFB	Minot, ND
VANDENBERG AFB	Lompoc, CA
ANDREWS AFB	Camp Springs, MD
PLATTSBURGH AFB	Plattsburgh, NY
MACDILL AFB	Tampa, FL
COLUMBUS AFB	Columbus, MS
PATRICK AFB	Cocoa Beach, FL
ALTUS AFB	Altus, Oklahoma
WURTSMITH AFB	Oscoda, Michigan
WILLIAMS AFB	Chandler, Arizona

For years we have been pushing the "If it doesn't look right, take it around" syndrome. But like Junior, who won't pay attention to anything the old man says, pilots sometimes have to learn the hard way. Here is a DC-8 Captain's report on an experience of his. If you believe it, you may not have to do it.

A Captain's Report

■ This incident occurred during vectors for a localizer approach to 5R with a side step to 5L. WX 8 2½ R-wind N 10 kts. HDG 240° at 7,000. Given a turn to 330° descend to 4,000. In the turn and through 6,000 the controller says, "You are 3 miles from the fix, can you get down in time if I turn you on now?" I tell the F/O to answer "yes," and we are given a turn to 030° descend to 2,800—intercept and cleared for the approach. Call TWR at the fix.

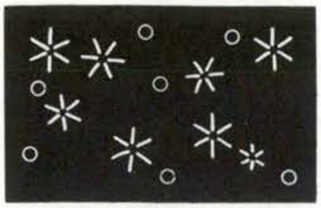
Sometime during this exercise, the S/O gets a new ATIS which he puts on the card for us—viz is now 1½ S-F. To get down, I have gone to flaps 25° and gear down. In the turn and descending at a good rate. Too good as a matter of fact because out of 4,000 and going down, the GPWS goes off. Startled, we all look around. It's obviously excessive rate. In that momentary confusion, I go through 2,800 and stop it at 2,100. The controller calls and tells us we are there and to go back to 2,800. I'm already going. Just reach 2,800 and there goes the fix. I'm mentally kicking myself when it registers that the F/O is telling me that 1½ is illegal for 5L and he is right. Still above MDA for 5L and there are the approach lights for 5R. A very sloppy approach, to say the least. I've been behind it ever since I accepted that turn on. At least three times now, things have occurred that called for a missed approach. Why am I here? The visual acquisition of a set of nice bright approach lights in limited visibility is one thing, but the acquisition of runway lights only in limited visibility is quite another. Our speed as I recall for flaps 35° is about 150/155 kts. I stay at MDA until we see the runway. Visibility not bad on the approach, but worse over the field. When we do see the runway, take full flaps and adjust power to get down, it is almost too late. I touch down at least 2,000 feet down the runway. We stop all right, but this is no way to run an airline!

I've been behind it ever since I accepted that turn on. At least three times now, things have occurred that called for a missed approach. Why am I here?

For days now I've been kicking myself and asking myself why? I'm sure the F/O was shaking his head all the way down. A comedy of errors. I dug my own hole, that's for sure. We tend to do more, I think, with a freighter than we would with passengers on board. We'll take a little more turbulence or make a steeper descent. The cargo pallets won't mind; we'll also, at times, accept a close-in turn from a little too high just to be cooperative. We can even cooperate ourselves right out of the ballpark. I could have and surely should have said no and made a missed approach but I didn't. Once I accepted that turn on I felt obligated. Pride? This was an illegal approach. The lower VIZ was received outside the LOM, and once the GPWS went off, I never did catch up. The only wise thing I did was stay at MDA until runway in sight. The rest I'd like to forget, but can't—Quoted in *Air Safety Review*. ■

OPS TOPICS

LEAKY SPARE



■ The F-4 pilot led his flight into an ACM tactical intercept. After obtaining a tally on his adversary, he started into a sustained 5G turn; however, before he could complete the engagement, he experienced tunnel vision and temporary loss of situation awareness. The attack was broken off and an uneventful RTB and landing accomplished. Cause of the incident was a faulty G suit valve and a leaking G suit. It seems that this was the pilot's spare suit that had been improperly stored at his residence. How about yours? – Major Bill Harrison, Directorate of Aerospace Safety.

WATCH THE T-39s!

An S-3A and a T-39D were parked on a transient line, tail to tail, approximately 80 feet apart. The T-39 had its gust lock set.

S-3A starting procedures require one engine to be at 80 percent power in order to start the other engine. After the S-3 was started, observers noted that the T-39 rudder was deflecting rapidly back and forth until it finally deflected hard left. The pilot of the S-3 taxied out and took off, unaware of any incident.

Inspection of the T-39 revealed that the torque tube had failed due to excessive loads on the rudder from the S-3 exhaust blast. The T-39 with its lightweight flight control surfaces and mechanical linkage is considerably more susceptible to gust load damage than tactical aircraft.

At its home base the T-39D is parked with 100 feet separating aircraft. All facilities servicing T-39 aircraft are advised of the T-39's susceptibility to structural damage of the rudder due to side loading. Care must be taken in parking T-39's in proximity to other aircraft where jet exhaust will strike the empennage. – (USN *Weekly Summary*.)

HUDDLE

In football season the word "huddle" is used to gather your group around you in an attempt to win or survive the game. In cold water survival "huddle" may help save your life.

Survival in cold water depends on many things. Thin people usually are overcome by the coldness of the water before large people because the thin body cools at a much faster rate.

Swimming or treading water will cause your body to cool 35 percent faster than remaining still. The "drownproofing technique" requires putting the head into the water, and will cause a person to cool about 82 percent faster than if floating with the head out of the water.

An "average" person, wearing light clothing and a personal flotation device (life preserver) may survive 2½ to 3 hours in 50 degree water by remaining still. This survival time can be increased considerably by getting as far out of the water as possible and covering your head. Getting into a boat or anything else that floats can be a real lifesaver.

It is important to remember that cold water conducts heat away from your body many times faster than air. Your life preserver will keep you afloat even though you may be unconscious. Remaining still and, if possible, assuming the fetal position will decrease your body heat loss and increase your survival time. About 50 percent of your body heat is lost from the head so it is important to keep the head out of the water. Other areas of high heat loss are the neck, the sides and the groin.

If several of you are in cold water together, you can "huddle" close, side by side in a circle to help preserve body heat.

Of course there comes a time of decision making when you are in the water. Knowing that body movement causes you to lose body heat at a greater rate, do you leave your position and attempt to swim to an object or shore? Distance on the water is very deceptive. We recommend that you stay put, unless you are absolutely sure that you can make it to shore, or that there is no chance for rescue. – Courtesy *Aviation Digest,* March 1979. ■

SAFETY TROPHIES for distinguished contributions during 1978

THE COLOMBIAN TROPHY

Symbolic of excellence in military aviation safety, the Colombian Trophy for 1978 was awarded to the 401 TFW. The wing flew 9,700 sorties and 14,400 hours in 1978 with no accidents. This achievement was attained while the wing conducted realistic combat training in high performance tactical fighter aircraft.

401st Tactical Fighter Wing, USAFE

THE SICOFAA AWARD

Awarded by the System of Cooperation Among Air Forces of the Americas for excellence in aircraft accident prevention. For its many achievements while flying 13,600 accident-free hours in 1978 in three different type helicopters and three models of the C-130, the 403d was selected the winner of the SICOFAA Trophy from among 10 nominees.

403d Rescue and Weather Reconnaissance Wing

Selfridge ANG Base, MI (AFRES)

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EDITOR
AEROSPACE SAFETY MAGAZINE
AFISC/SEDA
Norton AFB, CA 92409

READER SURVEY

Aerospace Safety is published for aircrews, their commanders and supervisors, and support personnel in such fields as operations, air traffic control and life support.

If you are assigned in one of these career fields, *Aerospace Safety* is for you. We would like for you to tell us how we are doing so that we can publish a magazine that best meets your needs. Please take a few minutes to complete the attached survey. It is pre-addressed and the postage is paid.

We also welcome letters and articles for publication. Please write to:

Editor, *Aerospace Safety* Magazine
AFISC/SEDA
Norton AFB CA 92409

In accordance with paragraph 30, AFR 12-35, Air Force Privacy Act Program, the following information about this survey is provided: (a) Authority: 10 USC 8012, Secy of the Air Force: Powers and duties; delegation by; (b) Principal Use: To collect a sampling of opinions on *Aerospace Safety* magazine; (C) Routine Use: To present resulting grouped data for use by decision makers in evaluating the effectiveness of the periodical; (d) Participation is voluntary, and no adverse action may be taken against nonrespondents, although honest responses are needed and appreciated.

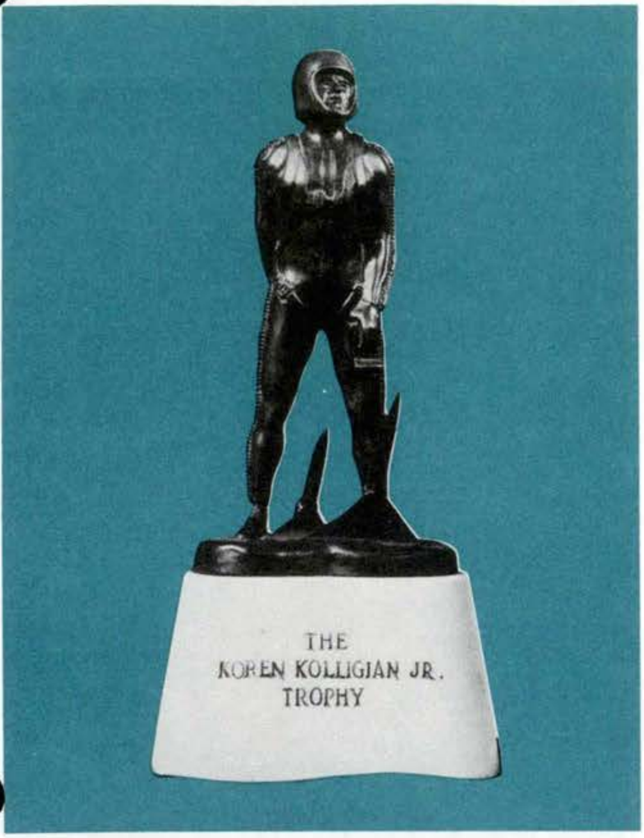
Thank you for participating in this survey.

USAF SCN 79-86
(Expires 31 Oct 79)

SURVEY QUESTIONS

1. How often do you see the monthly *Aerospace Safety* magazine?
   ( ) a. every issue ( ) d. have never seen it
   ( ) b. most issues ( ) e. have never heard of it
   ( ) c. some issues
2. When you see *Aerospace Safety* magazine, how much of it do you read?
   ( ) a. all of it ( ) c. some of it
   ( ) b. most of it ( ) d. never read it
3. Are the articles interesting to you?
   ( ) a. often ( ) c. seldom
   ( ) b. sometimes ( ) d. never
4. Are the articles of value to you?
   ( ) a. often ( ) c. seldom
   ( ) b. sometimes ( ) d. never
5. Are you currently an aircrew member? No______ Yes______
   What position?
6. What is your rank? ____________________
7. What is your AFSC? ____________________
8. What type of subject matter do you prefer to see in this magazine? ____________________
9. Please tell us how you would improve *Aerospace Safety*.

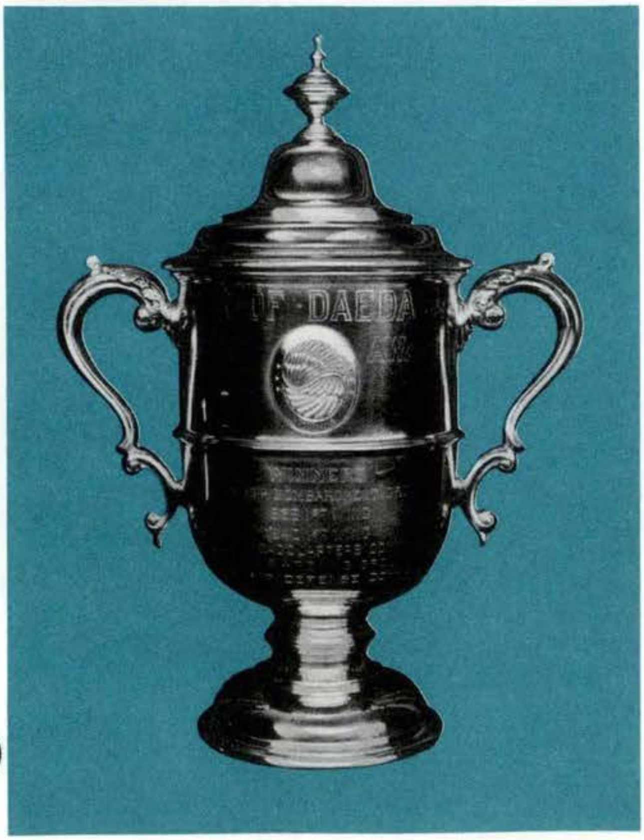
USAF SCN 79-86 (Expires 31 Oct 79)



THE KOREN KOLLIGIAN, JR. TROPHY

Major Fowler exhibited extraordinary skill while flying as an aggressor pilot in the F-5E. At 20,000′ and 1.2 mach, the aircraft canopy shattered, and flying plexiglass seriously injured his right eye. Nevertheless, Major Fowler successfully recovered the aircraft despite pain and loss of vision in one eye.

Major Raymond D. Fowler

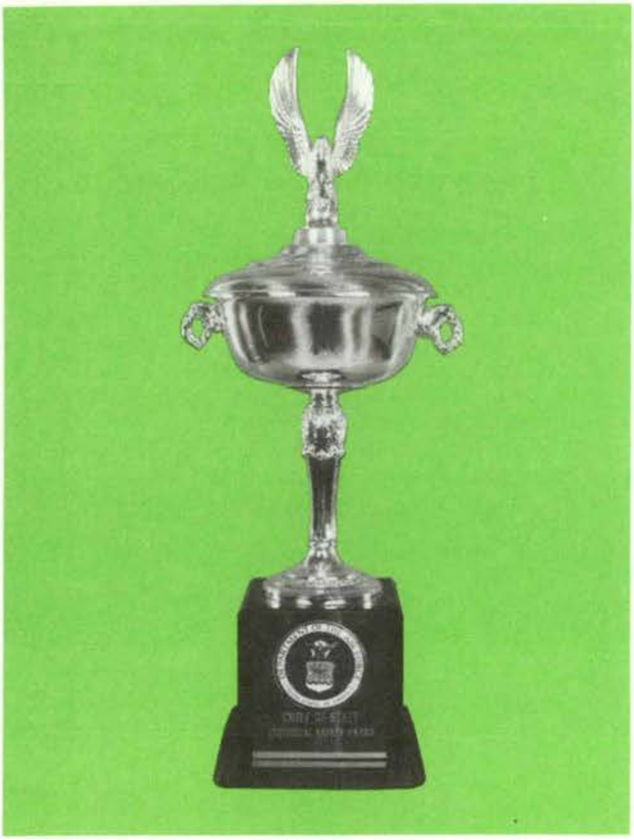


THE MAJOR GENERAL BENJAMIN D. FOULOIS MEMORIAL AWARD

Presented by the Order of Daedalians, the National Fraternity of Military Pilots, the Foulois Award recognizes the aircraft accident prevention program judged to have been the most effective of all major commands. SAC had only one Class A aircraft mishap while flying more than one-third of a million hours, worldwide.

Strategic Air Command

SAFETY TROPHIES for distinguished contributions during 1978



CHIEF OF STAFF INDIVIDUAL SAFETY AWARD

Presented to Air Force personnel who made significant contributions to safety during the previous calendar year.

MR. ARLIE E. ADAMS
AIR FORCE LOGISTICS COMMAND

Mr. Adams' efforts resulted in a number of accomplishments including management of system safety engineering analyses for hot refueling and combat turnaround of tactical and strategic aircraft which increased combat readiness and sortie surge capability of the USAF.

CAPTAIN CHARLES F. PLOETZ
UNITED STATES AIR FORCES IN EUROPE

Captain Ploetz, as explosives safety officer for USAFE, improved explosives safety criteria for hardened aircraft shelters and runway and taxiway protection which resulted in greatly enhancing the operational efficiency of USAFE.

SENIOR MASTER SERGEANT LEON B. SEXTON
AIR FORCE COMMUNICATIONS SERVICE

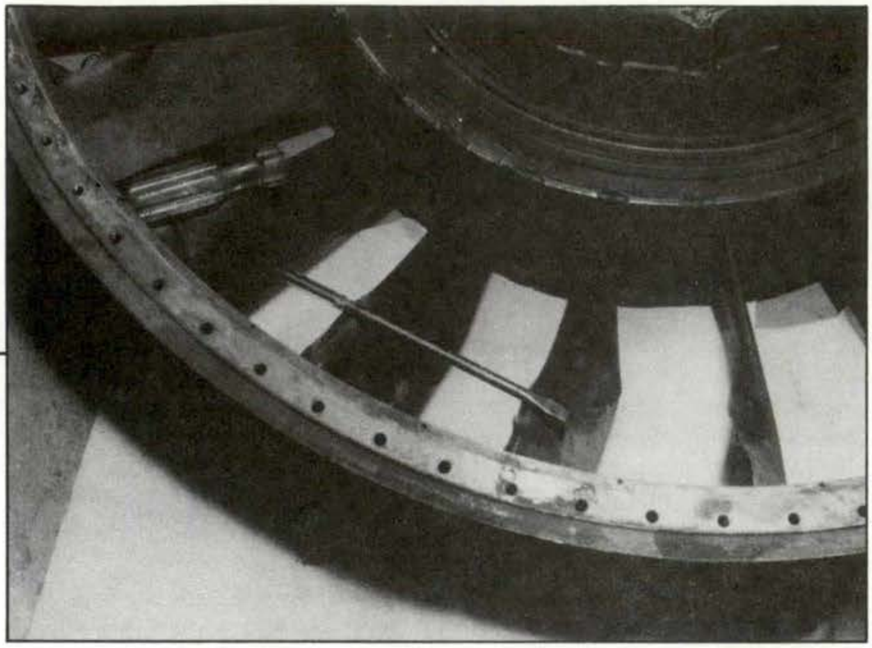
As safety superintendent for AFCS, SMSgt Sexton provided leadership in safety management for more than 700 Air Force units and 60,000 people. He contributed to reducing ground accident fatalities to the lowest in command history.

CAPTAIN GERALD P. BUCZEK
AIR TRAINING COMMAND

As safety training officer at Lowry Technical Training Center, Captain Buczek planned, developed and implemented programs that resulted in cost reductions while enhancing the Air Force's safety program management capability. ■

FOD For Thought

MAJOR JAMES GILLESPIE, CF
Directorate of Aerospace Safety



■ Foreign object damage (FOD), one of the most expensive and troublesome problems in the life cycle of aircraft turbojet engines, has cost the USAF more than $25 million in the past two years. The control of FOD is the primary concern of everyone who works in and around jet engines, from the man on the ramp to the crew in the cockpit. This is one area where extra effort will pay off in immediate savings through reduction of lost resources.

For convenience, FOD can be divided into two categories. One is that type over which we have very little direct control: birds, slush, snow or ice ingestion and the seemingly inevitable loose screw in the intake, to name but a few. It is the other category, however, which we will address here. That is, the obvious individualized contribution made by a careless or unthinking person who through complacency, thoughtlessness or circumstance, tries to satisfy the ravenous appetite of a howling compressor.

In the past few months, we have experienced several instances of persons unwittingly contributing to this feeding problem. The following examples, unfortunately, are typical:

- As an aircraft was being parked at a transient base, a lineman went under the aircraft to remove the gear pins and pitot cover from the stowage compartment to pin the aircraft. In the interim, the tower asked the pilot to move his aircraft to another spot. Unorthodox hand signals from the cockpit resulted in a bewildered lineman attempting to hand the pins to the rear seat occupant. The back seat pilot realized it was wrong to reach for the pins with the engines running but the circumstances influenced him to do so. The pitot cover was ingested in the right intake.

- During engine run-up on the runway, the pilot felt the left engine "chug" slightly passing 85 percent rpm. Number two engine flamed out at 85 percent rpm. Investigation following ground abort, revealed portions of the northwest high altitude approach plate booklet in the right engine and the northeast booklet in the left engine. This may seem reasonable if the runway direction was southerly, however, it is not conducive to long engine life. The occurrence was attributed to the previous mission. When the canopy was opened after clearing the runway, the FLIPs, which became lodged behind the ejection seat during BFM, fell out and were sucked into each intake.

- An aircraft was positioned in the dearming area configured with an empty SUU-20. The load crew chief approached the aircraft from behind the right intake to insert the pylon safety pin. The wind caught the streamer attached to the pin and carried it to a position near the intake. The airflow pulled the safety pin from the hand of the load crew chief and it disappeared into the right engine.

- An aircraft was being run up following an engine change. The technician finished inspecting panels on the underside of the aircraft and exited the work area between the left main gear and the left intake. As he passed near the intake, his hardhat, complete with ear protectors, swiftly departed his head and vanished up the intake, prompting him to wonder why he had not fastened his chin strap. And, on and on it goes. . . .

It can be said with some assurance that as long as we have people working in and around jet airplanes, the potential for personnel-induced FOD mishaps will exist. Our job as workers and supervisors is to ensure strict adherence to established procedures. An increased awareness and a healthy respect for the dangers posed by a jet engine duct are a must. Continuation training and increased situational awareness by all personnel are the backbones of an effective FOD program, and the elimination of carelessness and complacency is an essential step. FOD can be beaten. Let's do it! ■

FLYING FOSSILS

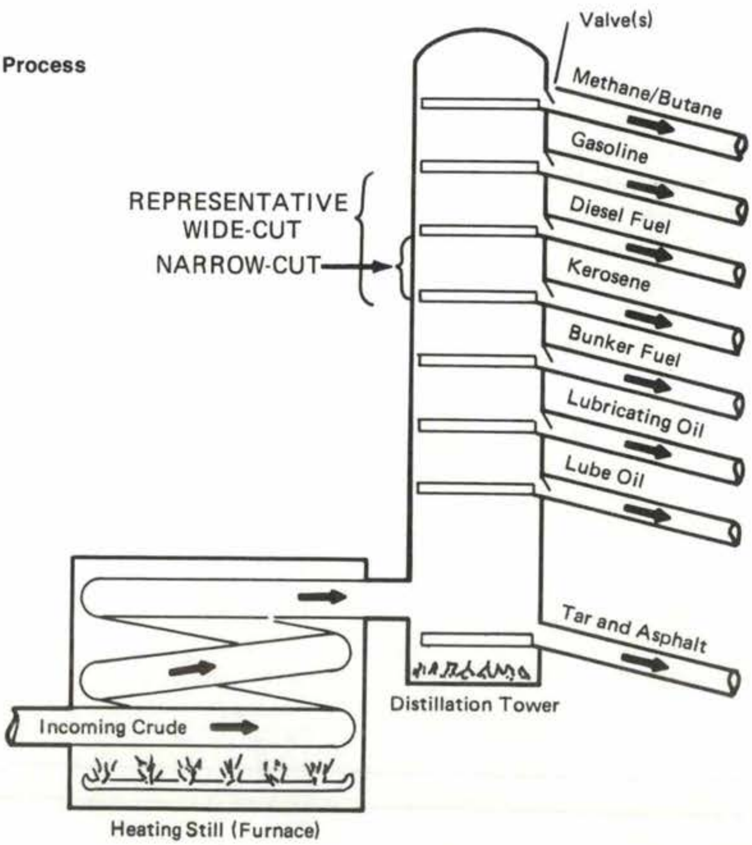
J. R. HENNINGFELD
Editor *DC Flight Approach*
in collaboration with
Technical Consultants
A. T. Peacock,
Power Plant Engineering
and C. E. Brown,
Flight Operations

Back in the old days, the real old days, like millions of years ago, society consisted of some pterodactyls and some very large land creatures like the triceratops, brontosaurus and a placid, graceful swamp dweller, diplodocus. At about the same time, the neighborhood began to grow—really grow! Ferns shot up to 90 feet or more, trees developed gigantic girths and heights; vegetation in general floruished on an unprecedented scale and inflation was very, very low. Then something happened. Perhaps it got very cold one night and just didn't warm up in the morning, causing all these creatures and plants to die off. Whatever the cause, all these fellows, along with the giant vegetation, simply settled into the ground, and there they sat, brooding for eons with very little to do but decompose. After millions of years the creatures and jungles slowly turned into pools of messy ooze deep in the ground, furnishing us with what we now call crude oil.

■ Crude oil and unrefined petroleum are synonymous. They are a mixture of organic compounds that are primarily hydrocarbons. Hydrocarbons are a mixture of two elements: hydrogen and carbon. Hydrogen is a highly flammable, colorless and odorless gas. Carbon comes in two forms, crystalline (solid) or non-crystalline (soot). When hydrogen is attached to carbon, you have the essential ingredient for producing petroleum products.

Hydrocarbons come in a variety of molecular weights which determine the products to be extracted from the crude. For instance, the very light

Figure 1. Petroleum Products Separation Process



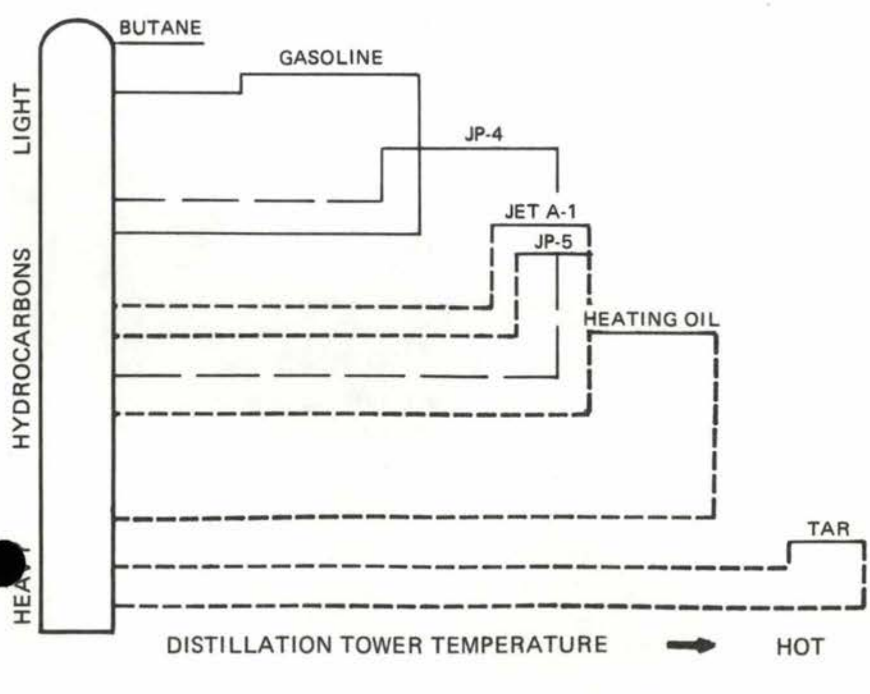
hydrocarbons will refine into bottled gases while the very heavy will yield products like tar and asphalt.

In the refining process, crude is pumped into a separator where the gases are drawn off, leaving only the liquid crude, which is then pumped to refinery storage areas. From this point it is forced into a furnace, or heating still (much like that used in making "moonshine," only on a much larger scale), where it is heated to the boiling point (figure 1).

When liquids boil they give off vapors, and crude oil is no exception. From the heating still, all vapors flow into a tall distillation tower, cooling as they rise. Each type of vapor rises only as high within the tower as its physical properties will allow. (It should be noted that the term "boiling point" is generally correlatable with molecular weight, but that some particles having the same molecular weights will have differing boiling point temperatures.) Lightweight hydrocarbons vaporize first and rise very nearly to the top of the tower where they cool and condense into liquid form. The progressively heavier hydrocarbons do the same thing, but condense at lower heights within the tower. When any of the vapors condense, the resultant liquid settles on a collector tray located at a height in the tower corresponding to the predicted condensation point of that specific hydrocarbon. The first vapors to boil off are the ultralight ethane, butane and propane gases. Next are gasoline vapors, followed by hydrocarbons of the distillate group from which kerosene is extracted. This group includes the various types of jet fuel. Heavier hydrocarbons vaporize last to form oils for lubrication, fuel for steam generation plants, and finally, solid lubricants, tars, asphalts and fertilizers. Over 40 percent of all U.S. petroleum use is within the gasoline group of hydrocarbons. The distillate group of hydrocarbons, which includes those used to make kerosene for jet engine fuel, comprises an additional 24 percent of U.S. petroleum use. Jet fuel alone consumes 6 percent of total petroleum use in the United States.

This article is actually concerned with the kerosene section of the refining spectrum, from which various types of jet fuel are derived. These fuels come from the wide kerosene area in the middle of the distillation tower and tend, in some instances, to include lightweight hydrocarbons from gasolines, either from an overlap in their distillation process or through deliberate blending. It is blending of hydrocarbons over a given condensation area that determines the "cut" of fuel. Notice in figure 2, the range over which JP-4, a wide cut fuel, has been collected as compared to the collection range of JP-5, a narrow cut fuel.

Figure 2. Wide Cut/Narrow Cut Approximations



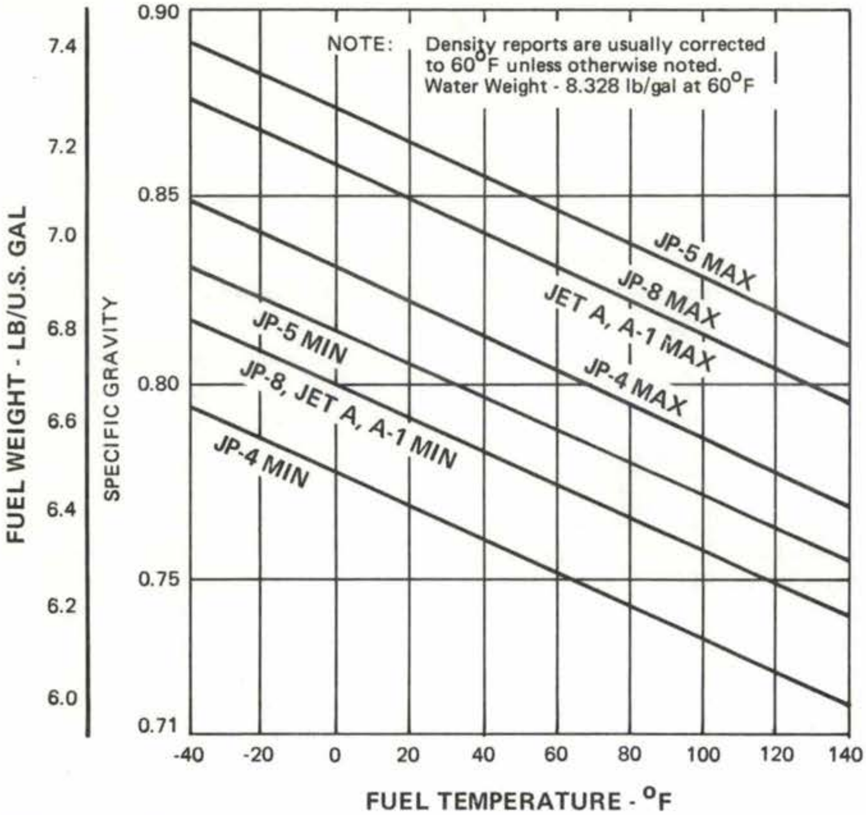


Figure 3. Jet Fuel Density Variations

As the first jet engines were developed in the 1930s, kerosene was the normal fuel requirement. Development and refinement of engines caused a need for special fuels for military uses. Meeting those special needs gave us our first jet-designated fuel, JP-1; the initials "JP" relate to jet propellant.

This new fuel was carefully refined strictly to satisfy the technical needs of newly designed engines, but little or no thought was given to the availability or cost structure of this fuel. Consequently, the military found it had specified a fuel that could not be produced economically. A new formula, JP-2, was initiated in 1945 and during its use it was found to lack certain viscosity requirements. An improved fuel was then devised in 1947; it was called JP-3 and, to a great degree, it made up for most of the problems posed by earlier fuels. But it too had a negative side that proved to be prohibitive. During a rapid climb to altitude in a high performance aircraft, it would boil off 25 percent of its own volume, severely restricting the aircraft's range. In 1951, the solution to that vaporization problem of JP-3 was solved by the introduction of JP-4, a fuel still used today by the United States Air Force.

As engine refinement advanced, more specialized fuels were needed; many new aircraft and engine designs introduced requirements which had to be met by speciality and new general purpose fuels. Meeting those needs were fuels such as JP-5, JP-6 and JP-7. Most common in use today is JP-5, which was formulated for use in hazardous areas where a high flash point was required, as aboard aircraft carriers. JP-6 was a specialty fuel specifically developed for the XB-70, an experimental bomber, while JP-7 was developed for use in the SR-71A.

Recently, JP-8 was introduced into the market; its properties are similar to jet A-1 (the international commercial jet fuel), with additives that control icing and corrosion.

While the Air Force is attempting to establish a world wide standardization of JP-8 fuel, commercial aviation uses seem to be taking a different path. Commercial jet engine fuel specifications are set in the United States by the American Society for Testing and Materials (ASTM). Current fuels are identified with letter designators: Jet-A, Jet A-1, and Jet-B. Jet-A and Jet A-1 are practically the same except Jet-A has a maximum allowable freezing point of −40°C, while jet A-1's freeze point is −50°C. Jet-B is a wider cut of fuel with separate specifications. An increase to a maximum of −47°C is being considered for Jet A-1 which will increase its availability by about 6 percent.

Other parts of the world use different designations to define fuels. Canada has a "GP" series, while the United Kingdom uses the "DERD" series. Many fuels are undergoing changes to meet the demand of an intensive energy business, indicating that the commercial fuel picture is not approaching anything universal.

Figure 3 shows how fuel weight varies with temperature. The specification density values are written assuming a standard temperature of 60°F. The JP-8 specification allows a density of approximately 6.5 to 7.0 pounds per gallon. Fuel density is inversely proportional to temperature: as fuel temperature increases its density decreases; if the temperature decreases, density increases along the characteristic curve. Frequently, reports are received quoting a "6-pounds-per-gallon" fuel, but the specification does not allow for a 6-

continued on page 26

Pilot/ Controller Confusion

The following mixup involved a pilot of one of our sister services, but it happens to our guys too. In some instances the results were fatal.

■ As the pilot of 12345 reached a point 16 miles from destination, he was cleared to descend from 13,000 to 9,000 feet. At that time he requested a PAR approach. While passing 11,000 feet further descent clearance was requested. After being asked to IDENT, he was then cleared to 3,500. This clearance was read back to Approach Control.

At 5 miles south of the airfield, 12345 was instructed to turn right to 150 degrees, to maintain 3,500 feet, and to contact Approach. The pilot read back these instructions and shortly thereafter reported passing 7,500 for 3,500. For the base turn, 12345 was instructed to turn right to 270 and maintain 3,500. On readback the pilot said "270 and 2,500 for 345?" with a definite interrogation reflection. The approach controller responded "345 affirm, pilot's discretion perform landing cockpit check." Pilot responded, "345."

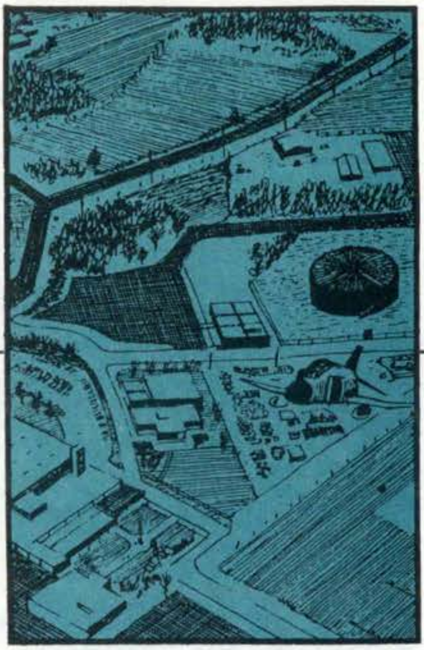
At this point control of 12345 was transferred to the PAR final controller. Approximately 1 minute later 12345 reported "345 is making a right turn inbound." The final controller responded, "345 roger, say your altitude." The pilot reported level at 2,500 and was immediately told to climb and maintain 3,500 and to turn right to heading 360.

In retrospect, the pilot stated that he had challenged the 2,500 foot assignment. What had happened, however, was that the pilot had mistakenly cleared himself to 2,500 vice 3,500. Unfortunately, the approach controller did not detect the pilot's confusion on the base leg readback. To further complicate the situation, it was at this point that control of 12345 was passed to the PAR controller. Subsequently, both the pilot and the PAR controller simultaneously recognized the error and corrective action was taken.

This breakdown in communication emphasizes the necessity of ensuring accuracy when transmitting back instructions received. As a result of this hazard report all controllers were reminded that communication encompasses not only formulation and transmission of information, but also includes interpretation and understanding as well. In cases where doubt or ambiguity exists, controllers have been directed to take positive action to clarify/verify intent.

A final point: It's not the controller whose bod is on the line. It's Joe Pilot and his PAX. So in self defense, let's listen a little better, enunciate better and *know absolutely* that you and the controller have a perfect mutual understanding. ■

LOOK TO SEE



When meteorological conditions permit, "regardless of type of flight plan, whether or not under control of a radar facility, the pilot is responsible to see and avoid other traffic, terrain and obstacles." AIM (traffic advisories)

■ The B-727 – Cessna 172 midair at San Diego last September heated up the controversy over how best to prevent midair collisions. The FAA has proposed extensive new traffic separation proposals that have been contested by other interested parties such as the Airline Pilots Assn (ALPA), Aircraft Owners and Operators Assn (AOPA), General Aviation Manufacturers Assn (GAMA) and others. Each has a vested interest in how the airspace is to be controlled.

All parties have, no doubt, valid reasons for the approach they take, but whatever the outcome, one thing is certain: midair collision prevention is a subject of utmost interest to all pilots.

Lest we forget, however, whether control is exercised from the ground or by airborne devices, along with various airspace restrictions and rules, *see and avoid* will be with us for a long, long time.

The trouble with see and avoid is that pilots do not always see aircraft that are a potential threat. Seeing means developing the technique of the fighter pilot, who knows that seeing a potential enemy first is his best life insurance. But there is more to seeing than just taking an occasional peek through the windscreen. Over the years we have learned some techniques for *seeing* rather than just *looking*.

An airplane at long range is seen as a mere dot; without relative motion it may not be seen at all. But to see the motion, the eye's gaze must be fixed. Therefore, the idea that the head and eyes must be constantly moving is erroneous. The best technique is to scan the sky in small segments, fixing the gaze, then moving to the next segment.

Unless there is something more distant to focus on, the eye will focus just outside the airplane – three to perhaps six feet away. If you see another airplane at that range, forget it! But you can see at a much greater distance by focusing on a cloud, an object on the ground or a mountain several miles away. Then search a sector, refocus and move to another sector.

There are a number of other aids to seeing. If you wear glasses, be sure they're clean. Ditto visors. Ditto, ditto windscreen. Also, you should know that haze may prevent you from seeing another aircraft until it is very near.

Hang loose. By that we mean move your head and body so you won't be the victim of a canopy bow or other structure. Several years ago a fighter and a helicopter collided at pattern altitude for the fighter. The two aircraft were flying on a converging course and the fighter pilot, who survived to testify, said he never saw the chopper. Reconstruction by the accident investigation board showed that the helicopter's motion relative to the fighter was zero, and that it was hidden behind the fighter's canopy bow the entire time.

Which brings us to an axiom: "If the other guy is moving relative to you, a collision is not likely to occur." On the contrary, if an aircraft is seen as having no relative motion – look out! You're about to become a statistic.

Now, having seen, one must act. Figure 1 will help illustrate actions to take depending upon relative position. First off, you want to keep the bloke in sight until the danger is past. In "D" Figure 1, a turn in his direction of movement would mean that you would lose control. In a near collision situation you wouldn't know when to turn back. Best

Figure 1

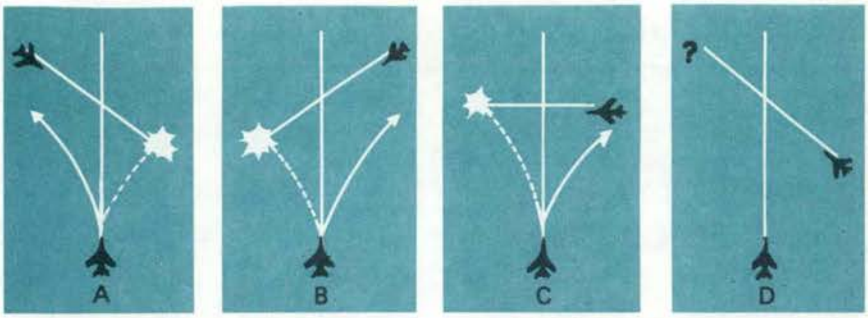


Figure 2

Each person has a blind spot, normally about 30° right of center, looking straight ahead. To find your blind spot hold this page at arms length with both eyes open, focusing on the cross at left. Bring the page in until it almost touches your face. With both eyes open you should not lose sight of the airplane (right). Close your left eye and try again, right eye focused on cross. The airplane should disappear and reappear as you draw the page closer.

action – if he is descending, climb.

When both aircraft are pointed at each other – headon – and in level flight, turn down and right to keep him in sight. If the above conditions exist but you don't know his altitude, look for clues like belly or underwing showing. If you see the top of the aircraft, fly up and right. You may lose sight of him, but you will be increasing separation.

See and Avoid is so important because uncontrolled aircraft frequently are not seen on radar. Up there in positive controlled airspace all aircraft are relatively safe. Not so in other types of controlled airspace such as the traffic pattern. (A NASA study showed that from July 1976 to November 1978, 65 percent of the near misses reported occurred in TCAs.) It's up to each crew to look out and keep track of other aircraft. Radar is invaluable but not if it doesn't see a light plane on a collision course with you, for instance.

Once you've acquired vision of another aircraft, you must keep track of him and assume he doesn't see you. The wisdom of this is underscored by a finding in the San Diego collision by the NTSB. The first finding, announced as this is being written, was that the crew of the B-727 lost track of the Cessna,

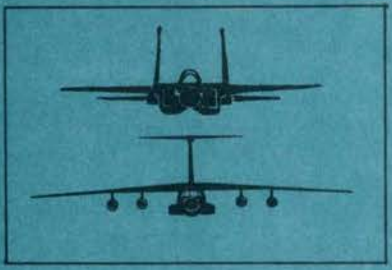
Figure 3

TEST YOURSELF

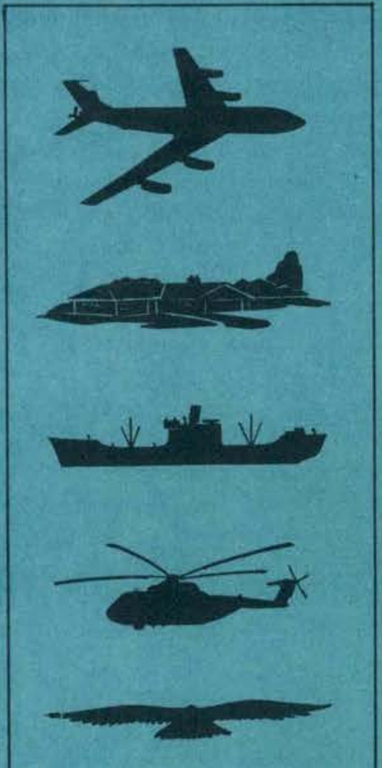
COVER THE BOXES AT RIGHT WITH YOUR HAND AND READ THE INSTRUCTIONS BELOW

What do you see? Below are silhouettes of various objects, including aircraft. Concentrate your gaze on the spot labeled "Focus Here." Which of the aircraft represent a threat? Which is the biggest? Are they coming or going? Identify the various objects.

This test should give you some idea of how good (poor) your peripheral vision is. Remember that your eye will be focused at the same distance as these examples and there is good contrast. Compare this to the varying conditions in flight and draw your own conclusions as to your visual limitations.



• FOCUS HERE



the most probable cause.

Controllers are sometimes bad-mouthed by pilots, but most of us respect their ability and their responsibility. They have prevented countless midairs. But sometimes there is a glitch in the system; Murphy works here, too. Therefore, the prudent pilot, while appreciating anything the controller does for him, accepts responsibility for his own aircraft.

Flying has little room for assumptions. If you lose sight of other traffic you can't assume he will maintain his present course or that he has seen you. Frequently he hasn't. Daily, the message traffic contains HATRs and NMACs wherein the Air Force pilot either sees or is advised of traffic and takes evasive action without the other guy taking any action. These are usually light airplanes not on a flight plan and not in touch with any controlling agency. Much of the time they don't appear on radar. However, if radar sees one, reports to you and you lose the target, don't be afraid to ask where he went. Your friendly controller will oblige.

Some fine advice is contained in the AIM. In addition to the quotation which began this article, the following points can help you have a good day.

Pilot:

- Acknowledge receipt of traffic advisories.
- Inform controller if traffic in sight.
- *Advise ATC if a vector to avoid traffic is desired.*
- Do not expect to receive radar advisories on all traffic. Some aircraft may not appear on the radar display. Be aware that the controller may be occupied with higher priority duties and unable to issue traffic for a variety of reasons.
- Advise controller if service is not desired.

Controller:

- Issues radar traffic to the maximum extent consistent with higher priority duties except in positive controlled airspace.
- *Provides vectors* to assist aircraft to avoid observed traffic *when requested by the pilot.*
- Issues traffic information to aircraft in the airport traffic area for sequencing purposes.

See and Avoid: Pilot – when meteorological conditions permit, regardless of type of flight plan, whether or not under control of a radar facility, *the pilot is responsible to see and avoid other traffic,* terrain and obstacles.

If a controller calls traffic that sounds too close, depending on conditions, ask for a vector – or if enough information is given start a turn to increase separation and advise the controller. The above underlined points highlight the responsibility of both the pilot and the controller under the present rules. The necessity of being constantly alert for VFR traffic especially outside of positive control cannot be overemphasized. ■

OK IS NOT OK!

Why not? Okay for starters let's look at one likely misuse of OK. Suppose we have an aircraft tooling along at the highest altitude in our sector of airspace at a busy time and the pilot requests a change to a specific higher altitude (not in our sector). Further suppose that our reply is "OK, stand by." Now suppose the pilot only hears the "OK" and starts the altitude change. Things could become not-so-OK in a hurry. Can't happen? It can, but it shouldn't!

Okay, to add to the problem, the controller in this theoretical incident misused OK to acknowledge receipt of the pilot's request, not to approve it. But how is the pilot to know that? If he's sharp, he'll request confirmation or otherwise realize that specific clearance to "climb and maintain" was not received. But, he may not, especially if he has become accustomed to using or receiving sloppy phraseology. Similarly, when aircrews acknowledge with "OK" it's difficult to know whether they mean "roger," "affirmative," "will comply," "that's correct," or something else.

According to most dictionaries OK and Okay are used primarily to express agreement or approval. OK means "approved" not "stand by" and not "Message received, reply follows." But in ATC, OK is not approved phraseology, and it's not "Professional"—OK is not OK in ATC!—(FAA Air Traffic Service) ■

THE PROFESSIONAL APPROACH

Air Force Communications Service
Scott AFB, IL

■ Almost in the beginning, life was simple and easy for a pilot and a controller. There was one pilot per plane, one tower controller, one control frequency, and one sky. Everyone was happy and if the radio was working, the pilot knew everything that was going on in the sky.

Then along came radar and another controller and now the sky was divided. Another frequency was added to keep the congestion down. Still everything was all right. A pilot still was aware of everyone in the immediate area because they were all on a common frequency.

Then along came precision radar (PAR), and things began to get complicated. The pilot on final approach wanted to have neither the tower controller and the tower controlled aircraft, nor the radar controller with the radar controlled aircraft, on the frequency while trying to fly an aircraft using instructions from a radar final controller. Now everyone was unhappy. The pilot demanded a discrete frequency for final approach so other instructions would not interfere with instructions from the final controller.

Then along came more controllers, more pilots, more frequencies and less sky in which to fly. Pilots were changed from ground, to tower, to departure, to approach, to arrival, and finally to the final controller frequencies. The pilot was now forced into a disorienting maneuver of changing frequencies in the weather, in close proximity to the ground during a turn. The pilot was now unhappy and annoyed with this harrassment until someone came up with the idea of a complete approach on one single frequency. Since the pilot normally flew a precision approach by radar, this frequency was more often than not a "single frequency approach (SFA)" on a discrete frequency. Now things looked brighter for the pilot. Pilots came to expect SFA and their habits were reinforced by air traffic controllers supplying a single frequency discrete approach.

Then along came the ILS which eventually replaced the PAR at most locations. The deletion of the PAR was accompanied by the deletion of discrete frequencies that were justified by it. The pilot started to worry again. The controller advertised "SFA" in the en route supplement but in most cases did not provide it for an ILS approach. This placed the pilot back in a hazardous situation of changing frequencies at a time when he should be smoothing off the rough edges of a final approach with two or three aircraft hanging on the wing.

What does your base advertise? If SFA is in the communications section of the en route supplement, are you complying with the advertisement? Does a letter of agreement (LOA) with an FAA facility state that the FAA will send the aircraft to your tower frequency at or prior to the final approach gate? If it does, you should not advertise SFA or you should change your LOA to let the FAA clear the aircraft to land after the FAA has accomplished coordination with your tower. Base operations, wing commanders, DOs, flying safety officers and air traffic control operations personnel should all review local and published procedures to ensure safe and expeditious flight and make sure ILS approaches are also handled as SFA. Air traffic control managers along with flying safety people should explain to the aviator in detail the differences between discrete approach frequencies (frequencies where one pilot only is on one frequency such as a PAR) and single frequency approaches (a service provided under a letter of agreement to military single piloted turbojet aircraft which permits use of a single UHF frequency during approach for landing). It should be noted that the FAA considers, in certain cases, a discrete frequency as one that is assigned to an area or sector for control use only in that sector. ■

pounds-per-gallon fuel at 60°F. Therfore, if 6-pounds-per-gallon fuel were loaded, it would be on the low side of the specifications and loaded at 130°F or higher.

Fuel choice is often based on the elements; weather is an important factor in any operating plan. For example, an aircraft departing Honolulu with full tanks of JP-4, on a given day, would reach its destination with relative ease. But, some time later, the same aircraft, departing on the same route and facing adverse winds would require more pounds of the same JP-4 than was used on the first trip and more than the tanks would hold (the aircraft range would be "fuel volume limited" with JP-4), so a different fuel offering a greater density, Jet A or Jet A-1, would have to be used.

There is a move to increase the maximum allowable freeze points in order to increase the availability of aircraft turbine fuel. Availability can be increased by including a heavier hydrocarbon in the refining process which will raise the fuel's freeze point. The producers have traditionally targeted the freeze point to be several degrees below the user's requirement. This ensures compliance with specifications should something happen to cause a variance in the properties during the refining process.

As petroleum products become scarcer, the producers begin to crowd the margin between the maximum allowable freeze point and the desired freeze point of the fuel they produce. It is an advantage for them to take the lighter fractions (figure 2) that they would normally make into aviation fuel, and sell it in another market for production into still lighter combustibles not associated with jet fuels. Generally, margins on freeze points of jet fuels are decreasing.

Douglas recommendations relevant to maintaining indicated tank fuel temperature at some margin above freeze points of fuel were contained in a recent DC-10 All-Operators Letter which reads in part:

Some operators are prohibited by regulation, or company policy, from dispatching into areas where forecast air temperatures are below certain values related to fuel freeze points and margin recommendations. A fuel temperature indicating system improvement will allow these operators greater freedom in route selection and flight planning. Current Douglas recommended operation is to maintain a margin of 5°C between indicated tank fuel temperatures and the freeze point of the fuel being used. If indicated fuel temperature cannot be maintained above this level and the flight continues for 30 minutes or longer at flight altitude, the flight crew should consider measures to increase total air temperature and limit fuel cooling. Total air temperature may be increased by increasing Mach number or by altering the flight path into warmer air by course changes or altitude reduction.

The recommended margin is based on fuel temperature indicating system tolerances, fuel system configuration and operation, and fuel physical property considerations. A reduction in the recommended fuel temperature margin from 5°C to 3°C may be effected on DC-10s by installing indication system components.

It should be remembered that aircraft instrumentation doesn't differentiate as to type of fuel used, but only indicates what is happening with a particular fuel aboard. Because of difficulty in determining the actual freeze point of a fuel batch as delivered to the aircraft, or resolving the actual freeze point of a tank of fuel which most likely is a mixture of other batches, all with varying freeze points, the airlines tend to look at the allowable maximum freeze point for the fuel purchased.

Fuel will naturally absorb water from the atmosphere when it is stored in vented tanks; the amount absorbed depends upon humidity and the temperature of the fuel. As the fuel temperature increases, its water solubility (the amount of water that fuel will absorb) increases, but as the temperature decreases the water comes out of solution, precipitates, and settles to the bottom of the storage tank. When fuel is loaded into the aircraft (at ground temperatures) and flown for a period of time, the fuel temperature reduces significantly and again the water remaining in the fuel settles to the bottom of the tanks. Some water will enter the sump areas where it could freeze if the temperature lowers sufficiently. If this were to happen, the ice crystals suspended in the fuel would be carried through the feedlines and accumulate on the filter. Eventually, the crystals would bypass the filter and move on toward the fuel control. Most aircraft, however, are equipped with various fuel heating methods to prevent ice crystals from progressing that far. The CF6 engine on the DC-10 uses a fuel/oil heat exchanger. It is located upstream of the fuel filter ensuring that any existing ice will be melted before it reaches the control. The Pratt & Whitney engines on the DC-10 use a demand heating method, which is operated either manually or automatically.

Aviation turbine fuel has a reputation for high quality; transported by ships, barges, or through pipeline systems to the terminal and then to an aircraft, it is filtered and processed through water separators several times. At the airfield, the fuel passes through a filter/separator one more time before it is pumped to the aircraft fuel tanks.

Fuel tanks are never fully water-free and sumps are provided to catch moisture that drains to the tanks' lower areas. This water can be withdrawn before operational problems develop, or before some microbiotic contamination causes corrosion.

Douglas transports are fitted with continuous scavenger systems either at the factory or through retrofit. The system does not replace manual tank sumping, but it does pick up water which runs to the bottom of the tank and helps to prevent water accumulation. A fuel-driven pump picks up the water, mixes it with fuel, and places it near the inlet of the fuel tank pump. It is then fed to the engine in very small percentage mixtures, which the engine can handily accept.

Fuel additives tend to limit icing, electrostatic generation and excessive fuel pump wear. Corrosion inhibitors are usually added to fuel systems to prevent rust in the pipeline, which can cause a rouge (a powder similar to jeweler's rouge) contamination in the fuel. The rouge particulate is extremely small and difficult to filter out. While this type of contaminant will not likely cause a clogging problem, it can cause wear on moving parts.

To increase jet fuel availability, there are moves afoot in the industry to broaden specifications by broadening the range of acceptability for parameters that define fuel specification. As previously mentioned, maximum allowable freeze points are going to be adjusted upward. The aromatic contents of jet fuel made to the various specifications have different limiting values: 25 percent in military fuels and 20 percent in commercial specifications. The commercial specifications are being changed to allow an increase, first to 22 percent and then probably to 25 percent, to match military allowances. The smoke point will be reduced from the current maximum allowable of 20mm to 19, and eventually to 18mm with the control on maximum allowable percentage of naphthalenes. In some military specifications, these parameters which control the burning quality of the fuel may be replaced by hydrogen content. Another move is to allow the same hydrogen specifications in commercial jet fuel.

The minimum allowable flash point of commercial fuel is currently 100°F, a reduction from about 120°F. Because the availability of fuel would increase if more range were allowed on the lighter ends (except lower-boiling hydrocarbons), it is then suggested that the minimum allowable flash point for Jet A be lowered to approximately 90° or even 80°F.

The word "availability," which we have used several times, does not imply more available crude oil for the world; nor is there going to be more product from a barrel of crude. If we should broaden the fuel specification, we allow a wider cut on the distillation curve, giving us access to more hydrocarbons available from a barrel of crude. Also, we are becoming less choosy about other fuel qualities.

Safety is paramount of course, and should not be compromised; therefore, in the competition for hydrocarbons it may be necessary to live with shorter time between overhauls of expensive engine components. In the future, there may be restrictions on fuel from current petroleum sources. This could come about either through political decisions or through depletion of natural supplies. But the petroleum industry is constantly researching alternative sources for jet fuel. – Edited from *Douglas Service Magazine*, Jan/Feb 1979. ■

MAIL & MISCELLANEOUS

THE CARE AND FEEDING OF ATTACHED CREW MEMBERS

■ To the advice offered in Dave Froehlich's excellent article on "The Care and Feeding of Attached Crew Members," (*Aerospace Safety,* February 1979) I would add, for the unit and flier, coordinate the scheduling as far ahead as feasible and spread out the limited sorties on as even a basis as possible. Get as much training benefit from each flight as can safely be worked in. One regular mission each Wednesday goes a heckuva lot farther than four back to back with a four week dry spell (admittedly tough to do in many attached flying situations).

For the attachee, bend your schedule to make a planned mission. There are always a hundred less important but more pressing things to do than go fly.

For those involved in reduction of overhead and attached fliers to make more sorties available for primary duty aircrews, I suggest the surgical vice the meat axe approach. There are benefits for staff familiarity (recent) with pre-flights in the cold and rain, air traffic control saturation, last minute diverts and mission changes, etc.

Col A.S. Warinner, attachee,
formerly attachor
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APO San Francisco 96301

BAILOUT

I have a small collection of aviation magazines from the early 60's that I was going through the other day. A couple of copies of *TAC Attack* from 1964 and 1965 caught my eye and I thought it might be interesting to see if "things" had changed.

Everyone in safety knows there are no new accidents. A review of the prangs of 15 years ago seems to confirm this. There are other things that catch the eye, though. In January 1965 TAC experienced twelve major non-combat accidents. There also seems to be more professional pride in flying as opposed to management in those articles. A lot of the thrust is directed toward a balance between aggressiveness and safety.

I did see something in those magazines that I haven't seen elsewhere in quite some time. The message was: "If you have a sick bird, get out. You aren't being paid to fly bad airplanes."

That made me wonder whether the lack of emphasis on that message might be a factor in the decreasing ejection survivability statistics. Naturally, there has been a lot of emphasis on the cost of hardware. At the bottom of each Well Done page is the statement ". . . saved a valuable combat aircraft." In '64 and '65 those pages ended with: ". . . was able to bring his aircraft to a safe landing so investigators were more able to find the cause of the malfunction," or, ". . . presence of mind and proficiency under extremely adverse conditions qualify him as Pilot of Distinction." Again I wonder if we don't, just a bit, make the aircrew too aware of the cost of their airplane and its place in the maintenance of the peace and security of the free world. I don't remember the last time I saw the one about always being able to build more airplanes.

I know of two incidents where the crew might have bailed out but didn't. In the first, a B-52 descended below the glide slope and struck some areas in an almond grove. The airplane continued through the trees for a bit before the pilot brought it out. The EWO told me (that) as the sound of the trees breaking started he looked at the gunner, both blew their hatches, then waited for the other to bail out. They were lucky. The second Buf lost some engines on takeoff, mushed along for a while and crashed about a mile from the end of the runway. Five were killed.

I don't know why those people didn't depart the airplane. I don't know that the fact the airplane didn't crash is justification for staying with it. Out of the envelope ejection is the leading killer of those who didn't make it. Unfortunately, by the time it becomes obvious the airplane isn't going to make it, the seat probably won't either.

It is fine to make up your mind to eject in a specific situation; in fact it is necessary. The problem lies in those situations that don't quite meet your ejection criteria. I submit that at those times when you are bombarded by all the factors in the emergency, there may be a subconscious desire to save one for the Gipper.

At the risk of offending the Gipper, I don't think he would mind you saving one for yourself. ■

Capt Bruce E. Slasienski
453 FTS
Mather AFB, CA 95655

☆U.S. Government Printing Office: 1979—683-011/8

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.

CAPTAIN **Joseph J. Mastascusa**

CAPTAIN **Wendell Johnson**

429th Tactical Fighter Squadron

Nellis Air Force Base, Nevada

■ On 28 June 1978, Captains Mastascusa and Johnson, flying an F-4D, were returning from a low level navigation/air-to-ground training mission. Immediately after touchdown, the right wing dropped and the aircraft entered a severe, uncontrollable drift toward the right edge of the runway. Captain Mastascusa applied full left rudder and aileron while simultaneously adding full afterburner thrust for go-around. These corrective actions arrested the aircraft's drift toward the GCA facility, although the aircraft departed the runway surface and continued on the hard packed sand infield for approximately 1000′ before becoming airborne. A chase aircraft informed the crew that the right main wheel was missing, as well as the aft section of the right external fuel tank. Quickly analyzing their alternatives (fuel supply was critically low), the crew elected to execute a gear-up, cable arrested landing. They retracted the gear, jettisoned their centerline SUU-23 gun pod in the published jettison area, and reviewed gear-up landing procedures with the SOF. Meanwhile, the base fire department foamed the first three thousand feet of the runway. With only a thousand pounds of fuel remaining, the crew performed a controllability check while maneuvering for a straignt-in approach. When Captain Mastascusa lowered the flaps the aircraft rolled violently. He immediately raised the flaps and Captain Johnson computed a no-flap final approach speed. The crew performed a perfect gear-up, no-flap, cable arrestment. The only damage incurred was to the two external wing tanks. Post flight inspection revealed that the right main gear strut cylinder fork had failed at touchdown. The wheel and tire assembly then impacted the right trailing edge flap with sufficient force to break the flap actuating rod. This crew's instant reaction to a critical emergency and their subsequent superior airmanship, crew coordination and sound judgment saved a valuable aircraft and averted possible injury or loss of life. WELL DONE!

The safety plaques are awarded to units below MAJCOM level, except for the Flight Safety Plaques for units below Air Division level. Award is based on outstanding safety achievement.

1978 USAF Safety Plaques

EXPLOSIVES SAFETY

AAC
5010th Consolidated Aircraft Maintenance Squadron
AFSC
Air Force Weapons Laboratory
Armament Development and Test Center
ATC
3290 Technical Training Group
NGB
107th Fighter Interceptor Group
PACAF
51st Composite Wing (Tactical)
SAC
1st Strategic Aerospace Division
TAC
1st Special Operations Wing
33d Tactical Fighter Wing
366th Tactical Fighter Wing
USAFE
26th Tactical Reconnaissance Wing
48th Tactical Fighter Wing
52d Tactical Fighter Wing
81st Tactical Fighter Wing
86th Tactical Fighter Wing

FLIGHT SAFETY

AAC
5010th Combat Support Group
AFCS
1866th Facility Checking Squadron
ATC
14th Flying Training Wing
557th Flying Training Squadron
Officer Training School
AFSC
3246th Test Wing
ADCOM
17th Defense Systems Evaluation Squadron
57th Fighter Interceptor Squadron
87th Fighter Interceptor Squadron
AFRES
302d Tactical Airlift Wing
403d Rescue and Weather Reconnaissance Wing
508th Tactical Fighter Group
911th Tactical Airlift Group
MAC
33d Aerospace Rescue and Recovery Squadron
39th Aerospace Rescue and Recovery Wing
53d Weather Reconnaisance Squadron
62d Military Airlift Wing
63d Military Airlift Wing
76th Military Airlift Wing
374th Tactical Airlift Wing
375th Aeromedical Airlift Wing
436th Military Airlift Wing
437th Military Airlift Wing
463d Tactical Airlift Wing
NGB
102d Fighter Interceptor Wing
107th Fighter Interceptor Group
165th Tactical Reconnaissance Squadron
174th Tactical Fighter Group
184th Tactical Fighter Training Group
189th Air Refueling Group
192d Tactical Fighter Group
PACAF
8th Tactical Fighter Wing
15th Air Base Wing
475th Air Base Wing
SAC
6th Strategic Wing
42d Bombardment Wing
43d Strategic Wing
380th Bombardment Wing
416th Bombardment Wing
TAC
1st Special Operations Wing
24th Composite Wing
27th Tactical Fighter Wing
347th Tactical Fighter Wing
366th Tactical Fighter Wing
507th Tactical Air Control Wing
552d Airborne Warning and Control Wing
USAFE
20th Tactical Fighter Wing
50th Tactical Fighter Wing
86th Tactical Fighter Wing
401st Tactical Fighter Wing

MISSILE SAFETY

AAC
343d Equipment Maintenance Squadron
5010th Consolidated Aircraft Maintenance Squadron
ADCOM
Air Defense Weapons Center
5th Fighter Interceptor Squadron
10th Aerospace Defense Squadron
57th Fighter Interceptor Squadron
318th Fighter Interceptor Squadron
4751st Air Defense Squadron
4756th Air Defense Squadron
AFSC
Armament Development and Test Center
Space and Missile Test Center
Det 1, Space and Missile Test Center
NGB
107th Fighter Interceptor Group
PACAF
8th Tactical Fighter Wing
51st Composite Wing (Tactical)
SAC
42d Bombardment Wing
416th Bombardment Wing
44th Strategic Missile Wing
90th Strategic Missile Wing
321st Strategic Missile Wing
TAC
33d Tactical Fighter Wing

NUCLEAR SAFETY

ADCOM
Det 3, 425th Munitions Support Squadron
AFLC
3097th Aviation Depot Squadron
MAC
6th Military Airlift Squadron
NGB
107th Fighter Interceptor Group
SAC
42d Bombardment Wing
43d Strategic Wing
319th Bombardment Wing
341st Strategic Missile Wing
4235th Strategic Training Squadron
USAFE
20th Tactical Fighter Wing