AEROSPACE

SAFETY • MAGAZINE FOR AIRCREWS MAY 1979

THE WAY IT WAS — complacency revisited

BE THE BEST — a professional look at professionalism

HOW HIGH IS YOUR ENDURANCE? — how long can your flight endure?

DUCKING UNDER: — performance and prevention

THE PROFESSIONAL APPROACH

Air Force Communications Service
Scott AFB, IL

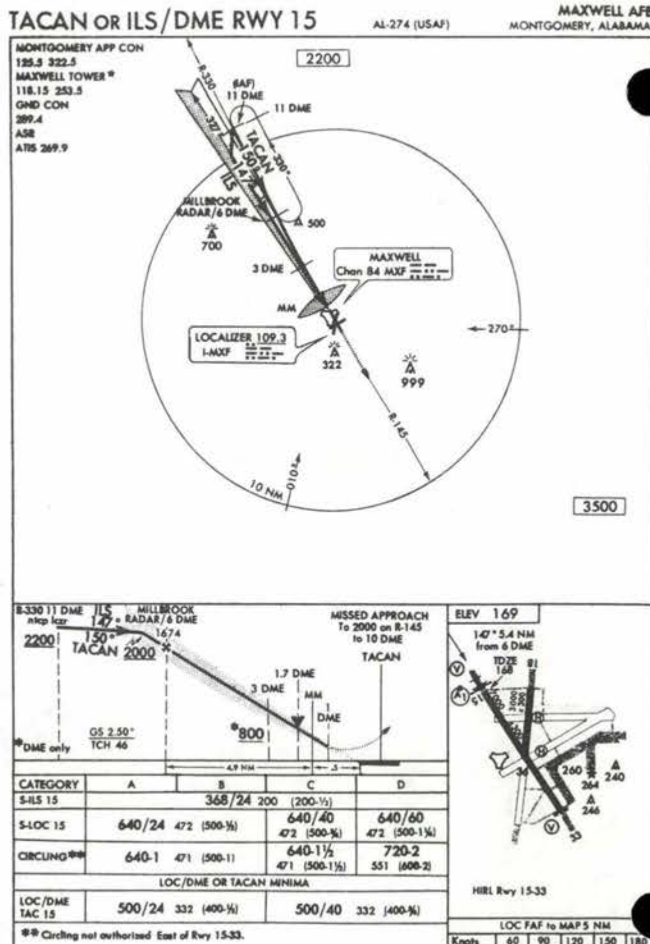
Recently a Hazardous Air Traffic Report (HATR) was generated concerning the "TACAN or ILS/DME Rwy 15" approach procedure for Maxwell AFB (right). The problem stemmed from the application of the 800 foot restriction for DME equipped aircraft. In the procedure, an aircraft with DME is restricted to 800 feet at 3DME, a step-down-fix (SDF), but without DME can go down to 640 feet (LOC minima) anywhere between the Final Approach Fix (FAF) and the runway threshold. To the pilot this restriction seems confusing and, at first glance, there doesn't seem to be any reason for it. Though there are very few approaches with this type of restriction, we feel an explanation is in order.

Under most circumstances, a step-down-fix altitude will appear as an MDA if the SDF is not received. The SDF/MDA altitude is usually due to an obstacle in the final approach segment between the FAF and the SDF. Thus, if the SDF is not received, there is no way to identify obstacle passage and the MDA will be higher. Of course, if the SDF is identified, a lower MDA will be authorized. In the case of the TACAN or ILS/DME Rwy 15 for Maxwell AFB, the SDF is only applicable to DME equipped aircraft and the altitude is higher than either the TAC or LOC MDA's. The reason, in this instance, is a combination of descent gradient and obstacle clearance. The descent gradient for this type of approach, according to the Terminal Instrument Procedures (TERPs) manual, can be no more than 400 feet per nautical mile in the final approach segment. The TERPs manual also states that neither the gradient from the FAF to the SDF, nor the gradient from the SDF to the runway threshold, can be more than 400 feet per nautical mile. The 800-foot altitude at 3DME is the lowest altitude that can be published and still comply with the intent of AFM 55-9 (TERPs). It results in a descent gradient of 400 feet per nautical mile between the FAF and the SDF. An altitude of 640 feet at the SDF could be used for obstacle clearance, but this would result in a descent gradient of 453 feet per nautical mile between the FAF and the SDF. If an aircraft is not DME equipped, it can only descend to LOC minima and there is no need for a SDF. Descent gradient in this case is figured between the FAF and the runway threshold resulting in a gradient of 339 feet per nautical mile.

In an effort to reduce pilot confusion with this type of SDF, action is being taken to separate the TACAN and ILS approaches for Maxwell and other bases. There still remains, however, some FAA and host nation procedures with this type of restriction.

FLIP DISTRIBUTION

In the past, several units have had problems receiving their FLIP products on time. In addition, some have had problems receiving the correct number. The normal sequence for FLIP distribution is from the contractor who is under contract to the Defense Mapping Agency Aerospace Center (DMAAC) to the local base account office (normally base operations) where it is distributed to the local units. If you are not receiving the correct number of publications, or receiving them late, check with your local account manager to verify you are on correct distribution. If this does not provide any solutions, follow-up action is required. Call HQ AFCS/FFOS at AUTOVON 638-5479; we will try to have the problems corrected. ★



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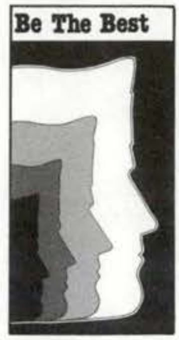
SPECIAL FEATURES


page 2



page 10

The Way It Was **2**

Ride the Wild Horse — Part Two **6**

Be the Best **10**

How High Is Your Endurance? **14**

Your System May Be Reliable, But Is It Safe? **16**

Problems to Anticipate With the Growth of Marijuana Smoking **18**

Ducking Under: Performance and Prevention **24**

REGULAR FEATURES

The Professional Approach .... IFC

News for Crews 5

Ops Topics 13

Well Done Award 28

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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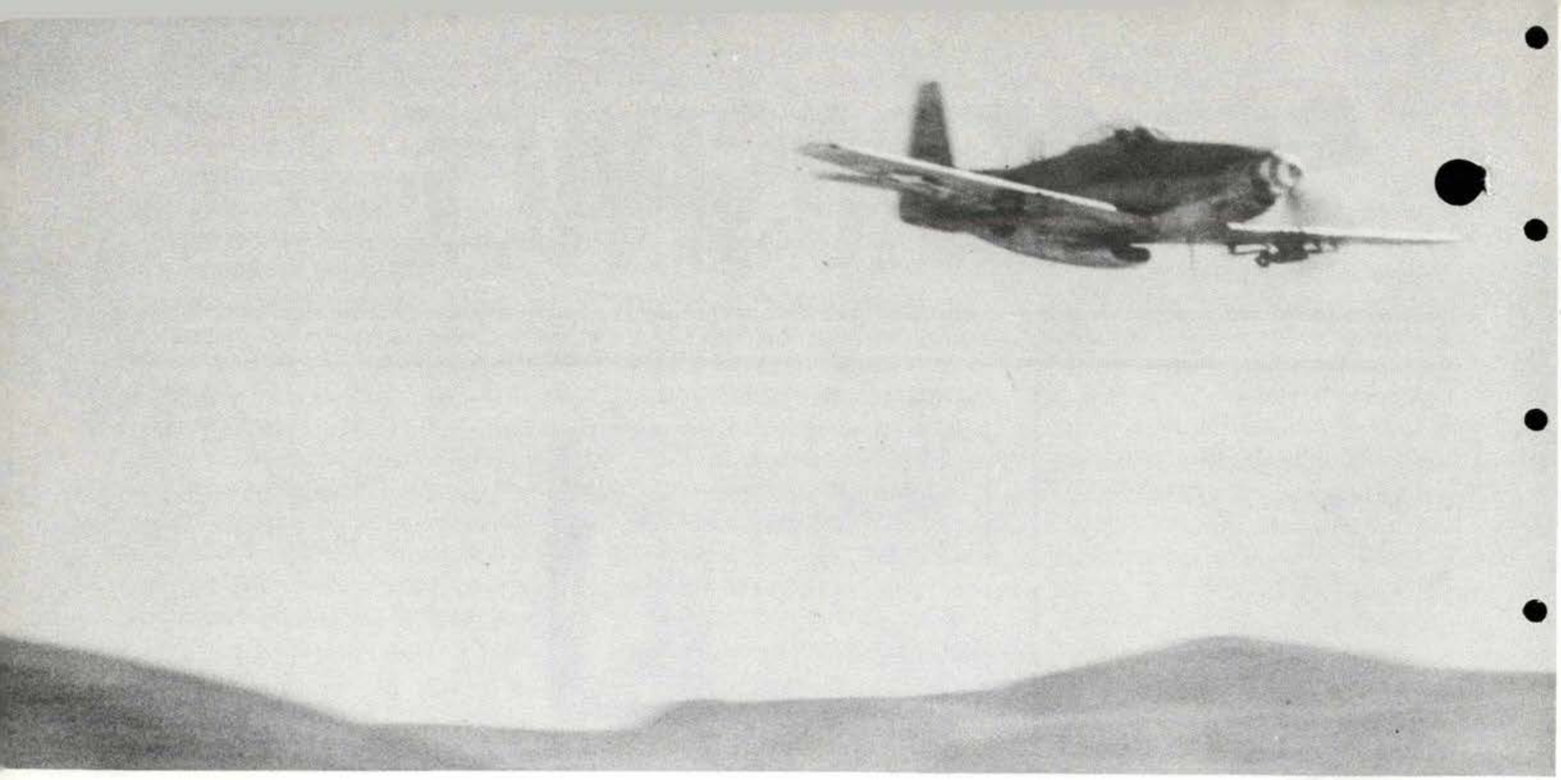


It was a bright, crisp, June morning, nearly 26 years ago, when the F-51D Mustang roared off the asphalt runway for a typical ADC solo training mission – practice GCI letdowns, GCI intercepts, practice aerobatics and another look at the New England countryside.

"What a great way to earn a living," thought the second lieutenant as he took his Mustang through a series of barrel rolls, Immelmanns and eight-point aileron rolls – the latter particularly suited to the aircraft's big, effective rudder and the pilot's long legs. He really felt good in the airplane, with a year of experience since graduation from aviation cadets and 700 hours of total time – over 400 of it in the 51. And, he had been flying a lot lately.

The lieutenant also felt that he had the confidence of his unit supervisors. He had recently qualified as expert in air-to-air gunnery (firing on the rag) and had been upgraded to element leader. He had recently led a flight of two Mustangs on a weekend cross-country. His ops officer had advised, "I don't care where you go on your trip, just have the airplanes back for 0730 Monday morning." The lieutenant had made it back with 5 minutes to spare.

There was no doubt that the lieutenant had a high degree of self-confidence. In fact, he thought he was the hottest fighter pilot since Dick Bong. Little did he know that he would soon be involved in a major aircraft accident that would burst his bubble and influence his future career plans.

The lieutenant really enjoyed this kind of "lone wolf" mission, where he could do whatever he wanted to do for 2 hours, with no supervisor. In the winter, he would buzz the ski slopes and the ice shanties on the lake. This time of year it was the swimmers on the beach, the sailboats, and the prisoners on their exercise break down at the Federal Penitentiary. The greatest sport was to hang and wait for a fellow squadron member to come up, bounce him, and mix it up in a mock dog fight.

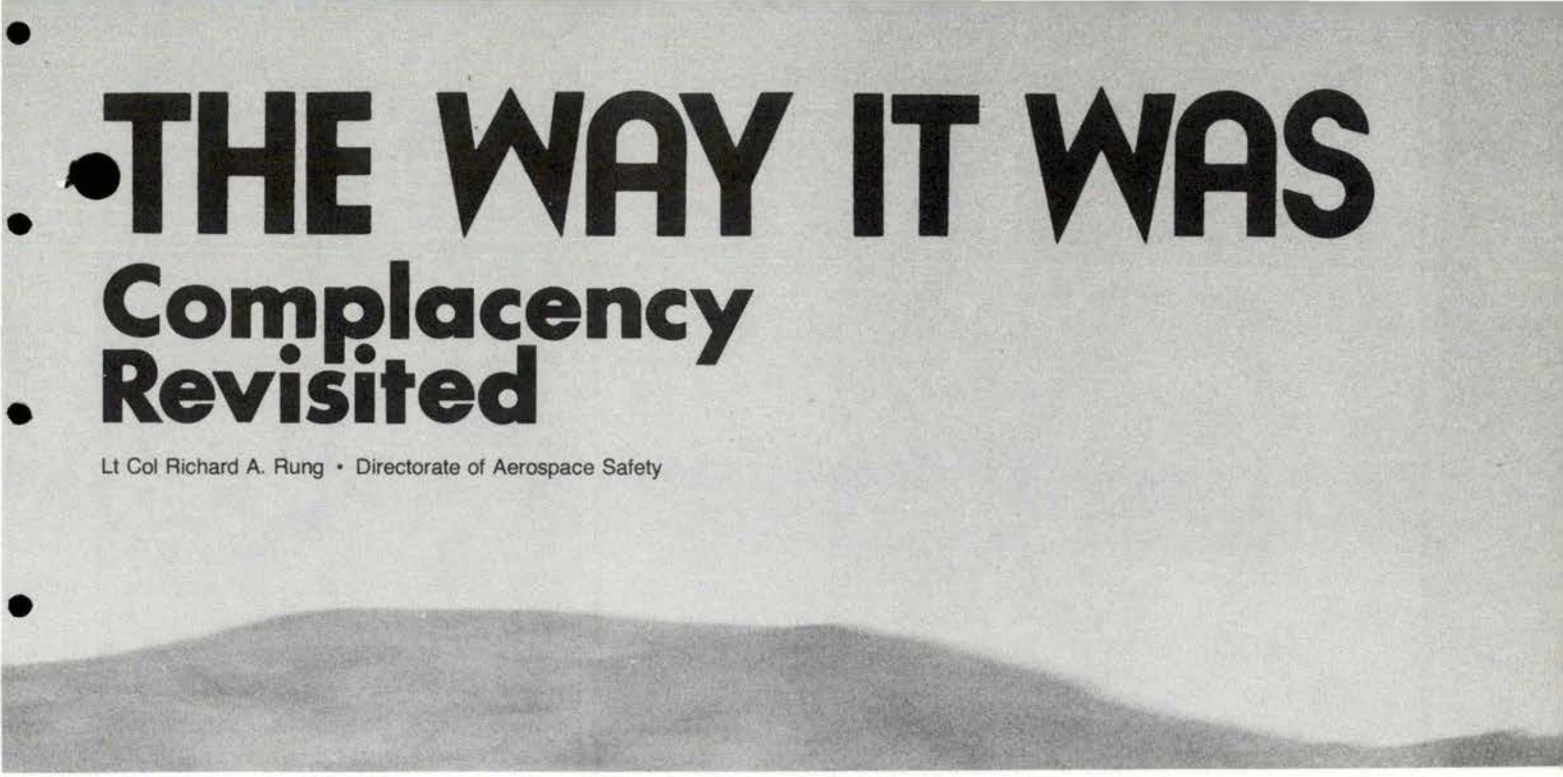
Today, however, was rather dull. Nobody came up to challenge his dominance of the skies, and the crosswind prevented his flying under the bridge today. No use taking chances.

The fuel gauge and the clock indicated time to land. The lieutenant made his split-S letdown, entered traffic and pitched out for a 360-overhead pattern. On downwind, he went through a quick GUMPF check – Gas (fullest tank selected), Under-carriage (gear down), Mixture (full forward), Prop (set for go-around rpm), and Flaps (full down).

But HOLD IT! The landing gear is not indicating "in the green." No problem. Check the bulb – no good. Hydraulic pressure – fine, 1,000 psi. No warning horn. Just a bad bulb.

Turning final, the lieutenant asked mobile to check his gear as he went by, as a precaution. He added power, floated past mobile about 15 feet in the air, got a "looks good" from mobile, and flared out, touching down a few hundred feet past the mobile unit.

He allowed the aircraft to slow down by rolling straight ahead for a few thousand feet, realizing that he was going too fast to make a left turn off the runway at the taxi strip to the Air Force area. After rolling a few hundred more feet, applying brakes, he elected to do a 180-degree turn and return to the taxiway. He moved the stick forward to unlock the tailwheel to full swivel and applied right brake



THE WAY IT WAS

Complacency Revisited

Lt Col Richard A. Rung • Directorate of Aerospace Safety

to start the turn.

Then it happened. The aircraft began a mild groundloop to the right, and the pilot countered with left brake in an attempt to regain control. The aircraft turned right quickly through 90 degrees, nosed up, and struck the propeller on the runway. The plane then settled back heavily on its tailwheel. The damage: Substantial. Three prop blades bent, sudden stoppage of the engine, and wrinkles in the fuselage aft of the radiator. Total cost for repair: $21,476, including 120 manhours of labor – $360. The pilot was not injured.

The accident investigating board did a good job in identifying the pilot error:

Finding 1. The pilot used poor judgment in estimating his taxi speed and prematurely unlocked his tailwheel causing him to lose directional control of his aircraft.

Finding 2. The pilot misused his brakes in that he applied excessive pressure, causing the aircraft to nose up.

Recommendations:

1. Pilot review all existing directives covering all phases of taxiing and ground handling of the aircraft.

2. Continued emphasis be placed on the need for constant supervision in maintaining the above mentioned discipline.

The board did a good job – *as far as it went*. Today, under the all-cause system of assigning causes to aircraft mishaps, investigating boards are instructed to probe deeper for root causes and try to answer the question: "Why?" "Why did the pilot err?" Under this system, any deficient act, omission or condition, which, singly or in combination with other causes contributed to the mishap, and which, if corrected, eliminated or avoided could have prevented the mishap, would also be designated as a cause. Boards also look closely at human factors to determine if any of these influenced the pilot's actions.

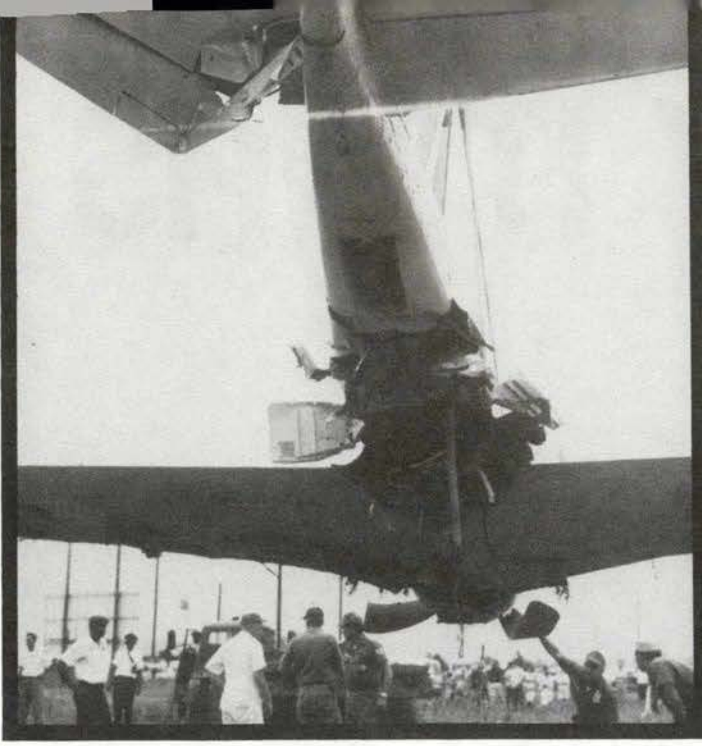
Deep in the catacombs of the Air Force Inspection and Safety Center's repository for aircraft mishap reports, this F-51D mishap report was discovered on microfilm. The old Form 14 (today's AF Form 711) revealed some enlightening facts:

First pilot time:
- last 90 days – 208:50
- last 30 days – 85:00
- last 24 hours – 8:50

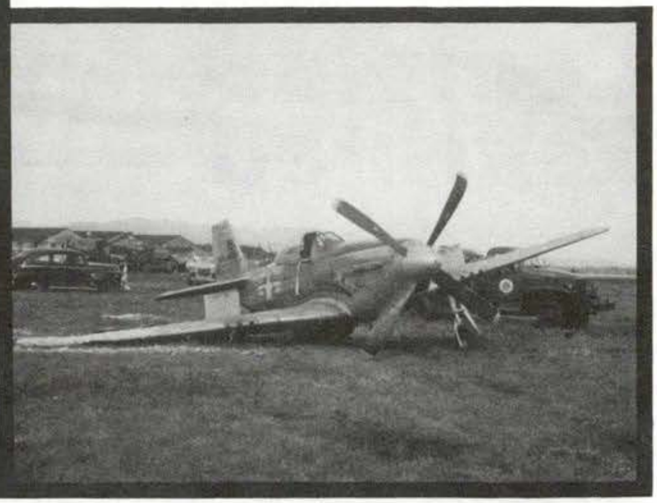
Board testimony also revealed that the pilot had been on ADC alert for the 24 hours preceding the flight, had been relieved from alert, and had proceeded directly to his aircraft for start engine. Takeoff was at 0730 and the mishap occurred at 0930. While on alert, he had flown six missions, logging 6 hours and 50 minutes, including 3 hours and 5 minutes of night time, landing at 2350 the night before the mishap.

The board members were apparently concerned about crew rest, but didn't draw any conclusions or make any recommendations. Board testimony went like this:

Q. What time did you get up?
A. 0630.
Q. Had you flown the night before?
A. Yes. Three hours and 50 minutes. All night time. Landed at 1150.
Q. How much sleep had you had the night before?
A. From 1230 'till 0630 – 6 hours.
Q. Do you feel you were under any undue stress because of fatigue brought on by previous work commitments?
A. I believe that there is a factor there – that a man may



They used to say "any landing you can walk away from is a good one." That's what they used to say. We don't say that today.



feel alert and not tired, but there may be a subliminal fatigue. As far as I was concerned, I wasn't tired at all that morning, but as I said, it may have been a factor.

Q. Do you often fly 8 hours and 50 minutes a day in the Mustang? Is that squadron policy?

A. As far as I know, there is no limit as to how many hours a pilot can get in a day.

The commanding general of the Eastern Air Defense Force, in his through-channels indorsement, also expressed concern over the pilot's excessive flying time – specifically the 85 hours in a 30-day period, stating, "possibly this may have had an indirect bearing on the accident." He directed that all pilots and supervisory personnel be alerted to the "possible detrimental effects of excessive flying, particularly among newly rated pilots with a natural desire to accumulate flying time."

This mishap undoubtedly was one of many which influenced Air Force managers in establishing the crew rest and flight duty limitations now found in AFR 60-1, Chapter 7. Under today's rules, the pilot would have to be afforded a minimum of 12 hours crew rest, including time for 8 hours of uninterupted rest, beginning at the termination of his flight the night before the mishap.

Today, the Directorate of Aerospace Safety, in assigning cause factor categories, would identify both pilot factor and supervisory factor for the crew rest violation. The rationale is that pilot fatigue, due to inadequate crew rest, contributed to the mishap. Pilots are responsible for compliance with the minimum requirements of the crew rest regulation. In addition, unit supervisors must ensure compliance with the crew rest provisions and flight duty limitations of the regulation.

Another factor which would be highlighted in today's investigation of the mishap is the human factor of complacency. The pilot taxied too fast and prematurely unlocked his tailwheel, probably due to complacency. His 200-plus hours in 90 days, 85 hours in 30 days, and 8 hours and 50 minutes in the last 24 hours made him overconfident and complacent in his handling of the aircraft during a critical phase of flight. He stopped "flying" the aircraft because it was in the chocks.

A human factor which was not explored by the board was habit pattern interference. During the week preceding the mishap, the pilot had been checking out in a T-33 in preparation for the unit's transition to F-86's. He had flown three sorties, logging 5 hours, mostly in the landing pattern. The heavy braking required in stopping the T-33 was in direct contrast to the cautious braking associated with the nose-up potential of the F-51. The pilot applied excessive brake pressure in attempting to regain control of the aircraft, probably due to habit pattern interference.

Today, as a result of Air Force managers' recognition of habit pattern interference hazards, simultaneous qualification in different types of aircraft is substantially curtailed. This human factor has been identified in mishaps related to the accelerated copilot enrichment (ACE) program.

Needless to say, Air Force regulations, supervision and leadership have developed to a point today where most of the "lone-wolf" missions of days gone by never get off the ground. The drastic reduction in mishap rate since those days is a reflection of sound management and mature leadership.

Those were fun days, but we can't afford to allow our pilots to have that kind of fun today – not at 10 million dollars per aircraft. ★

NEWS FOR CREWS

Career information and tips from the folks at Air Force Manpower and Personnel Center, Randolph AFB, TX.

Major Jim Hobson
Chief, Departmental/Joint Career Management Section

DEPARTMENTAL/Joint Opportunities

For rated officers seeking responsible positions in high-level policy drafting and decision making activities, AFMPC's Rated Departmental/Joint Career Management Section may have a challenging job for you. This office is tasked with providing outstanding pilot and navigator manning support to those activities of critical importance to the Air Force and the Department of Defense. Departmental and Joint manning activities exist throughout the defense establishment including: Air Force positions above MAJCOM level, as well as joint, combined, allied, and Secretary of Defense staff billets. AFR 36-20 (the officer assignment reg), Chapter 9, provides a list of these activities, which include among others, the Air Staff, White House, JCS, OSD, SAF, Readiness Command, NATO, SHAPE, EUCOM, UN Peace Observers, PACOM, and the MAAG and Mil Groups.

The sensitive mission and far-reaching impact of these activities warrant specialized manning consideration. Grade levels utilized by the various agencies manned by MPC include senior captain through lieutenant colonel with vacancies occurring worldwide. Typically, these positions become vacant due to an officer's completion of a controlled tour, promotion to colonel, assignment to in-residence PME, or reassignment to higher levels. Requirements exist for officers from all rated backgrounds. To do our job we constantly seek rated officers with strong operational and staff credentials, as well as those possessing experience or education in specialized areas such as operations research, computers, and research and development. Strong writing and briefing skills are universally requested by using agencies.

Now some specifics of how individual rated officers are identified to fill a Departmental/Joint requirement. All rated officers entering the assignment cycle as either availables (DEROS, stabilized tour completion, rated supplement tour completion, or graduation from intermediate or senior service school) or eligibles (three years time on station and completion of six of twelve-year gate) are screened for possible placement in this arena. If a requirement exists which cannot be filled from among officers in the assignment cycle, computer supported searches are undertaken to identify an officer meeting the qualifications. After a careful review of the officer's entire record, the Departmental /Joint career management team selects the individual officer for nomination and/or assignment against a specific requirement.

Many of the same factors influencing a normal assignment of a rated officer are considered in making a Departmental/Joint assignment. An individual's personal desires, rated expertise, and "gate" status all get consideration. Volunteers are certainly preferred, and a Form 90 indication of a desire to perform duty in the Departmental/Joint arena could well result in the most challenging job of your career. However, overall duty performance is the key to progressing into these high-impact positions. Top performers create demands for themselves by building strong records as aircrew members starting at the flying unit level. Professional military and advanced education, with some demonstration of ability to handle higher level duty, could be influential. However, basic duty performance is still the most important criteria. As advocated by AFMPC resource managers, "PERFORM WELL IN YOUR PRESENT JOB," is sound advice for military officers.

Overall, Departmental/Joint positions offer a high-visability challenging environment loaded with difficult yet rewarding opportunities. Awaiting those officers with a demonstrated superior performance capability are virtually unlimited personal and professional growth avenues of highest impact to the USAF and the nation. ★

ABOUT THE AUTHOR

Major Hobson is the Chief, Departmental/Joint Career Management Section at AFMPC. His previous assignments have included flying C-130B/E/H aircraft in Tactical Airlift, Systems Command and Special Operations.

Ride the WILD horse

Part two

Years ago **Aerospace Safety** *featured a series of three articles on helicopter flying by Major Charles O. Weir, who was assigned to the Helicopter Flying Training School then located at Stead AFB, Nevada. Since then we have had periodic requests for reprints and copies of the magazines. Recent requests led to the decision to again reprint the series. Helicopter types have changed–then mostly recips, now all jet–but the lessons to be learned remain the same. With minor editing, here is the second installment of three.*

Major Charles O. Weir

Imagine, if you will, one of your troops hunting. He has been injured at the 8000-foot level in rugged, jagged mountainous country. Send for a chopper! It's that simple; the chopper goes up, retrieves your boy and safely brings him home.

Not so fast! Let's ride along and see what this chopper guy does. If he is on alert, gross weight, amount of fuel, temperature, local winds and the power to hover charts have already been studied and filled out as far as possible. The bird has already been preflighted. It's cocked and ready to go. When landing altitude is known, one more check of the charts to see power available at that altitude and you're on your way.

As the chopper starts its climb, you may wonder, why the clinb now? He wants altitude before he gets there. Why is he looking and scanning continuously? May have an engine failure. The bird only has one, and it's good to know the precise spot he will set it down in. Finally, you get there and spot the injured party. The chopper flies around and around. Why doesn't he just go in and land? There's a good spot! Could be that he is checking for wind, slope, angle, escape routes (both for landing approach and takeoff paths), size of the area (bushes, trees, boulders, and canyon walls can tear the blades off), checking the temperature and altitude, and finally, he performs a power check.

When he starts his approach, he is nothing less than ready. He knows he can hack it. After landing, you notice a large hole, an animal hole nearby; your chopper pilot saw it from the air, old buddy, Why doesn't this yokel let down? We don't need all this altitude on the way back? Maybe not, friend, but the reason remains the same – time to auto-rotate and pick a landing spot just in case the engine does sputter and fizzle out. Finally the mission is over. Only the pilot knows how tired he is; no one else can appreciate how difficult a mission it really was.

Supervisor! Monitor your boys – get to know them, study with them, plan with them – they are a part of your success as a supervisor! The intent of this article is to give the supervisor an insight into the demanding and exacting work his crews are faced with. Perhaps it will serve as refresher training for some chopper pilots. At any rate, it should provide better understanding of the ways and means of helicopter mountain flying.

Mountainous areas are the breeding places for all sorts of phenomena. Of course, winds and turbulence can be generated in the plains areas or any other area for that matter by changing weather factors, fronts, squalls and build-ups. Rarely will they generate so quickly and ferociously that you cannot accomplish the famous "180" and scamper for home. No, only in mountainous terrain can one valley be peaceful and offer no resistance while the next one offers so much in the testing of your skills and know-how and proof of the solidity of your aircraft and how well and how sturdy it has been built! I'm sure we are all familiar with the old expression, "Flying is hours and hours of utter boredom, punctuated by moments of stark, raving, terror." We know that *experience is a hard teacher* because she *generally gives the test first, the lesson afterwards.* How, then, can we prepare ourselves for these unexpected and unpredictable factors which involve the safety of our bird, our crew and our passengers? Unfortunately, there are no hard and fast rules to follow. The rules are as infinite as time or space. Each experience will probably never happen again in the same place, in the same sequence or to the same crew or to any other crew who comes rattling along.

A great difference exists between summer mountain flying and winter mountain flying. Let us look at the winter aspect first. In most respects it is the toughest. We have blowing snow from the ridge tops – this obstructs vision to flying, particularly if it's from the ridge where a landing must be made. In the valleys and on the soft slopes we encounter deep unknown depths of snow to land in, danger of tipping over, straddling a boulder or log, sinking in, lurching, never knowing which way the aircraft will settle when the blades lose all sustaining lift. White-outs during the last phase of an approach into a hover or a landing and blowing snow swirling around the cockpit from the rotor blast greatly reduce pilot vision. Same thing on takeoff until you're up and out. Above the timber line, no trees or rocks jutting up through the snow to provide a reference to the ground, depth perception nil, you cannot determine way of slope or angle of slope. Some ridges are completely covered with snow and a white overcast with no horizon to look at. Some ridges angle up and away from you, some angle down towards you. Soon you don't know what the true horizon is.

Suddenly the chopper shudders, you're out of airspeed, the vertical speed needle is up, the gyro shows you're not level! How can this happen when conditions are VFR? Simple, there is no natural horizon you can trust; you have encountered a form of spatial disorientation. Get airspeed, level the aircraft, resume climb until you are oriented. Then throw smoke, pick an object or toss something out of the aircraft that will scuffle or mark the snow where you want to land, anything to establish a reference point. As simple as this one seems, don't play tag with trying to get through the pass when there's a lot of snow on the ground and wisps of fog or clouds are obscuring your way. This is a real quick way to get the wife and kids a one-way ticket to their home town. There is one blessing to winter mountain flying – lower density altitude. A peak with a measured elevation of 8000 feet may register only 6000 on your density altitude chart during the cold months. Whereas in July or August it may be well over 10,000 or 11,000 feet. For you stiff wing type pilots, this amounts to lengthening the runways in the winter and shortening them in the summer. The lower the density altitude, the more safety factor we have. Fly your marginal missions, if possible, in summer or winter with lightened aircraft at or before sunrise and at or after sunset. You would be surprised at the increased safety factor this will provide.

Take away the snow and most of the problems mentioned disappear. In the summertime, rain squalls are to be avoided and caution still exercised to the utmost. Wet grass, rocks and mud can cause wheel slippage, roll the bird over, or start an avalanche! Check slope limitations in the Dash One. Anything over 20 degrees is real hairy. You may have to hover with the nose wheel on the ground, forward rotor tips inches away from obstacles, the rear wheels 8 feet up – still flying. Use the hoist for your

Ride the WILD horse continued

transactions; don't be stubborn and try to continue a landing. For the more difficult mission, land downhill a couple thousand feet. Off-load anything you can then try again. For the impossible mission, land downhill somewhere where there is no sweat and let your work party climb up to where the job is. Bravery and determination are admirable traits but serve as lousy excuses for avoidable accidents!

Some pilots may like to stay within handshaking distance of the ground as they climb up through the valleys and slopes. The smart pilot will climb before he gets there. Cross the ridges high. If you get caught in a sudden downdraft, there is time to peel off one way or the other to gain airspeed; power alone, in most cases, is not sufficient. The only times you should be close (a minimum of 500 feet) to the ground is when you evaluate your intended landing area, power check it, approach it, land on it and depart it. At all other times, it is healthy to have altitude.

Get behind the speed curve on the approach or on the takeoff and, buddy, you had better have a patch selected where you can lower the nose and zoom away into translational lift. Settling with power can stain your aircraft with chlorophyll from the vegetation beneath you! Beware of the irregular and jagged peaks. They break up the wind flow and will hurl turbulence at you in a million pieces and from as many directions.

To develop your wind consciousness, you not only have to know how to hunt for wind, but also where to find it. An experienced quail hunter would not think of wasting his time and effort hunting where he knew there were no birds. The wind hunter knows that downdrafts are on the leeside of the slope. He also suspects wind currents to be down slope in the morning and up slope in the afternoon. Areas of sunlight and shade can be tricky. As you fly from a sunlit area into the shadow of a mountain, you can expect a burble of turbulence. I have observed as high as six degrees temperature change in going from one to the other. Cool air settles and slithers its way down slope. Warm air is displaced and rises in the same manner.

The smart pilot knows that the wind rolls and curls over the crest of ridges and creates a bubble or swirl that can snatch your aircraft and toss it up and down. Yes, this pilot is continuously scanning for wind indications, smoke, rippling grass, bushes, trees, water ripples on a lake, birds on the takeoff – I don't know of any that takeoff downwind. A continuous watch will keep you fairly informed. You can dogleg and check your drift. For high landings, smoke grenades provide you with three essential bits of information – wind speed, amount of boil and velocity. But it has its drawbacks. Drop it inside the chopper and you're in real trouble. Tossed into weeds or a high and dry timber area, it can start forest fires.

We have already mentioned weight but keep in mind, the higher the landing, the less your gross weight should be. Years ago, the H-5 and even the H-19A Dash Ones outlined what we referred to as a diminishing gross weight factor – 150 pounds for each 100 feet of altitude. For takeoff at sea level, you could fully gross the chopper, say at 7000 pounds. BUT for landing at a density altitude of 6000 feet, your gross had to be 5950 pounds. From rule of thumb procedures such as these, our performance charts have slowly gone through the process of evolution and are now trustworthy charts – use them!

Another thing we often overlook – straight wing pilots are cleared to cruise and maintain 10-11-12-15 thousand feet. They are required to use oxygen, which is not news to us.

Only when airspeed, approach angle and rate of descent are controlled, can you say "I've got it made."

BUT, how many of you chopper people have a portable bottle with you when it's necessary to work at 10,000 or over? With the coming of turbine powered choppers helicopters are called in to do jobs the piston engine choppers couldn't hack. A few years ago, I had occasion to work Mt. McKinley up to 16,500 feet. Our daily operations were from sea level to at least 12,000 feet. Who thought of using oxygen in a chopper during rescue missions? No one! I suspect that two fliers died on this mission due to no oxygen. Their Cessna 180 was last seen in a turn, then a plume of smoke, and all was quiet at 18,000 feet. We think, "Me need it? Don't be foolish, I'm climatized." Little do we realize that our reaction time is the first victim of this hallucination. We know who the second victim will be. I hope to see the day when our choppers have built-in oxygen systems. There's little room in the cockpit of today's helicopters to accommodate even a walk around bottle.

Obstacles to landing approaches and takeoff routes are always of the utmost concern to the chopper pilot. There are three items to be checked during landing site evaluation – the height of the obstacles, the size of the clearing and the loss of wind effect. The sharp pilot will not commit himself to landing until he has figured out whether and how a safe takeoff can be made. In most cases, the size and height of approach obstacles are closely related to the size area required to safely land and takeoff from. Too many times, pilots have landed in an area like the bottom of a barrel and, when takeoff time came, hit the first obstacle trying to climb, zoom or claw their way up and out. Sometimes, even a maximum performance takeoff is a feeble attempt to get airborne. Obstacles should be given all respect necessary. In some cases, 180-degree approaches and 90-degree approaches are necessary to avoid obstacles to landing.

Approaches should be made as nearly into the wind as possible and over the lowest obstacles. The same applies to takeoffs. Who can say whether for this particular takeoff the pilot should head into a 10-knot wind and attempt to clear a 100-foot obstacle in 50 to 75 feet? Would it be better to turn 20 degrees right and utilize 100 feet of run and then pull up over a 50-foot obstacle? Only the pilot can determine which method is the safest to attempt. There is a whale of a difference in whether the load is being carried into a particular clearing or out of it. Less room is required to carry the load in, more to lift it out. When the throttle is full open, the blades have maximum angle of attack and the manifold pressure needle is as high as it will go – you're not about to lift a load up over any obstacle! For the same reason, when carrying loads into high density altitude areas, a rate of descent of no more than 300 feet per minute is recommended. Anything higher than that can put you behind the power curve again. As you near the ground, sink rate may be so great that full power will not stop it. Settling to the ground and impacting on a ridge at 300 feet per minute can be a hairy situation. Only when you control airspeed, approach angle and rate of descent can you assure yourself that you have it made.

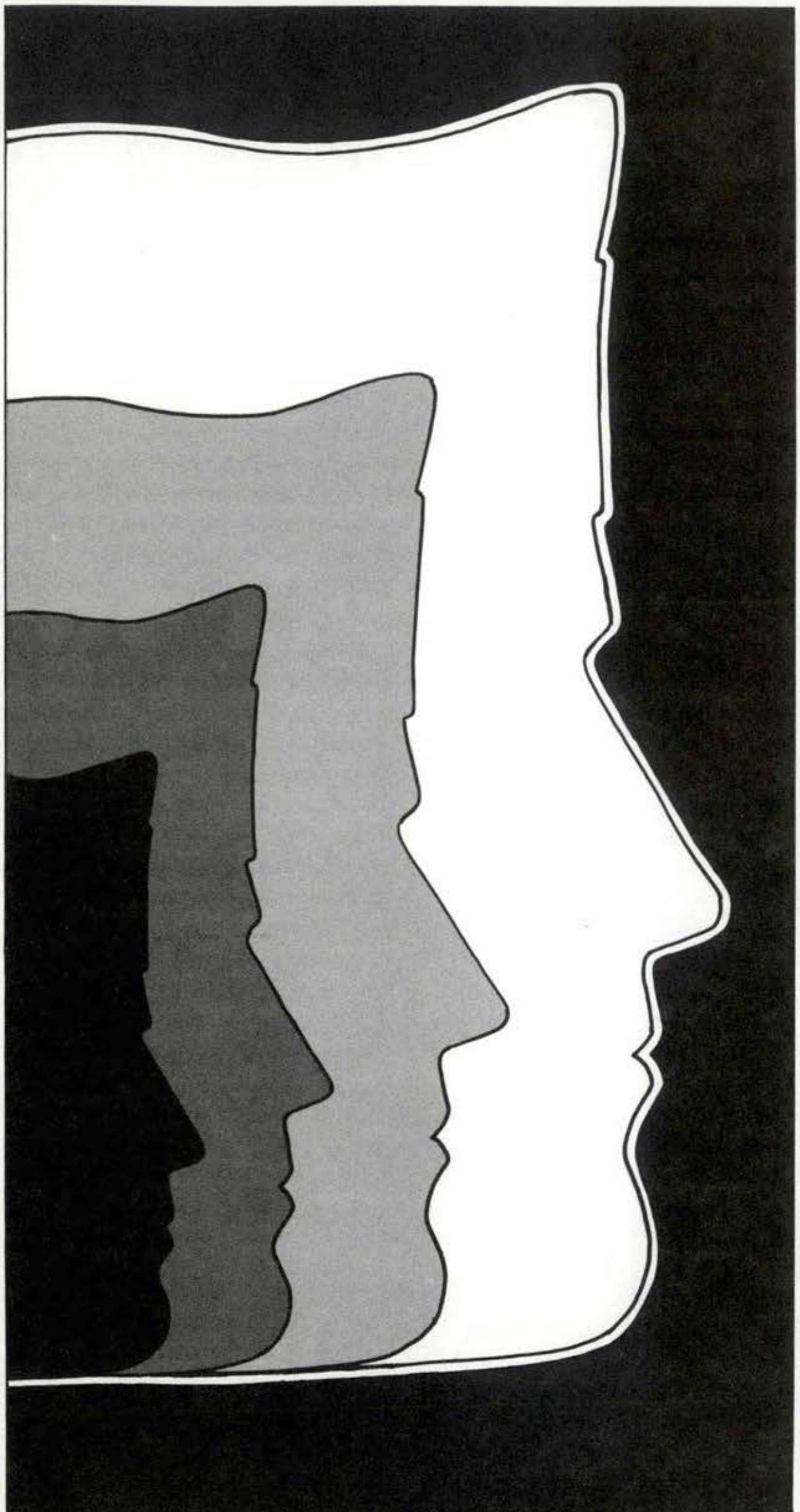
This is not the time to manhandle the controls. Gentle stick movements are necessary. You must be slow enough in the final stages of leaving translational lift behind you, at about 12-14 knots of airspeed, to allow the ground cushion to catch up to the aircraft and sustain it as you gently add what available power is left. At altitudes of 10,000 to 12,000 feet, a 100-foot per minute rate of descent during the approach is certainly the most desirable. The reason is simple – it doesn't take a sharp surge of horsepower to stop the rate of descent.

Even in the USAF Survival School they teach the survival students a bit about helicopter operating conditions and limitations. In case of bailout or forced landing, chances are, rescue will be effected by helicopter. Too many times survivors have placed themselves in locations where a helicopter cannot get close enough to land or else a difficult hoisting job has to be accomplished. If you anticipate rescue by chopper, then there are three factors that you should consider. In helping the chopper pilot, you are certainly helping yourself. Consider the altitude of your location, the terrain and obstacles and the influence of the direction and velocity of the wind. These items will assist you in the selection of a suitable landing place where the pick-up can be accomplished. You will have done your part. The rest is up to the chopper man.

(At the 1550 Aircrew Training and Test Wing at Kirtland, we teach the only sure method that has yet been devised to get in and out of mountainous confined areas of operation. . . .) If you cannot use those guides and if the power check doesn't give you the tolerance recommended, then friend, you had better seek another line of business to get into! (They stress landing site selection, landing site evaluation, high reconnaissance, low reconnaissance, power check, approaches, hovering and landings.)

Next month we'll look into the details of each. ★

Be The Best



Cliff L. Stout
Director, Flight Operations
Douglas Aircraft Company

Major Roger L. Jacks
Directorate of Aerospace Safety

The other day while going some research, I came across an article written by Cliff L. Stout at Douglas Aircraft. It was entitled "Professionalism" and had been distributed to all operators of their aircraft. The article was subsequently published by the International Air Transport Association. It was a short article, well written, which seemed to capsulize what the word Professional should mean to the airline pilot. I'd like to share some of Mr. Stout's comments with you since what he had to say is equally beneficial to us. Take a few minutes and give the article a perusal.

WHAT'S ALL THE UPROAR ABOUT?

O.K. So everyone wants perfection. Well, no other segment of the transportation industry has ever come so close to it. Yet even the critics must realize that we can only strive for it. And that's where the trouble is. That's what the uproar is about. Are we, you and I and everyone else, really striving for perfection? Or are we sitting on our duffs, settling for considerably less than perfection and just standing by to become a statistic?

If you as a pilot haven't heard the phrase "complacency in the cockpit" in recent months, you must be the only one who hasn't. It's a distasteful phrase, projecting the image of a smug know-it-all who has forgotten about the pitfalls of flying. In so doing he has become one himself. By not constantly trying to do better, to eliminate every chance for an error, he accepts a lowering of his standards and prepares himself psychologically for sub-par performances. This casual approach to a demanding task has unquestionably resulted in the deaths of some of the casual approachers as well as many of the not-so-casual passengers riding behind them.

PROFESSIONALISM— OR THE LACK OF IT

The phrase "complacency in the cockpit" seems to imply that the occupants of that space have become so well satisfied with their skill, judgment, excellent equipment, ability to cope and overall superiority that they can let down a bit and still do just as good a job. Like the Boston Celtics playing the Podunk High "B" team. While occasionally this may be true, it is more likely that it overstates the case. Rather than a conscious letdown, what we appear to have is a lack of continuing effort to improve.

Someone sometime advanced the theory that an airline pilot's performance could be graphed. During his career he faces many challenges and, if he is to successfully continue that career, he must rise to meet each one. At the beginning, his level of performance is low, but as he applies himself it rises. After a few years it peaks, levels off, and as self-confidence, perhaps boredom, maybe even dissatisfaction grows, it begins a slow decline.

With a change to new equipment he is challenged again and the cycle is repeated. Upgrading to captain is probably the sternest test and usually results in the most prolonged climb in the quality of his performance. Eventually it peaks, however, and again decline sets in. One can easily picture such a curve on a graph, occasionally there will be brief excursions from the norm, minor variations caused by incidents which shocked, scared or otherwise instructed the pilot and resulted in a temporary change of direction. But in the long run the shape of the curve will vary little.

Obviously a far more desirable curve would be one which reflected the normal variations when challenges are met, but did not peak and then decline after a few months or years. Rather it should reach a plateau, not a flat one, but one which slopes slightly upward.

How does one achieve such a performance pattern? By being a full-time professional. You say that's what you are? Then you know why Heifetz still plays scales on the violin, why Jack Nicklaus walks directly from the 18th green to the practice tee, why Rich Little entertains himself for hours doing imitations in front of a mirror. A full-time professional continually seeks to improve by eliminating mistakes.

PREPARATION FOR FLIGHT— BE PROFESSIONAL!

Reliance on someone else, whether it be the other pilot, a dispatcher or the Almighty, for a weather briefing or a review of field conditions can be hazardous. The first two might miss something which you consider significant and the third may not be on your side. It's better to arrive early and devote the necessary time to a thorough look at conditions.

You reply, "We're going to go anyway." Maybe and maybe not. Don't assume anything. Get in the habit of making a complete preparation for every flight, regardless of the weather. Then it won't sneak up on you. But it takes a conscious effort to develop the habit. That's what a professional does.

Get to the airplane early, not late. Complete preflight inspections and checklists ahead of time. Last minute rushing causes mistakes and professionals shouldn't make mistakes in anything as simple and basic as checklists.

Preparation for flight also includes being physically ready, maintaining one's health and getting proper food and rest. A pilot reporting for a flight in ill health, insufficiently rested or hungover places an unfair burden on his fellow pilot and jeopardizes the safety of the flight. He is not acting professionally.

CHECKLISTS— BE PROFESSIONAL!

The checklist helps you to make sure that certain things are accomplished, correctly, every time. Both pilots share the responsibility for the completion of the checklist, but the one reading the challenges has the larger share. He must first make sure that he doesn't skip any items. He should consider that the other pilot is doing something besides waiting to hear his dulcet tones. He should be sure he has the man's attention before reading a challenge. And he should read the challenges as they are written, every time. Colorful individual interpretations with rhymes and clever patter thrown in may be enjoyable to the author, but most pilots don't use them. Most use the phrases as written. Hearing something else when you are expecting the standard challenge is distracting, confusing and leads to errors. The professional way is the right way, the way that eliminates errors.

COMMUNICATIONS— BE PROFESSIONAL!

A professional radio operator knows that "communication" means "the transmission of information" and it implies the reception and understanding of the information. Otherwise it has not been communicated. A professional knows how to communicate most effectively with a minimum number of exchanges. He uses conventional terms and standard phraseology in the proper sequence to eliminate repeating or misinterpretation. He also observes regulations concerning ATC contacts such as reporting altitude on initial call, reporting leaving altitudes and listening to and reporting the reception of the ATIS.

He does these things because they reduce the repetition of calls and they eliminate errors.

PRECISION— BE PROFESSIONAL!

With the equipment now at our disposal, precision flying is easier than ever before. Witness the few missed approaches in two hundred and one-half weather. But precision flying shouldn't be limited to approaches. The airways should be flown just as precisely.

A professional doesn't do anything in an amateurish way. We, as professionals should fly exactly on course and exactly on altitude. No one enjoys having ATC broadcast to him and the rest of the world that he is five miles off the centerline. A professional is precise, too, in following standard operating procedures, observing speed restrictions and operating limitations without the presence of a check pilot to inspire him. A professional doesn't need a check ride.

WHAT ELSE MAKES UP PROFESSIONALISM?

Years of experience teach a pilot so many things that a catalog of them would fill volumes. However, certain general topics emerge which can be discussed in a few paragraphs.

Beginning with "A" for no particular reason, we think of "alertness." Whereas a pilot's attention used to be focused on keeping the wings level, maintaining altitude and course and "keeping his head on a swivel," now the autopilot flies the airplane and radar controllers point out traffic. We hope. Is hope enough? Not enough for a full time professional. He spends his time monitoring instruments and looking around.

Being constantly aware of exactly where one is in relation to airways, outer markers, airports and most important, the ground, is another form of alertness. In these days of almost continual radar vectoring, complete reliance on an outside agency for navigational guidance is the easy way, but it can lead you down the garden path or up the proverbial creek. It is not the professional way. Healthy skepticism of a radar controller is not an insult to his ability; it is a tribute to your professionalism.

The responsibility shouldered by an airline pilot when he departs on a flight is awesome. Acceptance of responsibility these days is unusual. Thus the airline pilot becomes unusual. People expect more of him. This becomes an additional responsibility, a responsibility to conduct himself at all times in a way that is a credit to him and to his colleagues, in a way that moves people to look up to him, not sideways, or even down. His high professional standards should be carried over into his personal standards. In a job that is of necessity largely unsupervised, his personal integrity must be unquestioned. Cheating should never occur to him. His reports of "on, in, out and off" times should be just as precise and exact as his ILS approach with 1800 RVR. The pilot who doesn't meet these standards damages his own reputation and those of his colleagues.

A cockpit organized along highly professional lines will never have room for complacency.

BE THE BEST!!

Be the best is becoming more than a challenge in the Air Force; it's becoming a necessity. I'm not putting you on, pulling your leg, jive talking you or pumping out garbage. With the emphasis on realistic training we are asking more from our aircrews than ever before. Aircrews are training harder, participating in more joint exercises, flying lower, faster, getting more out of their aircraft and being subjected to war training scenarios that in the past only laid on a planner's desk. Red Flag is an example of an exercise that thrives on realism and will undoubtedly better prepare our aircrews for future conflicts. Better prepared? You bet! But what will be the price we pay in lost aircrews and equipment? The answer to that question will be determined by us!! If we honestly try to be the best and accomplish every task in a professional manner, I'll give "The Greek" 2-to-1 odds we train better with a lower mishap rate. ★

WANTED: TECH EDITOR

This fall our technical editor for *Maintenance* magazine will be leaving. The position requires a personable SMSgt, AFSC 43199, with a broad maintenance background and who also enjoys meeting people at all levels. Applicants should have above average writing ability and be PCS eligible. Previous writing and/or safety experience is desirable.

Anyone with the above qualifications, who would like a very interesting and challenging assignment may write or call us at:

Safety Magazine Branch
AFISC/SEDA
Norton AFB, CA 92409
AUTOVON 876-2113

OPS TOPICS

CARE IN THE COCKPIT

Following the mission, the crew member pulled the helmet bag from next to his seat and his interphone cord tangled and fired the man-seat separator initiator. Nobody in the way and therefore no blood, no foul, right? Wrong! Could have been bloody, and most of us have at one time or another stuffed a checklist, helmet bag, jacket or other associated garbage next to our seat. Take care and don't store things where they may get caught in the machinery.

CONTROLLER CHATTER

A multi-engine, multi-crew member transport was shooting an approach to a sister service field in marginal weather. Handoff to GCA final controller placed the pilot on an extremely noisy and confusing frequency. The freq had bleed-through from a nearby civilian airport which, coupled with continuous controller chatter and marginal weather, led to a GCA which placed the aircraft in a position wide of centerline. The incident will be checked but it sets an old throttle bender remembering "if you're up to your epulets in soup and the approach isn't going good, for any reason, go missed approach and straighten out the problem." If the situation is critical enough (meets emergency criteria), two emergency attention-getters are GUARD and/or 7700. They should be last resort but don't let yourself get backed into a corner without options.

AIRCREW DISCIPLINE

Many things we were taught in UPT should keep us from bashing into the terra firma . . . but only if we remember and practice discipline. A young crew recently jumped into their Phantom for a night instrument practice mission. The weather was forecast to be the type that you could probably plan on seeing ground from or only slightly above minimums. After aborting the original machine, they were preflighting a replacement, and the AC was unable to get the lights to work on the primary attitude indicator. He turned the cockpit utility light on the ADI and pressed! Yes, Virginia, let me review—*Night, Weather, Instrument practice mission,* turned the C-4 light on the ADI and pressed!

Their first approach at one of the local airports started bad and got worse. They turned in tight, stayed unconfigured, picked up a high rate of descent, the utility light slipped or failed, they attempted a go-around and didn't make it. Two fatals? No, as luck would have it, the machine bounced and both folks ejected before the Phantom bounced again and then burned. Super lucky crew members who have their Martin-Baker chairs to thank.

- AFR 60-16 requires operative cockpit instrument lights for night flight with good reason.
- Right after takeoff, you'd better plan on asking for an extended pattern due to higher weights, speeds, etc.
- If the approach isn't working as planned, start the go-around *early*. Food for thought!

HOW GOOD ARE YOUR PREFLIGHTS?

An alert aircraft commander inspecting a T-39 found a second stage turbine blade snapped in half, a first stage compressor blade nicked, and two empty rivet holes on the forward lip of the engine nacelle. That is particularly commendable when the weather conditions are considered. The engine intake on the T-39 aircraft is not very easy to preflight, but on a frigid, predawn departure it is virtually impossible. (Footnote: The empty rivet holes were the result of incorrect rivets being installed in the engine intakes.)

The second, equally observant, aircraft commander detected a small static leak at a chafe mark around the hydraulic pressure line on the main landing gear actuating cylinder. Further investigation revealed three other aircraft from the same base with similar chafing.

Flight crew inspections are designated to check the aircraft general condition and not to duplicate inspections already performed by maintenance personnel. However, they are also in an ideal situation to look at the "big picture." Remember that a few extra minutes on that walk-around can save hours of paperwork later. Do you just kick the tires and light the fires?—Sqn Ldr John C. Griffiths, RAAF, Directorate of Aerospace Safety. ★

HOW HIGH IS YOUR

Lt Col Robert J. Vanden-Heuvel
Armament Development and Test Center
Eglin AFB, FL

As any jet crew member knows, to get from A to B on the least amount of fuel, you go high. How high depends on what you're flying, configuration, distance, etc. If you are a qualified jet crew member, you should be proficient at determining optimum cruise for your aircraft. Can you say the same about endurance?

For purposes of illustration, assume that you are to perform a sea-level mission at a designated point. Upon reaching the point and working altitude, you find that there will be a delay and are instructed to hold to conserve fuel. For an F-4D, consider a gross weight of 45,000 lbs and drag index of 20; A-7, 30,000 lbs/50; F-111F, 80,000 lbs/50. Out of the top of your head

ENDURANCE COMPARISON CHART

Acft Type	(Ft X 1000) Altitude	Endurance FF	FF	ΔCF	1 Hour Saving
F-4	SL	6500	---	---	---
	5	6200	300	225	75
	10	6000	500	450	50
	15	5850	650	625	25
	20	5700	800	925	-125
A-7	SL	2700	---	---	---
	5	2550	150	100	50
	10	2460	240	200	40
	15	2400	300	300	00
	20	2340	360	425	-65
F-111F	SL	6300	---	---	---
	5	6100	200	250	-50
	10	5950	350	550	-200
	15	5800	500	850	-350
	20	5800	500	1150	-650
F-15	SL	4800	---	---	---
	10	4350	450	250	200
	20	4000	800	500	300
	30	3800	1000	800	200

ENDURANCE?

pick the holding altitudes for delays of 15, 30, and 60 minutes. No fair going home or air refueling. For the sake of simplicity, assume you will not be permitted a fuel-saving descent. Do not confuse this scenario with a possible divert situation, which is really a range/cruise problem. Estimate how much fuel you will save at your chosen altitude for each time interval. When you've done this, read on.

The accompanying endurance comparison charts were constructed using performance data from each aircraft's flight manual. Endurance fuel flow for each altitude is from the maximum endurance fuel flow chart. ΔFF is the difference in endurance fuel flow between a specified altitude and sea level. Climb fuel (CF) data from the military power climb charts assumes the aircraft is at climb speed. The last column is what we are after, showing the fuel saved by climbing to a particular altitude and holding for an hour. It is determined by subtracting the climb fuel from the fuel saved by holding at that altitude for an hour (ΔFF - CF). Again, for simplicity, time in the climb was discounted.

The F-4 chart shows that the best saving you can expect by climbing for a one-hour hold is 75 pounds and you only have to go to 5,000 feet to do it. Ten or fifteen thousand feet saves less, and going higher will cost you. Holding for an hour made the computations easy, but is unrealistic. How about half an hour? Fifteen minutes? With a fixed expenditure of climb fuel and a reduced saving of holding fuel (½ or ¼ ΔFF), you are going to spend more fuel by climbing than you will save at altitude. The F-4 5,000-foot saving becomes −75 pounds for 30 minutes and −150 pounds for 15 minutes. The A-7 is worse than the F-4, and the F-111F is the worst of the three. The F-15 was better, showing a saving of 300 pounds in an hour at the optimum altitude of 20,000 feet, but still incurring a 100-pound loss for a 30-minute hold. How did your estimates turn out?

If you accept 30 minutes as a maximum reasonable holding time for a fighter aircraft, it follows that there is no fuel-saving advantage in climbing to a fuel-conserving altitude while holding, at least for the aircraft configurations checked. Since sea-level operation offered the best case for climbing, starting altitudes above that produce lower savings. You can see that by analyzing the charts, if you care to.

Naturally, if you are at a higher altitude to start with, stay there. If you are at Warp 9 when the call to hold comes, zoom to exchange airspeed for altitude. What you don't want to do is invest fuel that won't be paid back.

The purpose of this exercise was to stimulate further thought about a subject that is seldom dealt with and less frequently understood. When I began it, I did not realize that the fuel savings were as little, or the optimum altitudes as low, as they turned out to be. Interested individuals should try other configurations or consult the performance charts of other jet aircraft to see how they compare. If you want to, take into account time in the climb, time and fuel in the descent, bank angle, and the variation of gross weight with time. I don't think they will significantly change the results. You may improve the results by using low drag index numbers and low gross weights, but that is not realistic. As far as I am concerned, the best rule of thumb for climbing to conserve fuel while holding is – forget it! ★

your system may be reliable, but IS IT SAFE?

Donald L. Kurle

When we in the Air Force decide to add a new weapon system to the Air Force inventory, the list of requirements that our new system must satisfy will invariably include high reliability and a high degree of safety. Our new system must perform its intended function at the intended time and place, and it must do so in a safe manner.

Unfortunately, system designers, builders, and users often equate reliability with safety. A great deal of time and money is spent on a weapon system to make it reliable with the assumption that a reliable system is also a safe system. Generally, it is true that the more reliable a system is, the safer it is. If we are to take an airplane trip, we naturally feel safer in a reliable airplane than in an airplane that is not quite as reliable. However, it is not always true that steps taken to improve system reliability automatically serve to improve system safety. It is this point that we will explore further.

For our purposes, system reliability is defined as "the probability of a system performing adequately for the period of time intended under the operating conditions encountered." An accident is defined as "an unplanned event that causes expenditure of resources, injury, illness, or death." A system can be considered to be "safe" when the risk of accident is acceptable.

When discussing reliability, a system is thought of in terms of the components that make up that system. The reliability of the total system depends upon the reliability and arrangement of the individual components. The same is true of system safety.

It is axiomatic that the reliability of a system is always reduced by adding a component in series with other components and is always improved by adding a component in parallel with other components. This does not necessarily hold true for the safety of a system. We must also realize that systems are usually not of the pure-series or pure parallel type but are a mixture of both.

Let's examine an imaginary, simple system and see what happens to the safety of the system when we take steps to increase and decrease the system's reliability.

Assume we are developing a new "Cobra" surface-to-air missile system and we are going to conduct a series of test launches. As shown in Figure 1 our missile is connected to a power supply through a switch such that when the switch is closed, power is supplied to the missile and it is launched. We can say that our system is composed of three components – missile, power supply, and switch. (Actually, our system is composed of many components but for purposes of illustration we assume three components.)

Let us further assume that the switch can fail in two ways. First, it could close (short) inadvertently before we are ready for launch, in which case the missile would explode on the launch pad or inadvertently lift off (an accident). Second, the switch could fail to close when activated resulting in no missile launch (system failure but no accident). From a reliability viewpoint we are interested in both failure modes. From a safety viewpoint we are also interested in both failure modes, but we are most interested in the failure mode which will cause an accident.

Assuming our switch has been tested adequately, we know the reliability of the switch is 0.8 (and thus probability of failure is 0.2) and when the switch fails it fails closed half of

The point here is that while it is always desirable to have a highly reliable and highly safe system, an increase in one does not necessarily increase the other.

the time and open half of the time. Therefore, in Figure 1 the probability of the switch operating successfully (Ps) is equal to 0.8 and the probability of the switch failing such that an accident results (Pa) is equal to 0.1.

Since our system appears to be unreliable we can ask ourselves what can we do to make it more reliable. We decide that if we put a second switch in parallel with the first we will increase reliability (see Figure 2). Now, for our system to fail, both switches have to fail. Our system will operate properly if only one switch functions properly. Ps is now equal to one minus the probability of both switches failing or Ps = 1 - (0.2) (0.2) = .96, we have indeed increased our switching reliability (from 0.8 to 0.96). But let's take a look at what we have done to system safety. Again if one switch fails closed we have an accident, and now we have twice as many switches as before. Pa is now equal to one minus the probability of both switches not failing closed or Pa = 1 - (.9) (.9) = .19. Our probability of having an accident has increased from 0.1 to .19.

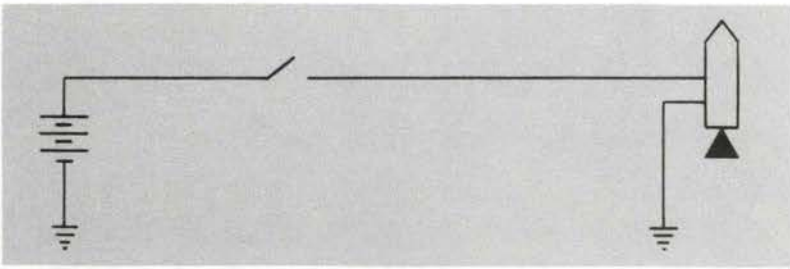


Figure 1
COBRA MISSILE SYSTEM

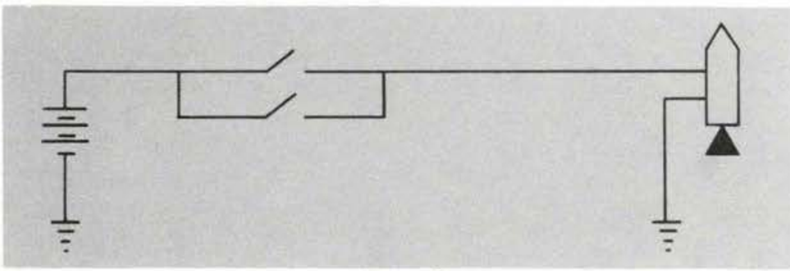


Figure 2
COBRA MISSILE SYSTEM WITH PARALLEL REDUNDANT SWITCHES

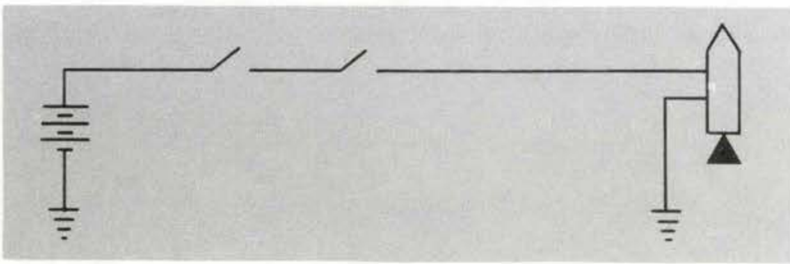


Figure 3
COBRA MISSILE SYSTEM WITH SWITCHES IN SERIES

If we now decide that our system, although reliable, is not safe enough we can modify the switch arrangement again. Let's see what happens if we put two switches in series (see Figure 3). In this case the system will operate properly only if both switches do not fail. Our probability of success (Ps) is now equal to (0.8) (0.8) = 0.64. However, to have an accident both switches must fail inadvertently in the closed position. No accident will occur if only one switch fails. So the probability of an accident equals the probability of both switches failing in the closed position or Pa = (0.1) (0.1) = 0.01. Thus, in this situation, our reliability has decreased from 0.8 (for the original one switch system) to 0.64. But our probability of having an accident has decreased by a factor of 10. This arrangement gives us a less reliable but safer weapon system.

The point here is that while it is always desirable to have a highly reliable and highly safe system, an increase in one does not necessarily increase the other. We in the Air Force who deal with highly sophisticated systems on a daily basis must ensure that steps taken to increase the reliability of our systems do not increase the risk of accident to an unacceptable level. This applies equally to system designers, builders, and users, and applies throughout the entire life cycle of any system. ★

Problems to Anticipate With the Growth of Marijuana Smoking

Hardin B. Jones, Ph.D.
Senior Scientist,
University of California

This is the best paper we've seen on the subject of marijuana and its use. We highly recommend it, especially to aircrew personnel. Permission to present it here has been granted by *Executive Health Report*, P.O. Box 589, Rancho Santa Fe, CA 92067, holders of the world copyright.

Today, many adults smoke marijuana. Some start using marijuana to help themselves stop drinking. Some use it in an attempt to revive their failing sexual powers. Some find marijuana a substitute for tranquilizers or other medication. Some use the drug to keep up with the younger generation. Although the reasons older users smoke marijuana may differ somewhat from the reasons given by younger users (who may use it for peer identification or to alleviate social and sexual problems associated with adolescence and early adulthood), the deleterious effects are much the same. Those past the years when they plan to become parents may not worry so much about genetic damage as should younger users, but the damage to the brain and the sexual mechanisms caused by marijuana should still be a subject of concern.

For more than a decade, we have been subjected to a flood of articles, books, and reports supporting the idea that smoking marijuana is simple fun and has no serious consequences. Earlier observations that marijuana was linked to mental disorders, to the use of narcotics, and to personality changes have been declared "obsolete" or "exaggerated." That these early observations are now supported by scientific studies and that many of the early studies were carefully conducted have been ignored.

There are problems with many of the reports supporting the harmlessness of marijuana. First, examinations of marijuana smokers early in their use do not reveal the long-range effects. Second, as marijuana causes adverse behavioral changes that the user cannot recognize in himself, some investigators may have been deceived by their own experiences with the drug. Because they cannot have assumed that marijuana would turn out to be as free of long-term effects as most well-tested medicines.

Throughout the same period that the promarijuana reports were being published, the World Health Organization has continued to warn against the use of marijuana. Although some promarijuana inquiries in the past were sponsored by the British and Canadian governments, these governments have since issued clear warnings about marijuana.

The effect of marijuana is probably never transistory. Marijuana is an unusual drug in that the active ingredient, tetra hydrocannabinol (THC), is retained in the body for long periods of time. One study, conducted by Louis Lemberger of the Indiana University School of Medicine, has indicated that 30 percent of the THC is retained in the body at the end of a week. Similar retention occurs whether the users are heavily or lightly exposed to marijuana. From animal studies it appears that the 30 percent retained at the end of a week is eliminated much more slowly than the first 70 percent. Therefore, with repeated exposure, THC accumulates in the body.

THC is changed only slightly by metabolism. In this process, some is converted to a more psychoactive form. (There are about fifty cannabinoids in marijuana; those that have been studied retain their basic cannabinoid structure and fat solubility even though partly altered by metabolism). THC is highly fat soluble and is, therefore, deposited in the fatty outer membrane of cells, but there is reason to be especially concerned about its effects on brain cells and on the reproductive process.

Damage to the Cell Membrane

An important source for information on the toxic effects of THC on cells is the report of a symposium on marijuana presented at the Sixth International Congress of Pharmacology held in Helsinki in 1975.

More recently W.D.M. Paton, professor of pharmacology at Oxford, and Robert Heath, chairman of the Department of Psychiatry and Neurology at Tulane University, and their colleagues have shown the profound changes that occur in the surface membranes of brain cells in animals exposed to doses of marijuana within the range of typical human doses. Changes have been found to occur in the membrane of brain cells, red and white blood cells, liver and lung cells, and sperm.

Marijuana appears to injure the fine, hairlike extensions of the brain cell membranes that communicate with the other brain cells. Such damage is critical, for although each cell has tens of thousands of these connectors, the brain needs them all. They are the mechanisms of the mind.

One important study on the damage caused to the brain by marijuana has received too little attention. The late A.M.G. Campbell of the Department of Neurology, Bristol University, conducted a study of ten consecutive cases of young marijuana users who showed marked behavioral changes. X-ray examinations of their brains revealed that all suffered from cerebral atrophy. The degree of atrophy correlated with the duration of marijuana use.

In the United States, Harold Kolansky and William Moore, professors of psychiatry at the University of Pennsylvania, were able to correlate the appearnace of the symptoms of organic brain disease with marijuana use. In the Journal of the American Medical Association (June

2, 1975), they stated: "In our reports, we detailed the toxic psychological effects of cannabis use in 51 of our patients, all of whom demonstrated symptoms that simultaneously began with cannabis use and disappeared within 3 to 24 months after cessation of drug use. Moreover, a correlation of the symptoms to the duration and frequency of smoking was established. When these observations were coupled with the stereotyped nature of the symptom seen, regardless of psychological predisposition, we presumed that with intensive cannabis use, biochemical and structural changes occurred in the central nervous system."

That marijuana can cause brain damage has recently been confirmed by Robert G. Heath. In his study, Heath exposed monkeys for six months to doses of marijuana corresponding to moderate and heavy doses. Before the brains of the monkeys were examined, they were taken off marijuana for eight months. The site and degree of brain atrophy in the monkeys were similar to those in the young men in the Campbell study. Heath also examined the hair-like extensions of the brain cell membranes and found that these synaptic structures were also altered.

The findings of the Heath study were important confirmations of the Campbell study. The brain damage associated with marijuana observed in these two studies appears to account for the behavioral changes often observed in marijuana users.

Genetic and Embryologic Damage

THC has been associated with genetic changes through the suppression of cell division and the alteration of protein synthesis. E. Sassenrath (in the 8th Technical Review on Genetics and Drug Abuse, August 1976) has reported recent findings on the increase in malformations in the offspring of monkeys exposed to marijuana. These results, the first definitive findings on primate malformation associated with marijuana, confirm the results of earlier studies involving laboratory rodents. As many developmental abnormalities were found in the offspring when the father monkey alone was exposed to marijuana as when the mother was.

Even before Sassenrath's study was published, there was reason to suspect an association between malformation in human offspring and exposure to marijuana. Statistical tabulations on the number of malformed infants born in the United States over the past decade are now available. Although malformations had been on the decline in the United States for thirty years, since 1970 (coincident with the rise in marijuana use) there have been striking increases in malformations of the hip joint and of the cardiovascular system. It will take several years to compile more complete data, but it seems probable that marijuana use is the cause of this epidemic of malformation.

Two major studies have shown genetic and developmental damage in laboratory rodents after exposure to marijuana. One unpublished study, conducted by de Paul Lynch of Saint John's University, New York, examined the transmission of defects to succeeding generations. Excessive abnormalities appeared in two generations after exposure of the original animals. In this instance only two generations were studied. The other study conducted by Peter Fried of Carlton University, Canada, establishes a variety of genetic changes in offspring of rats exposed to marijuana. Developmental abnormalities were found to be equally frequent after the exposure of either male or female parents.

There are indications that the risks involved with "normal" marijuana use probably exceed the genetic risks associated with exposure to sublethal levels of radiation.

Damage to the Respiratory System

With marijuana, because fewer cigarettes are smoked, less carbon monoxide is taken up in the blood. However, the lungs of the marijuana smoker become more irritated than those of the tobacco smoker.

The correlation between cigarette smoking and lung cancer, emphysema, and other respiratory problems is well known. Emphysema is found in 52 percent of those who smoke more than a pack of cigarettes a day; only three percent of nonsmokers develop emphysema. . . .

Tobacco smoking diminishes lung capacity. The amount of oxygen transported in the blood is decreased when some hemoglobin unites with molecules of carbon monoxide rather than oxygen. In addition, the lungs are irritated by the smoke and become inflamed.

With marijuana, because fewer cigarettes are smoked, less carbon monoxide is taken up in the blood. However, the lungs of the marijuana smoker become more irritated than those of the tobacco smoker. The irritation is greater because THC is more tightly bound to the carbon particles in the smoke than nicotine is, and, in order to get an effect, the marijuana smoker must inhale deeply and hold the smoke in his lungs. After even a short period of exposure, as the carbon particles accumulate, the lungs of the marijuana smoker change permanently from pink to black.

According to the Leuchtenbergers, working at the Institute of Experimental Cancer Research in Lausanne, Switzerland, marijuana smoke causes a greater range and degree of damage to lung cells than tobacco smoke. Studies by the U.S. Army indicate that lung impairment occurs more rapidly with marijuana. Precancerous lesions have been observed in the air passages of the lungs of marijuana smokers, and autopsy examinations of the lungs of heavy marijuana smokers have revealed severe breakdowns in the lung structure.

Marijuana Vs. Alcohol

. The marijuana user is under the influence of the drug even between highs.

Marijuana is often said to be like alcohol, but the two drugs are not at all alike. THC, the principal active ingredient in marijuana is highly soluble in fat and insoluble in water. THC remains in the fatty structures of cells for long periods and, with repeated use, accumulates there. Alcohol is a water-soluble food and is metabolized to provide cell energy. It leaves the body rapidly and completely. There is no residue.

Molecule for molecule, THC is 10,000 times stronger than alcohol in its ability to produce mild intoxication. For example, one drink containing 10 grams of ethyl alcohol is metabolized in an average-sized person in about one hour into carbon dioxide, water, and acetone: 50 grams of alcohol produces mild intoxication and is metabolized in about five hours. Only 5 milligrams (1.011 gram) of THC are required to produce the same degree of intoxication. THC is removed slowly from the body, and many months are required to recover from its effects. The marijuana user is under the influence of the drug even between highs.

It takes decades for irreversible brain changes to appear in the heavy drinker. In the marijuana smoker, irreversible brain changes may appear within three years.

Marijuana is a complex mixture of many cannabinoids, each of which may have different effects on the body. In addition, the retention of the cannabinoids in the body means that even small doses may have adverse effects. Many of the adverse effects correlate with the duration of use rather than with the size of the dose, and there may be no truly safe range of exposure. With alcohol the adverse effects are brought about by the larger doses.

It takes decades for irreversible brain changes to appear in the heavy drinker. In the marijuana smoker, irreversible brain changes may appear within three years. Comparing alcohol and cannabis, W.D.M. Paton, professor of pharmacology, Oxford University, said: "The price (in health) for (marijuana) overuse is paid in adolescence or in early life; the price for alcohol overuse is paid in later life."

Along with cancer and cardiovascular disease, which are linked to cigarette smoking, alcoholism is another of the major health problems of this country. With the increasing use of marijuana, another major health problem has now been added. The problem is increased when marijuana is used with alcohol, as it often is. The two druges in combination have a greater effect than the sum of their individual effects.

Sensual Drugs and the Pleasure Centers

Sensual drugs, of which marijuana is one, are drugs that the body has no need for but that give the user a strong sense of pleasure. These drugs affect the reflex centers located deep within the cerebrum that appear to be the site in the brain of the pleasures we derive from the body, including the pleasures of eating, feeling alive and fit, and sex. The pleasure centers are probably very important in the development of learned behavior, for, along with pain, they form the basis for conditioning. Self-activation, emotions and mood, memory storage and recall, perception and awareness, desire, satisfaction of appetites, and sexual activity are dependent on the balance of reactions in these reflex centers.

The pleasure centers become active after marijuana is smoked. This has been demonstrated by Heath, the discoverer of the pleasure centers. Heath observed the response to marijuana of humans who had undergone brain surgery during which electrodes were placed at the site of the pleasure centers deep within the brain. He conducted similar studies on monkeys.

Although the pleasure centers are activated artificially by marijuana, the process would probably be more properly termed irritation, as the normal operation of the pleasure reflexes becomes impaired after they have been activated by marijuana. With heavy exposure to marijuana, the operation of the pleasure centers is suppressed. This suppression seems to correspond to what many researchers have called sensory deprivation. Sensory deprivation becomes progressively more severe the longer marijuana is used.

Even those who do not seem to be much affected by marijuana show a marked degree of recovery of their sensory perception and thought processes after several months of abstinence. The user's memory is the first thought process to improve; then his thought formation becomes more vigorous; finally, after several months of abstinence, he begins to notice that he feels more alive. The recovery of the sensual capacity comes last. The restoration of sexual inclination and capacity is a pleasant surprise to the person recovering from the chronic effects of marijuana. Although the user often was not aware of the gradual dimming of his mental and sensual functions he feels his recovery and is impressed by this proof that marijuana had indeed had adverse effects.

I have had less opportunity to study adults than I have men and women in their late teens and early twenties, but they seem to follow the same pattern in their recovery: mental functions that had not been missed return, especially memory and the accuracy of thought formation. However, for older people, recovery may be slower. This is to be expected. The body metabolism gradually declines with age and decreasing physical activity. The accumulated marijuana is eliminated from the body through the circulation and is excreted in the bile; this process is vigorous in youth and declines as we get older.

On Addiction

Contrary to many reports and popular belief, marijuana is chemically addictive. It is addictive because the user can develop tolerance to its effects and suffers withdrawal symptoms when he abstains. The withdrawal symptoms are mild, so mild, in fact, that until recently they were not recognized as withdrawal symptoms. The mild symptoms include irritability, restlessness, and sleeplessness. More intense withdrawal symptoms have been observed in persons exposed for a few weeks to high doses of THC: restlessness, sleeplessness, rapid onset of irritability, loss of weight, nausea and vomiting, diarrhea, salivation, sweating, hot flashes, runny nose, hiccups, and electroencephalographic changes during sleep.

The mildness of the marijuana withdrawal symptoms is explained by the fact that THC accumulates and is retained in the brain and body fat. Other sensual drugs that are not stored in the body produce more marked withdrawal symptoms.

Actually, there is an inseparable relationship between chemical and psychological addiction, and the two forms coincide when the addictive substance is a pleasure-giving drug.

Much debate over the dangers of specific drugs centers on the question of chemical or psychological addiction. A purely psychological addiction is usually considered controllable through conscious effort. Chemical addiction is considered less susceptible to mental control. Drugs thought to be mere psychologically addictive are considered relatively harmless; those that are chemically addictive are thought to have more serious consequences. Actually, there is an inseparable relationship between chemical and psychological addiction, and the two forms coincide when the addictive substance is a pleasure-giving drug.

The sensual drugs give pleasure chemically by stimulating the pleasure centers below the conscious level. The brain produces psychological responses to the chemical stimulation of its pleasure mechanisms. The brain's controls then become adjusted so that unmistakable discomfort results if the chemical is not supplied. Thus, chemical and psychological addictions are developed at the same time. Breaking a chemical addiction may be simple compared with breaking the psychological addiction. In fact, a psychological need for chemically induced pleasure drives even occasional users to repeat drug use.

On Marijuana and Sex

The magnification effect fails, and the sensory endings become anesthetized.

Some adults begin to use marijuana in an attempt to revive their failing sexual powers. They say marijuana does this by expanding the sense of time and by increasing the senses of touch, sight, and hearing. The aphrodesiac effect some users claim marijuana has can also be explained through the power of suggestion. Because the user believes in the effect, he actually feels the effect, at least for a time.

If the user, however, becomes tolerant of the drug and begins to take larger doses or more potent kinds of marijuana, he may find that he is decreasing the amount sensory information his brain interprets as pleasurable. The magnification effect fails, and the sensory endings become anesthetized. The sense of touch diminishes. As a result, although marijuana may seem to enhance sex at the beginning when taken in small doese, it becomes progressively less satisfying as a sexual stimulant.

Older users who take marijuana to enhance their sex lives may find that at first the novely itself increases their desire and makes the sex act more exciting. With continued use, however, their pleasure usually decreases. If they stop using the drug, they may find that they have become conditioned to arousal only with the aid of the drug and so cannot perform without it. If they are willing to try higher doses, the numbing effect increases and they may have difficulty reaching a climax. They may blame their difficulties or impotence on advancing age. Many of them, however, could probably recover their physical and mental health through the proper effort.

The vigor or failure of the sexual capacity is usually not dependent on the sexual organs. These organs are merely appendages of the skin, and, except for trauma or prolapses that may affect either man or women and which rarely occur. the sexual organs remain mechanically functional for the life of the individual. The sexual reflexes – sexual inclination, erection, preorgasmic events, orgasm, and postorgasmic changes – all center in the brain.

Many separate brain functions are involved in the sexual cycle, including the functions of both divisions of the autonomic nervous system (the divisions of the brain below the level of consciousness that rule over the vegative functions of the body and also regulate mood). The norms for the balance of the functional divisions of the brain necessary for sexual activity are probably narrower than for other types of responses. In the young and healthy person, the brain is able to compensate for much disturbance of the balance of the divisions of the autonomic nervous system brought on by alcohol, marijuana, or more powerful drugs. Thus, in the young, the sexual functions may not show many signs of disturbance. With age, the autonomic nerve centers lose their capacity to adjust, and the sexual response mechanisms are much more likely to be severely affected.

Effects of Marijuana on Other Mental Functions

There are, however, many marijuana users in factories and offices who appear to be normal but who suffer chronically from an altered judgment that may affect the quality of their work.

We have all seen examples of the tragic effects of marijuana on the mind. Marijuana smokers seem to suffer from distorted emotional responses, disordered thinking, dullness, and slothfulness. Early in the use of the drug, these behavioral changes appear to be reversible, but as exposure continues, recovery is less and less complete. Those most severely affected are usually not employed. There are, however, many marijuana users in factories and offices who appear to be normal but who suffer chronically from an altered judgment that may affect the quality of their work.

The most extensive study of the lingering effect of the hemp drugs was conducted at the request of the Egyptian government by Professor Soueif. Over a period of twenty-five years, he observed 850 cases of hemp-drug users, which he matched against control cases. Both the users and the controls were given standardized tests of mental function. The tests showed that "those with a higher level of education and/or intelligence – show the largest amount of deterioration from marijuana use." It appears that the cumulative detrimental changes induced by marijuana result in impaired judgment and a diminished capacity to take responsibility.

Marijuana has an adverse effect on the performance of high-level jobs. The user is frequently lethargic, lacks motivation, is prone to error, has trouble remembering important details, and cannot think practically about the future. These transformations are gradual and are not marked by the obvious signs of impaired ability; it is easy to spot the alcoholic, but not so easy to spot the marijuana user.

The dullness of the marijuana user appears long before he can actually be called amotivated. Although there have been no proper quantitative studies of the degree to which marijuana use induces carelessness, lack of attention, or failure to achieve the highest job performance level, the cost of marijuana use to the individual and to society appears to be high. In industry there appears to be as much reason to limit the job responsibilities of the marijuana user as to limit those of the alcoholic.

Studies of the influence of marijuana on drivers have shown that marijuana impairs judgment and reduces the driver's ability to gauge distance, speed, and road conditions. The severely altered behavior typical of the chronic marijuana user suggests that driving performance would be impaired even between uses: the user is never free from the burden of the active material.

There are other reasons for believing that the judgment of marijuana smokers is impaired. Marijuana users often accept the use of LSD, heroin, or cocaine, while the non-users reject these more powerful drugs. The adverse effects of marijuana ranks next to the adverse effects of opiates as the reason given for admission to federally financed treatment centers. Marijuana use interferes with practical success and produces alienation, sometimes mild, but sometimes severe enough to be called paranoia.

Recognizing the marijuana user in the early stages of use presents a problem. The appearance of the residues of the cannabinoids in urine can be used to indicate use within the past twenty-four hours. The level of THC in the blood, fat, or feces can be used as an indication of the average level of intake over a period of many months. Chemical testing for these residues is now possible but expensive; rapid, inexpensive methods will probably be developed. A legal issue will then arise: Does a firm have the right to require that employees take a test for marijuana use?

A Case History

Until recently most of the requests I received for advice about marijuana were from people in their teens and early twenties. Now I am receiving more and more requests for help from older people.

Recently an executive who read my article in Private Practice telephoned me. "Your article described me," he said. "It enabled me to comprehend how desperately I need help." He had started to use marijuana a few years ago, he told me, at the invitation of a just-out-of college salesman he had hired. He found smoking marijuana a great way to unwind and began to smoke more and more frequently. "I now roll and smoke a joint six or seven times a day," he said. "To have enough appetite to eat, I usually have to start smoking before breakfast. If I haven't stoked up since the previous evening, I get so paranoid by morning that I can't bear my awful thoughts. I got my wife started on marijuana, and now she is even worse off than I am. She has begun to have headaches continuously. We've tried to quit now for several months, but we can't; we need help. What shall we do?"

Bit by bit, under my questioning, he revealed that his income, which had been quite high, had fallen to a minimum. He had changed from a robust, healthy, enthusiastic, sexually active man, in love with his wife and devoted to his family, to a man emotionally empty and sexually and physically inactive. He and his wife, he felt, had stayed together only because there was no better alternative for either of them. He has begun, he said, to lose weight—his buttocks are now too thin to sit on a hard chair; his face is thin and sallow; his fingers tremble; and his memory plays tricks on him. His wife's headaches have become worse and worse. (From interviews with drug users, I have found that women get headaches after prolonged exposure to marijuana, whereas men get headaches during withdrawal.) Both he and his wife desperately want to return to the life they had before they started smoking marijuana.

They are already on the way back, for they sincerely want to stop using marijuana. But to be able to abstain completely, they will undoubtedly need professional help. Their recovery should be striking after six months of abstinence; their full recovery will probably take several years.

Recent research indicated that marijuana is far from harmless, and . . . chronic use can produce adverse psychological and physiological effects. Therefore, its use should be strongly discouraged as a matter of national policy.

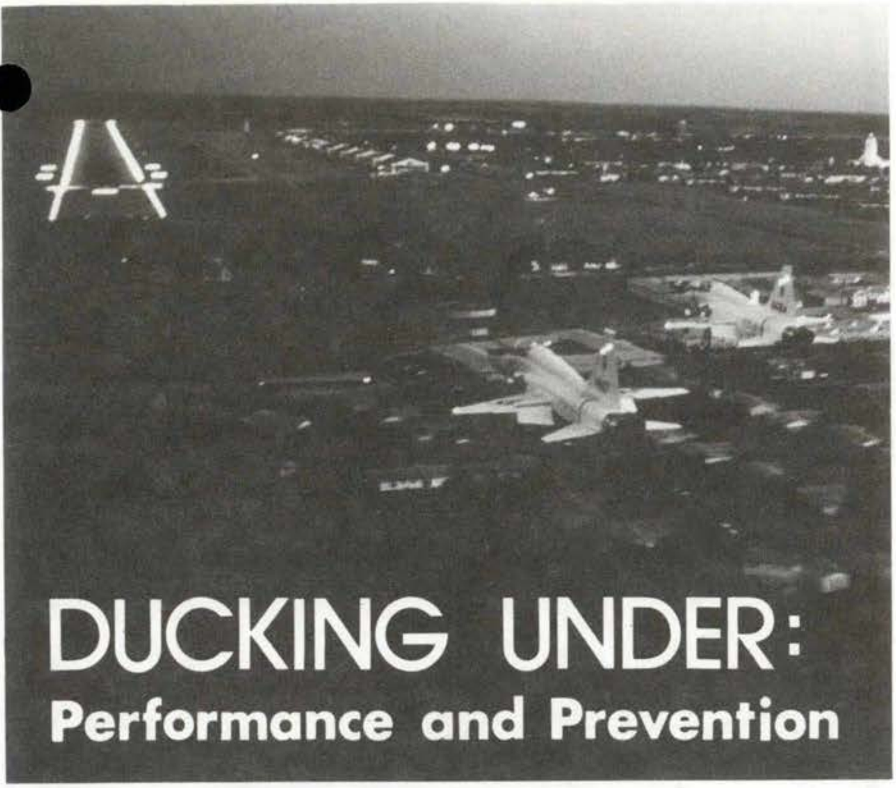
The belief that marijuana is safe has become so entrenched that the steadily mounting proofs of its dangers are ignored. The political movement to "decriminalize" (legalize) marijuana has distracted attention from the health hazards. There are those in government, education, and science who have chosen to cope with the marijuana problem by making light of it or by condoning the use of the drug. For example, the following statement was treated merely as a footnote in the 1976 Annual Report to the President by the Domestic Council Drug Abuse Task Force. "Recent research indicated that marijuana is far from harmless, and . . . chronic use can produce adverse psychological and physiological effects. Therefore, its use should be strongly discouraged as a matter of national policy." When such statements as this are buried in footnotes, it is easy to see why people become confused.

This situation must change, for, in my experience, people are eager to know the facts. When I explain the effects of marijuana to audiences, someone always asks, "Why haven't we been told this before?"

I believe that if people know the evidence indicating the real dangers of marijuana, they will be discouraged from using it. In my teaching of drug abuse courses at the University of California, and in my counseling around the world, I have found that by explaining how the brain functions and how marijuana affects this functioning, I was able to help people stop using the drug and to keep others from experimenting. The study of the brain is fascinating. The brain is the master control for both mind and body. It governs sensations, moods, thoughts, and actions, not by a magical process, but by a complex series of chemically regulated controls that are easily upset by sensual drugs. People become interested in knowing about the programming of sexual development in the brain; how the brain's control of sexual functioning and sexual dreaming can be disturbed by drugs; how drugs can cause the brain to make colors appear brighter, sounds clearer, and odors more intense; how drugs distort images and the sense of time. They learn the causes of drug-induced hallucinations, flashbacks, memory loss, pleasure and pain, and changes in mood. They are usually surprised to learn that these effects occur in the brain and that, although fascinating, they are indications of disturbed brain function.

All that we are is in the interactions of our brain cells.

Our thoughts and perceptions as normal persons cannot be improved by drugs. All that we are is in the interactions of our brain cells. With this understanding of how our brains work, the false notion that the mind is expanded by drugs can be replaced by a more profound appreciation of the complexity of our being. When orders induced by drugs are interferences rather than additions to perception, they will be in a better position to reject the use of mind-altering drugs. ★



DUCKING UNDER:
Performance and Prevention

Captain Ron Sams • 9th Air Refueling Squadron • Beale AFB, CA

A few years ago, eleven of Boeing's most experienced instructor pilots all crashed in the same day. Though the average flight time logged by these captains was over 10,000 hours, each landed short of the runway. Nobody was hurt, because these crashes took place in the simulator.

Actually, the pilots were part of an experiment that was conducted to determine why four 727's had crashed in rapid succession during landings at Tokyo, Cincinnati, Salt Lake City, and Chicago. A model of a lighted city was constructed which was visible from the simulator windows. Each pilot was instructed to perform a visual approach using all instruments except the altimeter.

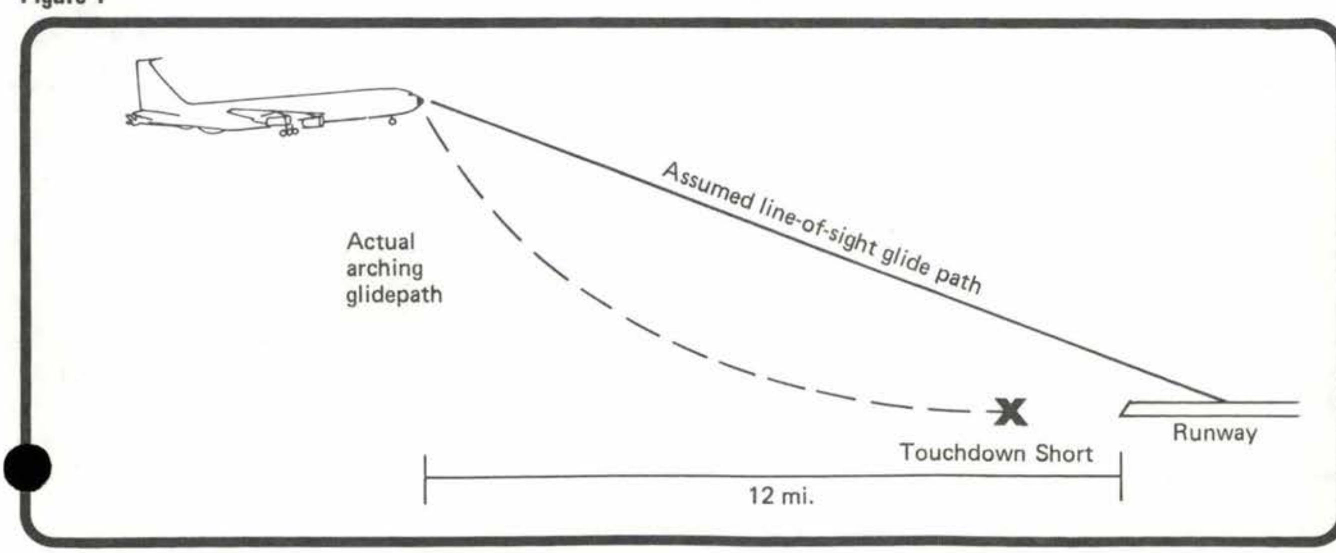
In effect, this experiment simulated what happens when the pilot leaves the instruments and "goes visual" for landing. Eleven of the twelve pilots in the simulator experiment landed short. (One guy made it safely. He was a former Navy carrier pilot.) Each pilot was somewhat dazzled by his unspectacular performance, because this should have been a "piece of cake" maneuver. It wasn't.

Why would eleven highly experienced pilots duck under the proper glide path and land short? The study concluded that perhaps there was more to the duck under problem than simple pilot error. The pilots in the experiment were actually being asked to solve a problem which exceeded normal visual ability.

Given the proper set of circumstances, any pilot will duck under, regardless of experience level or eyesight. As an instructor pilot, I've seen many duck under maneuvers performed, especially at night. Usually the pilot believes that perfect glide path is being maintained and is mildly outraged when I direct a go around. Why don't pilots recognize a duck under? To find out, let's discuss some visual phenomena which serve to deceive even the most proficient pilot.

Assume we are shooting a straight-in approach from approximately 12 miles (fig. 1).

Figure 1



Though line-of-sight is a straight line, it's possible for the actual flight path of the aircraft to follow the arc of a circle whose circumference hits the ground short of the airport. As the aircraft arcs below glide path, the pilot shifts his aim point up in the windshield and maintains line-of-sight with the touchdown target. The pilot assumes that a precise glide path is being flown, yet the aircraft is actually arcing toward a touch-down point short of the runway.

Our eyes are especially deceived at night, and a number of factors can contribute to a duck under. Beware of approaches over dark water or land where there are no lights below or to the side of the aircraft. It is impossible to visually judge your height above the terrain. Sloping or irregular terrain surrounding the airport, or an extremely wide or narrow runway present sensory illusions. Subconsciously, the glide path will be adjusted to reproduce the visual approach picture you're used to seeing (i.e., the home drome syndrome). This may cause you to duck under and land short.

When smoke, fog, haze or other obscurring factor reduces the brightness of the lights below, it can create an illusion that the airplane is too high. This can cause you to prematurely lower the glide path angle or visually change your aim point. There are many other circumstances which can create visual illusions and cause you to duck under, but let's discuss what happens to the airplane when the pilot ducks under.

Consider a KC-135 flying a normal 2.5 degree glide path (fig. 2). Remember, the main landing gear is about 65 feet behind and 14 feet below the pilot. If the pilot maintains a precise 2.5 degree glide path, the main landing gear will cross the runway threshold at approximately 25 feet above the runway (assuming no landing flare). Using the standard 1,000 ft visual aiming point, there is surprisingly little room for error.

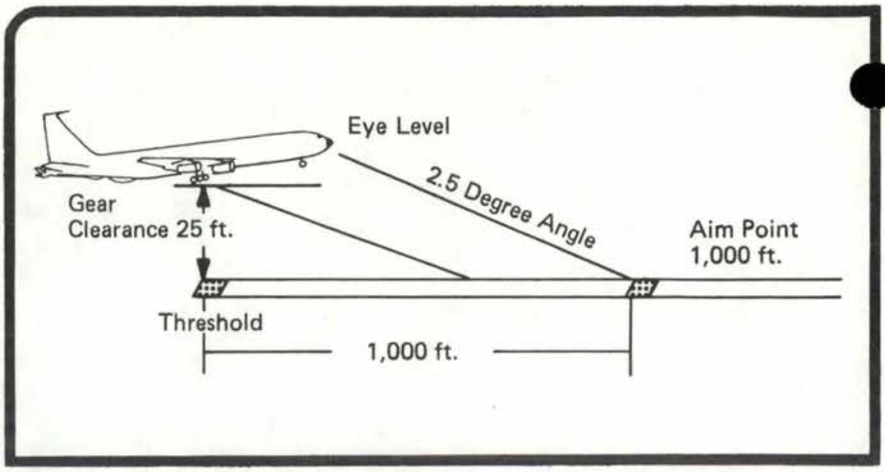


Figure 2 Approach path with normal 2.5 degree approach angle and 1,000 ft target visual aim point

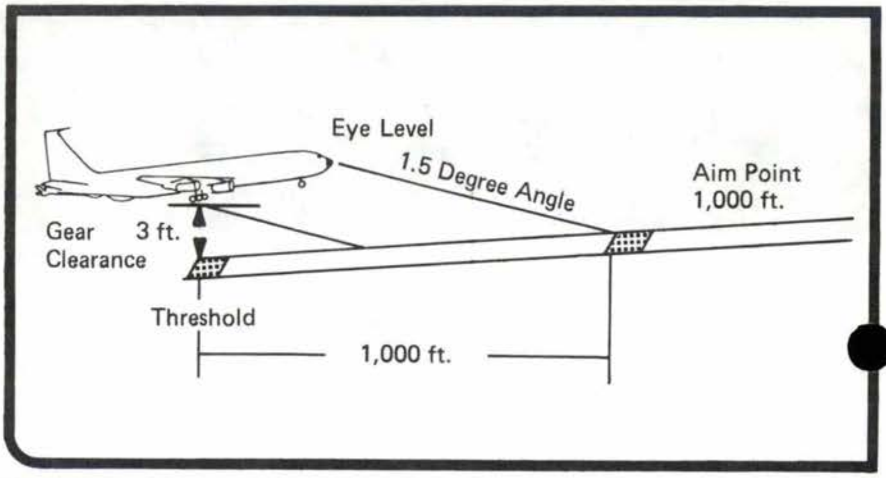


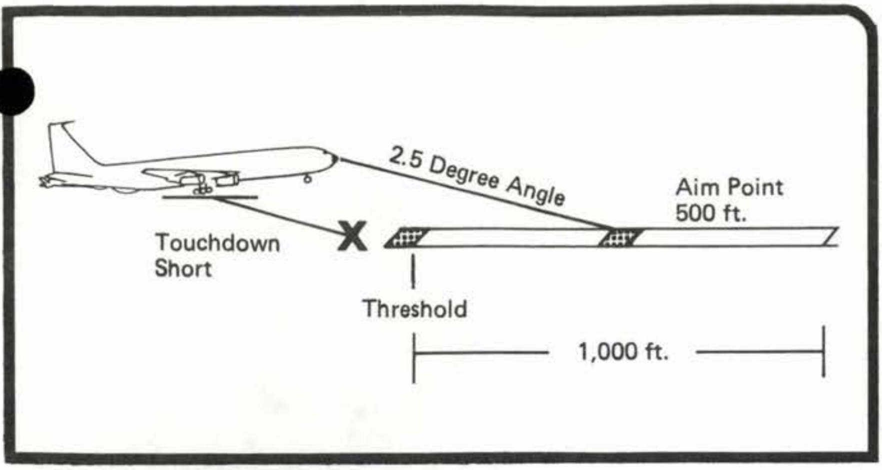
Figure 3 Approach path with 1.5 degree approach angle and 1,000 ft target aim point

Now let's add some visual illusions and consider the possible effects. Suppose the pilot shoots an approach to a runway with a 1 degree upslope. Believing that the airplane is too high, he ducks under and changes his glide path to a flatter 1.5 degrees (fig. 3). At this shallower, dragged-in approach angle, the landing gear will cross the threshold at approximately 3 feet.

Next, let's suppose there is a smoke, dust or fog layer which is lying low across the touchdown zone of the runway. The pilot maintains the 2.5 degree glide path, but changes the visual aiming point from 1,000 ft to 500 ft (fig. 4). The airplane will touchdown short of the runway.

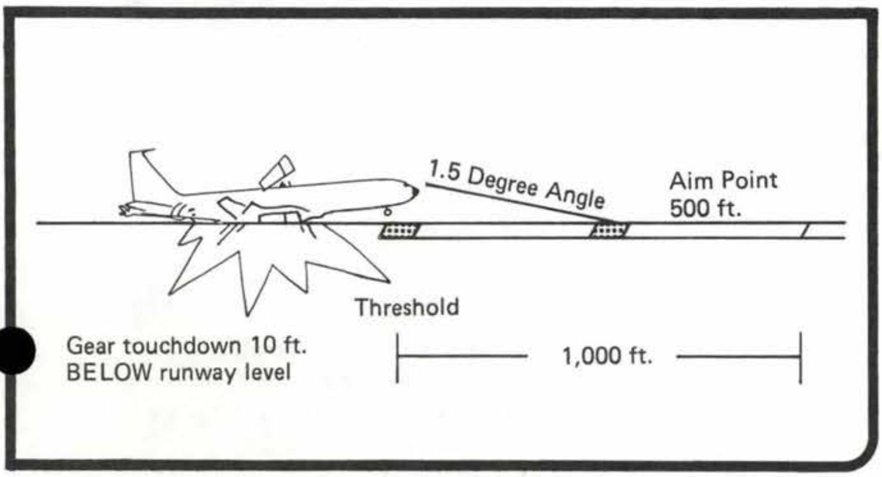
Finally, let's discuss the most dangerous case. Suppose the pilot is shooting a night precision approach in the rain. Let's assume that he disregards his instruments at minimums and ducks under to get below a ragged ceiling. Let's further assume that he also changes his visual aiming point closer to the end of the runway in a misguided attempt to provide additional stopping distance. The pilot has committed two sins. He has changed his glide path to 1.5 degrees *and* changed his aim point to 500 ft. In this case, the landing gear will try and touch down 10 feet below the runway at the threshold! (Fig. 5)

If you are on course and glide



Approach path with 2.5 degree approach angle and 500 ft. target aim point

Figure 4



Approach path with 1.5 degree approach angle and 500 ft. visual aim point

Figure 5

path when you break out at minimums, don't radically change anything. Yanking the power off and diving at the runway in order to establish what you think is a "normal" approach creates a high sink rate close to the ground. This is hazardous to your health. If you level off from a duck under using just the elevator, you will quickly find yourself in a poor thrust/life relationship.

At approach speeds, a small increase in AOA causes a relatively large increase in drag, thus requiring more than normal thrust. If the throttle setting is too low, there may not be enough engine spool up time stop the sink rate. The flatter the approach angle, the more difficult it is to visually detect any rate of change. Therefore, the pilot flying a dragged in approach may not realize his aircraft's sink rate is greater than his means to stop it. If you add a sudden wind shear, the situation quickly becomes hopeless.

How do we prevent duck under maneuvers? First, admit to yourself that your eyes can lie to you, and that your "normal" approach may not be normal at all. There are too many visual illusions to fake out your eyes.

Secondly, don't give up vertical guidance (i.e., ILS glide slope, PAR glide path or VASI) after you go visual. Have your copilot cross-check the glide slope while you are visual. Once you go full scale below the glide slope, or red over red on the VASI, it's impossible to tell exactly how far below the proper glide path you really are.

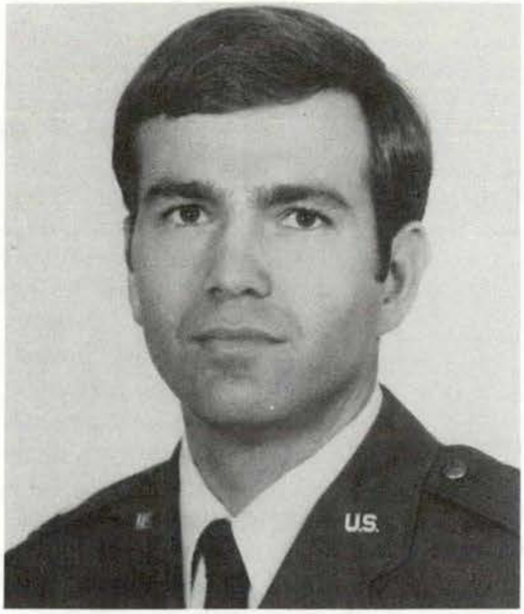
Remember your altimeter. If the approach has published altimeter checkpoints, use them. Monitor your descent rate. For a 2.5 to 3 degree glide path, the rate of descent should be approximately 700 feet per minute. If your VVI is grossly out of that parameter, it should tell you something. You either have a strong headwind/tailwind, or a duck under.

Your radio altimeter can be used to help determine your absolute altitude after you go below the DH/MDA. One technique is to have the pilot not flying the approach call off the radio altimeter readings at 100 ft, 50 ft, and 20 ft. This is not designed as an order to flare for landing, but as an additional cross-check for height above the runway to aid the pilot's depth perception.

Remember that the performance of your jet right now has been determined by what you did a few moments before. If your approach is stable, on glide path and airspeed, and the airplane is properly trimmed, nothing drastic should happen when you look outside at minimums. At some bases, the PAR glide path and the VASI may not agree, so don't let it sucker you into ducking under. If you're fighting to stabilize the approach, take it around.

The last 200 to 300 feet of any approach demand the utmost in professional discipline. The safest approach, considering the stopping distance and the landing gear clearance over the threshold, is along a normal 2.5 to 3 degree approach path using a visual touchdown target 1,000 feet down the runway. The possible consequences of ducking below those parameters are devastating.

The next time you find yourself well below the glide path, or VASI red over red, remember what happened to a handful of Boeing IP's. They crashed in the simulator. You may not be so lucky. ★



CAPTAIN
Donald A. Roberts

CAPTAIN
Ronald B. Lunsford

187th Tactical Reconnaissance Group
Dannelly Field (ANG), Montgomery, Alabama

On 19 July 1978, Captains Donald A. Roberts and Ronald B. Lunsford were flying a day low level reconnaissance mission in an RF-4C at 500 ft AGL and 600 kts when the master caution light illuminated. The aircraft utility hydraulic system had been lost. Captain Roberts began a climb toward home base as Captain Lunsford confirmed through the rearview mirrors that hydraulic fluid was streaming from the aircraft. A chase aircraft joined to escort the disabled aircraft home. The tower was notified that an approach end arrestment would be necessary. Enroute, Captain Lunsford completed an exhaustive preview of procedures for emergency gear and flap extension and barrier engagement. When the emergency gear lowering system was activated, only the right main and the nose gear extended, the left main remaining full up. This condition was visually confirmed by the chase aircraft. Captains Roberts and Lunsford assessed their situation and decided to land the aircraft. All attempts to extend the hung gear were fruitless. Captain Roberts instructed his chase aircraft to land and set up an orbit to allow other inbound aircraft to land. Captain Roberts requested the base to foam the runway and disconnect the MA-1A on the approach threshold. A slightly flat and fast approach was decided upon to enhance aircraft control during the landing phase. When fuel was reduced to the preplanned fuel weight of 2,000 lbs, the approach was begun and the aircraft touched down 500 feet in front of the cable. The left drop tank contacted the runway momentarily but Captain Roberts was able to elevate the wing until barrier engagement, thus preventing damage to the cable. As the aircraft slowed down, it began to skid to the left uncontrollably and a fire ignited in the left drop tank area. The aircraft stopped on the runway 85 feet left of centerline and the crew safely egressed. The only damage to the aircraft was a destroyed drop tank and a small amount of fire damage to underwing surfaces. The high standard of airmanship and crew coordination demonstrated by Captains Roberts and Lunsford, their thorough evaluation of the situation, and their totally professional execution of emergency procedures prevented the loss of a valuable aircraft. WELL DONE!

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
William O. Spradling, Jr.

CAPTAIN
James F. Wilson

35th Tactical Fighter Squadron

Captains Spradling and Wilson, flying an F-4D, were number two in a close air support mission. While maneuvering at 420 knots and 10,000 feet, there was a noticeable loss of thrust and Captain Spradling saw the left engine rpm decreasing through 80 percent and noted low fuel flow on the left engine. The rpm stabilized below idle, so the aircrew elected to shut down the engine and attempt a restart which was unsuccessful. Captain Wilson requested a snap vector toward Kunsan AB, notified the SOF of the emergency and that a single engine approach was planned. When the speed brakes were lowered to increase drag, the utility hydraulic pressure fluctuated below operating limits. Approach control told the aircrew to expect a GCA. During landing gear lowering, the utility hydraulic pressure decreased to zero and all three gear indicated unsafe. Captain Spradling then extended the landing gear using the emergency lowering system. The empty external wing tanks were not jettisoned through the overcast due to populated areas below and because of the likelihood of their striking the gear and compounding an already critical situation. The aircrew informed the SOF of the loss of utility hydraulics and their intention to engage the departure end barrier. Captain Spradling positioned his disabled Phantom on a 15-mile, 250 knot final approach at 5000 feet MSL. Shortly after they entered the undercast at 3000 feet MSL on a 5-mile final GCA, transmissions became unreadable, whereupon Captain Spradling transitioned to a TACAN final approach. The aircraft broke out of the overcast at 1000 feet MSL and 2 miles on final. Once the landing was assured, power was reduced to 200 knots for touchdown. When past the approach end barriers the hook was lowered and a successful departure end BAK-13 arrestment was accomplished. The exceptional airmanship and professional reaction of Captains Spradling and Wilson to an in-flight emergency resulted in the successful recovery of a valuable aircraft. WELL DONE! ★


B.C.
by johnny hart
SHOW ME A PILOT SITTING ON HIS CHECKLIST...
AND I'LL SHOW YOU A GUY FLYING BY THE SEAT OF HIS PANTS.
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