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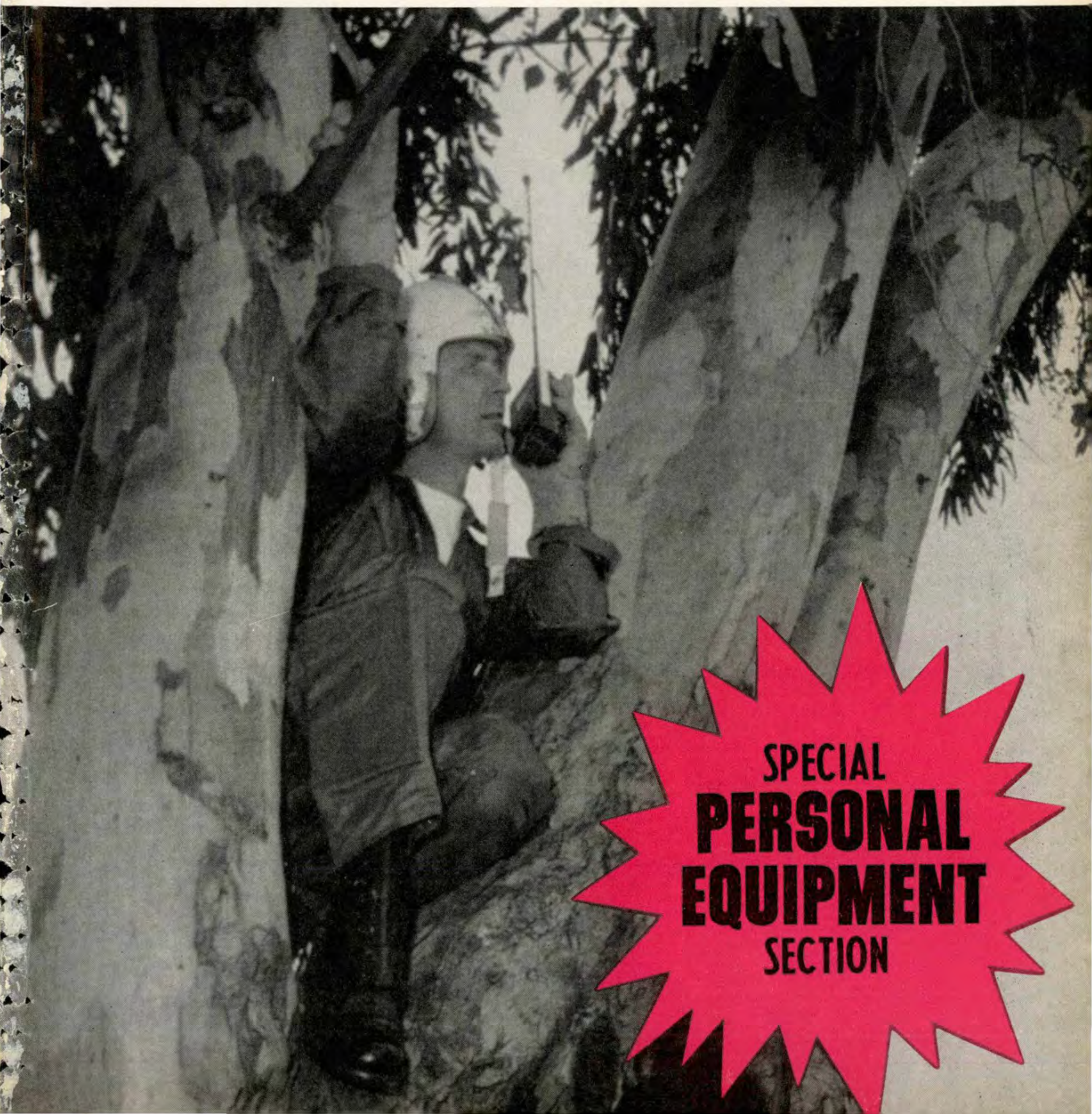
Aerospace SAFETY

THE MAGAZINE DEVOTED TO YOUR INTERESTS IN FLIGHT



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June 1967 AFRP 62-1 — Volume 23 — Number 6

FEATURE ARTICLES

REGULAR FEATURES

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THE INSPECTOR GENERAL

LT GEN THEODORE R. MILTON, former Chief of Staff, TAC, has been assigned as The Inspector General, USAF. He succeeds Lt Gen Glen W. Martin, who has been named Deputy Chief of Staff, Plans and Operations, Hq USAF.

General Milton graduated from the U. S. Military Academy in 1940 and became a rated pilot in March 1941. During World War II he served in the European Theater as group operations officer and group commander in the Eighth Air Force. A B-17 pilot, he led the historic October raid on the ball bearing plants at Schweinfurt, Germany, and the first daylight raid on Berlin.

General Milton attended the Air War College in 1953 and since then has served in a variety of positions including executive assistant to the Secretary of the Air Force, Commander of the 13th Air Force, Clark AB, Philippines, and Deputy Chief of Staff, Plans and Operations, PACAF, where he remained until he became TAC Chief of Staff. ★

101 CRITICAL DAYS

You've probably heard that phrase before but if you haven't, it refers to the highest accident potential period of the year — the Memorial Day weekend through Labor Day. This year that's from May 27 through September 4.

Boiled down to its essence, the mission statement of the Directorate of Aerospace Safety would be this: Prevent accidents. To accomplish this we in the safety business do our best to assure, through education, that Air Force people understand the hazards they are exposed to both on and off the job. We do everything in our power to provide the safest possible environment in which to work. We cannot, however, control the environment off base where most of you will be spending much of your time driving and engaging in off-duty occupations during the summer months. The highways, lakes, rivers, mountains and seashores are outside Air Force jurisdiction. These are the places we are most concerned with during the months ahead and that is where you take over. That is where the only people who can prevent accidents are those who are going to be the victims, one way or another. By this I mean those who are going to be killed, injured or assessed for the blame.

Now if you think I am passing the buck to you, you're right. It is time we look this problem of accidents right in the eye and say, unequivocably, that the real accident preventer is the guy who prevents the accident. If this sounds like double talk, consider: No safety expert can exercise your judgment as to how well you can swim and, therefore, how far out in the lake you can safely go. No one but you can make the decision as to whether gasoline is going to be used to start a barbecue fire. No one, including the flight surgeon, or your family doctor, can specify an exact limit as to how far you can exert yourself in hiking up a mountain, or running in the surf with your kids. There is only one person in the world who can sit behind the wheel of your car and exercise the judgment and skill necessary to keep you out of trouble on the highway — that's you.

I realize that I'm handing you a tall order when I ask that you be a safety expert, a doctor, a professional driver and probably a specialist in several other areas during the critical 101 days ahead. But I know that there isn't a person in the Air Force who can't be all of these things for himself and his family, if he is aware of the hazards and is determined to protect himself and those he loves from them.

Of course, I don't know all of you, but I know a lot about you in a general way. And I do know this, and so do you, if your country didn't need you in the military service you wouldn't be wearing an Air Force uniform.

Think about that a little while and you will realize what an important guy you are: to your country, to your Air Force, to your loved ones and to yourself. Regardless of rank, years of service, job specialty or your age, to all those I mentioned, YOU are a V.I.P. But remember, one thing that can remove you from that exalted status is a foolish accident that would put you out of action. Let's see how well you can do this summer to prove that you deserve the rank of VERY IMPORTANT PERSON. ★

Frank K. Everest, Jr.

FRANK K. EVEREST, Jr., Brig Gen
Director of Aerospace Safety

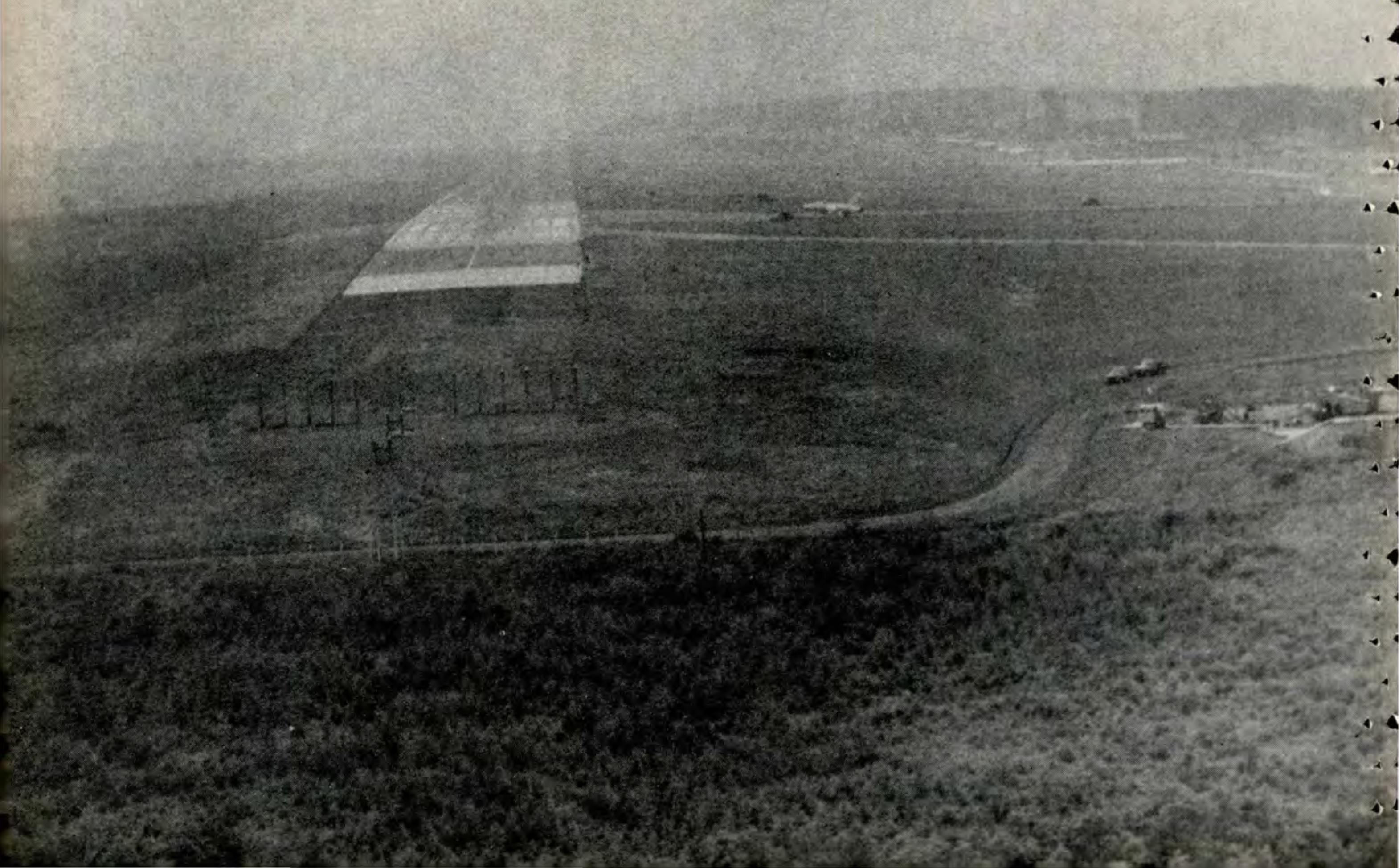
RUNWAY VIS

How many times have you been diverted because of poor visibility while trying to make it back to home base? Now, RVR may make it possible to land even though minimums say No.

Soon you will be hearing a strange new term as you make an instrument approach. Suppose you are approaching Home Plate AFB on a foggy night after a long flight—looking forward to that martini and the wife and kids—and the RAPCON controller reports the weather at "300 feet overcast, one-eighth mile visibility in fog, RVR 2400 feet." Remembering the visibility minimum is one-fourth mile, "Damn," you say, as your vision of a martini by the fireplace with your family is replaced by memories of the weak martinis and tough steaks at the O Club at Podunk AFB, your alternate. But wait a second, what was that last part about RVR? What's that?

The new AFR 60-27 contains a new method for determining landing minimums by using RVR, or Runway Visual Range, which the regulation defines as "An instrumentally derived value reported in hundreds of feet representing the horizontal distance a pilot will see down the runway." Or, in simpler terms, visibility down the landing runway. The regulation then proceeds to set up landing minimums for various approaches in terms of both prevailing visibility and RVR. *(AFR 60-27 is being implemented incrementally. As of magazine deadline RVR has not been implemented.—Ed.)* Although this new version of 60-27 does not specifically so state, it implies that RVR, if available, will be used to determine whether an approach can be

Lt Col Henry E. Sievers, Hq AWS, Scott AFB, Ill.



UAL RANGE

made. And certainly, in most cases it will be to the pilot's advantage to do so. To understand why, we must delve into the visibility determination problem a little more deeply.

Visibility is a rather vague term, meaning different things to different people. To the meteorologist it means the light transmissivity of the air, or the amount of diminution of light per unit path length. To the pilot in flight it is how far ahead he can see recognizable features on the ground, or other aircraft, and to the landing pilot on an instrument approach it is how far he can see the approach or runway lights. In an effort to distinguish between these various types of visibility, they have been given several different and often confusing names and abbreviations.

The meteorologist, for example, generally uses prevailing visibility, abbreviated VSBY, which is the average distance an observer can recognize a known object, or 25 candlepower light over at least half the horizon circle.

The Weather Bureau uses a term *Runway Visibility,* abbreviated *RVV,* which is the distance an observer can recognize a known object or 25 candlepower light, looking in the direction of a given runway. Until recently, we in the Air Force used our own version of runway visibility, abbreviated *RV,* which represented the distance in miles that a pilot could see the runway lights, when set to their maximum intensity. And finally we have *RVR,* now used by both civil and military meteorological services and which we think gives the pilot the most important visibility information—how far he can see the runway lights on the landing runway.

You can readily see that the weather observer is caught between the goal of giving the most complete weather information possible to the pilot and the controllers, and the necessity for keeping the weather report simple and short so the user can understand it. The Air Weather Service has therefore adopted, with the Weather Bureau, the procedure of reporting prevailing (meteorological) visibility at all times, plus reporting the visibility on the landing runway (RVR) when it is critically low. Thus, RVR is reported whenever it is below 6000 feet or the prevailing visibility is one mile or less.

You might wonder how we determine how far a pilot can see the landing lights. Obviously, we can't have a pilot landing every few minutes reporting the RVR conditions. Neither can we keep a weather observer stationed at the end of every runway. So the Weather Service uses an instrument called the transmissometer which measures the amount of light attenuation over a 500-foot path located near the touchdown point of the runway. Many tests under conditions of poor visibility have resulted in an equation relating the readings from this instrument to the distance that the landing pilot can see various intensities of runway lights. For the mathematically minded, the equation used is shown below.

The mathematics are not important, but the fact that the values we plug in are empirically determined is. Thus, the RVR value you are given represents the distance that an average pilot in an average airplane will see the runway lights, assuming that the conditions at the instrument sensor are representative of the entire visible distance. Now nobody will admit to being an average pilot, and certainly the C-141 is no average airplane, so how can the RVR be accurate? The answer is that it's the best approximation that the weather man can give you under all conditions. Remember the definition, *an instrumentally derived value representing the horizontal distance a pilot will see down the runway.* Perhaps it should have been more accurately stated as representing the distance an aver-

RVR Formulas

$$\log t = \frac{b}{V}\, 2 \log \frac{V}{5280} + \log \frac{E_t}{I}$$

where t = transmissometer reading

E_t = pilots visual illuminance threshold (empirically determined to be 1000 mile-candles)

b = path length of sample (usually 500 feet)

I = intensity of runway lights (25 to 10,000 candles)

V = RVR in feet

For daytime RVR, a somewhat simpler equation is used:

$$\log t = \frac{b}{V} \log e_o$$

where e_o is the pilots contrast threshold (empirically determined to be .055) age pilot will see under average conditions.

Another note of caution to keep in mind when using RVR: The RVR measured by the weather observer and transmitted to the tower or RAPCON for further dissemination to the pilot, is a one minute mean value, based upon existing runway light setting, which in turn is determined by the visibility *and* the existence of traffic. With no departing or arriving aircraft, the lights usually are kept at a low value (light setting 2 or 3) to conserve power. Thus, if you are the first traffic at a base in some time, you may get an RVR based on a lower light setting that will be in use when you land. If the RVR is in the critical range (near or below minimums), you should ask if a higher light setting is available, before making a final decision to land or divert to your alternate.

The RVR that the observer transmits on the weather teletype, for off-base use is a *10-minute* mean value based upon the highest available light setting, normally 5. A 10-minute mean is used for this purpose because it has a higher "predictability" value. The use of the highest available setting also standardized the reports so that pilots and controllers can know what the highest visibility conditions are likely to be at the time of landing.

Despite the minor limitations previously discussed, in thousands of landing tests conducted by FAA before the RVR concept was adopted and in many more since then, RVR has proven to be remarkably useful to the pilot. So much so that pilots of civil airlines have demanded, and get, RVR readings from

Table 1. Comparison of prevailing visibility with RVR (assuming homogeneous distribution of obstruction to vision, such as fog).

PREVAILING VISIBILITY		RVR (feet)					
Miles	Feet	Lightsetting (day)			Lightsetting (night)		
		3	4	5	3	4	5
1/8	660	900	1500	1900			
3/16	990	1000	1300	1500	1100	1300	1500
1/4	1320	1400	1500	1900	1500	1700	2000
1/2	2640	2640	2640	3100	2800	3300	3700
3/4	3960	3960	3960	4000	3960	4700	5500

Table 2. USAF Landing Minimums

RULE	IF APPROACH IS	AND TYPE OF APPROACH IS	THEN MINIMUMS ARE		
			Ceiling	Visibility (in statute miles)	RVR
1	PRECISION (see notes 1 and 2	ILS with US Standard (A) approach lights	200 feet	1/2	2400 feet
2		ILS without US Standard (A) approach lights	300 feet	3/4	4000 feet
3		PAR with HIRL and US Standard (A) approach lights	100 feet	1/4	1600 feet
4		PAR with HIRL and other than US Standard (A) approach lights	200 feet	1/2	2400 feet
5		PAR without HIRL or approach lights	300 feet	3/4	4000 feet
6	NONPRECISION (see note 3)	Range, ADF (straight-in)	400 feet	1	
7		TACAN and ILS Localizer only	300 feet	1	
8		VOR, VOR-DME and surveillance (ASR)	300 feet	1	
9		UHF/VHF/DF, Airborne Radar and UHF Beacon	500 feet	1	
10	CIRCLING	Category A	400 feet	1	
11		Category B	500 feet	1	
12		Category C	500 feet	1½	
13		Category D/E	600 feet	2	

NOTES:

1. At U.S. Navy aerodromes with 100 ft/1/4 mile for PAR approaches without HIRL and approach lights separate Air Force minimums will be published.

2. Touchdown zone and centerline lighting is desired but not mandatory. Secondary runways may use 100-1/4 for PAR if lighting requirements are met.

3. Visibility minimums for TACAN, ILS Localizer, VOR, VOR-DME and ASR may be reduced to 1/2 mile IAW TERPs criteria.

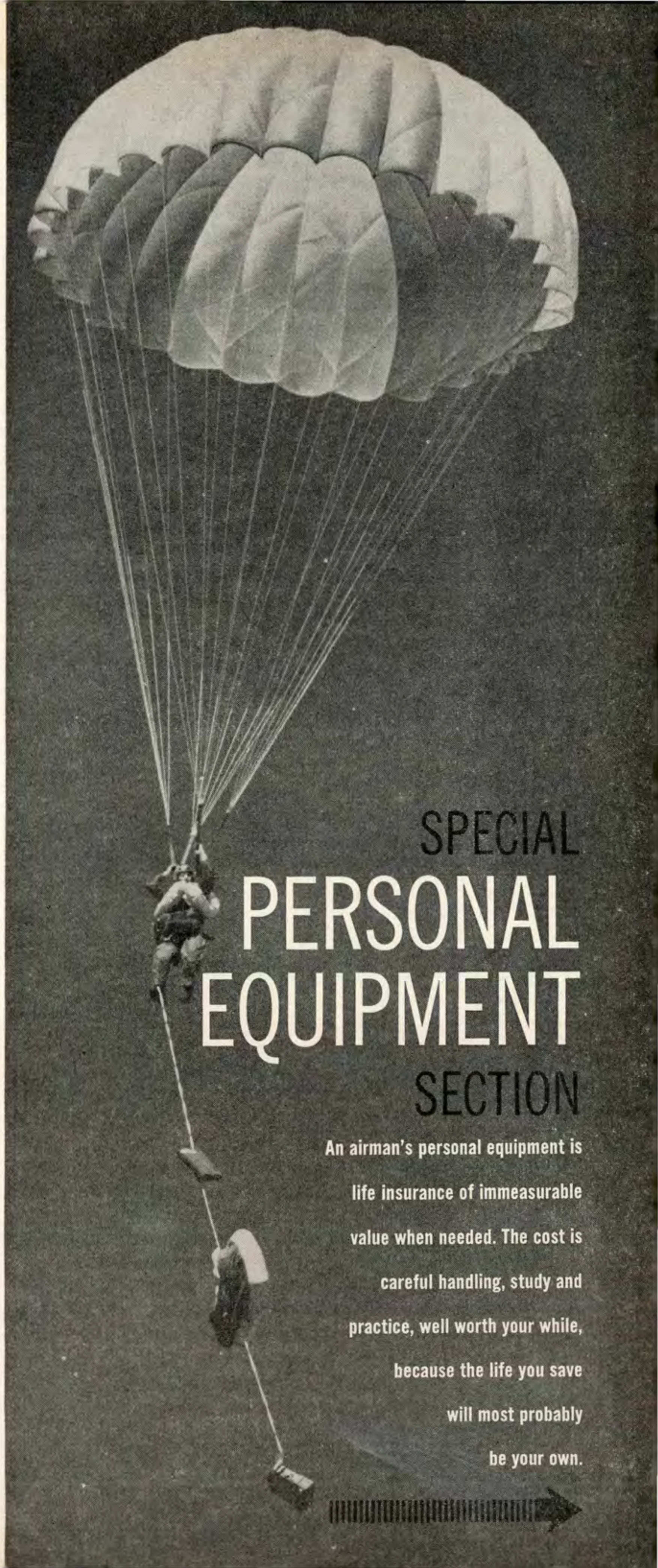
For further information refer to AFR 60-27.

each of the several runways at such airports as O'Hare and JFK, on which to base their landing decisions. In fact, so useful is RVR as an indicator of the pilot's ability to see the runway and make a safe landing, that FAA approves the use of RVR alone (without regard to ceiling height) to determine whether an instrument approach can be initiated. The Air Force has not as yet seen fit to do this, but perhaps we will do so after gaining more experience with the use of RVR.

Now, what does RVR mean to you as a pilot? First, because high intensity runway lights can be seen farther than the 25 candlepower lights used in determining "prevailing" visibility, RVR will usually be greater than prevailing visibility, thus perhaps permitting safe landings when prevailing visibility is below landing minimums. (Table 1)

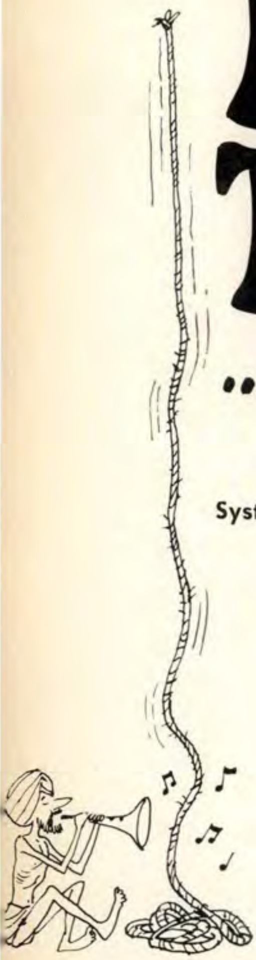
Second, because RVR is measured along the landing runway and is thus more representative of actual landing conditions than prevailing visibility, FAA and USAF have in certain cases established RVR minimums lower than the prevailing visibility minimums. Thus, for an ILS with standard approach lights, the prevailing visibility minimum is one-half mile (2640 feet), but the corresponding RVR minimum is 2500 feet. (Table 2)

So, to return to the hypothetical case of Home Plate AFB, which we assume has a PAR with standard approach lights and published minimums no higher than those established in AFR 60-27 (100 feet ceiling, RVR 1600 feet). With an RVR of 2400 feet you can begin your PAR approach legally and with every expectation of being able to see the runway by the time that decision height has been reached. So maybe the old man will get home tonight after all. If happiness is a dry martini, it may also be RVR on a foggy night. ★



Rope Trick

...IN REVERSE



Howard F. Holton,
Systems Engineering Division,
W-P AFB

Following a successful ejection from an F-4C, one of the two crewmembers was injured when he fell while descending the trunk of a tree in which he landed. The other pilot got hung up in the tree and could not get down.

This story has a good ending in that both men were rescued. But it could have been happier had this crew been equipped with a new device designed to prevent just the sort of predicament these crewmembers found themselves in.

In many of the jungle areas of Vietnam the trees are as much as 200 feet high with an upper canopy of dense foliage 25 to 50 feet thick, a limbless region 50 to 75 feet in depth below this canopy, and a second canopy of foliage 25 to 50 feet in depth. Below this it is clear to the ground. Military aviators descending by parachute over the jungle can become marooned in the top of the jungle canopy. Obviously, this is undesirable.

Now, however there is a means for a survivor to lower himself from the tops of such trees. It's called a personnel lowering device.

This equipment consists of a steel rectangular frame 1-5/16 inches wide and 2-3/8 inches long, with a fixed bar one inch from the top of the frame. A sliding adjuster is installed in the space between the fixed bar and the top of the frame. A hook is positioned at the bottom of the frame to engage the device to the "V" ring of the parachute chest strap. Two bails are located on the back of the frame at top and bottom to guide a 2300-pound tensile strength nylon webbing which is reeved around the fixed bar and sliding adjuster.

The nylon webbing exiting the top of the frame is sewn into a 1¼ inch steel ring. A 27-inch length of 2300-pound webbing is sewn to the opposite side of the ring and terminates in a hook with safety guard. The nylon webbing exiting from the bottom of the frame is hand tacked to the parachute harness at the point where it enters the back pad of the parachute. The remainder of the 150-foot continuous webbing is stowed in 20-foot hanks inside the converted back pad. The device, ring and hook are kept in a small pocket

This small, potent package replaces the old parachute comfort pad for SEA and other selected areas. The photo gives a close look at the hardware stowed in the harness pouch.

Study your situation carefully. DO NOT TRY TO FREE CHUTE. DO NOT MOVE ABOUT EXCESSIVELY.
(1)

Remove lowering device hardware from pocket on harness.
(2)

Pass webbing thru "V" in both risers and fasten hook (A) to ring. (B)
(3)

tacked to the parachute harness above the ripcord and below the left canopy release. The webbing stowage pack replaces the parachute back comfort pad and thus does not occupy additional space. The only significant bulk added to the standard parachute is the 2″x 2″x4″ pocket.

To operate, the marooned survivor removes the device from the pocket (Fig 2) and passes the 27-inch length of webbing through the risers of the parachute above the canopy releases as illustrated. He connects the hook (A) to the ring (B) in the webbing (Fig 3). He next engages the hook at the bottom of the sliding frame (C) to the D-ring of the parachute chest strap (Fig 4), and then actuates the canopy releases one at a time. He is then suspended from the entangled parachute canopy by the 2300-pound webbing.

The webbing coming out of the back pad and around his body exerts sufficient drag to hold the survivor. The webbing is then pulled out of the pack to arm's length. By permitting the webbing to enter the device from below at a slight angle, the survivor's body weight will start the descent. Since the device is at this time approximately in front of the survivor's face, control of the descent can be maintained by lifting the entering webbing at right angles to the device to stop motion. The webbing is held stationary relative to any limbs or branches to avoid abrasion, cutting, or burn damage. This facilitates maneuvering through limbs, branches, and foliage. If the webbing is kinked inadvertently, the survivor can grip the webbing above his head, lift himself slightly and release his weight which will pull the kink through the device. The last 25 feet of webbing is dyed yellow to identify the approach of the end. The end of the webbing is sewn back against itself to provide a stop.

The weight of the lowering device assembly is two pounds, three ounces, and it replaces an eight-ounce back comfort pad which results in a total increase to the parachute weight of one pound, 11 ounces. A special installation is provided F-4 aircrewmen that integrates with the Martin-Baker parachute and seat. This installation is in a lumbar pad attached to the torso harness and is a replacement for the lumbar pad provided with the parachute. Tests have shown this installation to be superior to the earlier lumbar pads provided with the parachute and seat and nearly equal to the lumbar pads in use at the completion of this development.

The lowering device, developed at Wright-Patterson AFB by Systems Engineering Group engineers and an experimental parachute fabricator, is presently under contract and has been given a federal stock number. Designated, in its various configurations, PCU 9, 10, 11 or 12, it comes for the following parachutes:

PCU 9 — seat style parachute

10 — back pack automatic

11 — convertible for non-auto back and seat styles

12 — Martin-Baker integrated harness, F-4 aircraft. (The PCU 12 configuration is not yet final.) ★

Fasten hook on the sliding frame (C) to the D-ring of your chest strap.
(4)

Actuate canopy releases one at a time while holding webbing at 90-degree angle to sliding frame.
(5)

Pull webbing out of back pack to arm's length and . . .
(6)

Feed webbing slowly thru sli ing frame from slight angl below, and complete descen
(7)

SAVED BY

Lt Col Robert J. Destiche
Aeronautical Systems Division
W-P AFB

Could you ever find a similarity between a mod-dressed teenager on an American main street and the Air Force flyer in a survival situation in Vietnam? It may be "way out," baby, but each is clutching a transistor radio and both are seeking recognition.

The teenager's transistor may be tuned in to the local "jump" station but it's his clue to success with the girls. In the air crewman's case, it could mean his life.

Survival radios have come a long way since the "Gibson Girl" cranked out her plaintive message. Today in combat ready units the URC-10, or its modified counterpart the RT-10, is an airman's most prized survival possession. Countless lives in Vietnam have already been saved by its proper use. Unfortunately, there have been some users who didn't operate it properly or were unaware of its capabilities and limitations.

My purpose is not to tell you how the URC-10 or RT-10 functions or how to work it. If you want to know how it works, I suggest you read the T.O. or talk to a communications specialist. If you want to know how to operate it—and you should—please consult your personal equipment specialist. In addition, you should receive training in its operation, preferably by actually handling the unit and practicing with it. Check your operations officer for the training, but be sure you obtain clearance before using the radio in a practice situation. Remember! It operates on Guard frequency.

My objective is to give you helpful hints on operational use of this radio — hints that could save your

"SAVVY"

ANTENNA PATTERN FOR URC-10 (RT-10) SURVIVAL RADIO (NOT TO SCALE)

life — and facts on its operation that cannot be found in any T.O. and, perhaps, not from some of your most experienced survival or personal equipment specialists.

To understand the capabilities and limitations of this miniaturized radio transceiver, let's look first at how it sends out its signal. Figure 1 shows the transmitting pattern for its antenna. Note that its ultra-high frequency emission is in a kind of doughnut pattern. This means that the radio gives its best performance with its aerial at a right angle to the ground. Also note this can cause decreased transmission efficiency directly over the tip of the antenna, perhaps even a *cone of silence* like navigational radio ranges.

Recently in several rescue incidents in Vietnam poor radio contact was reported. The rescued air crewman later told debriefing officers he could not understand it, because he could see the rescue bird and kept pointing his antenna directly at it. Poor procedure? No. Poor training!

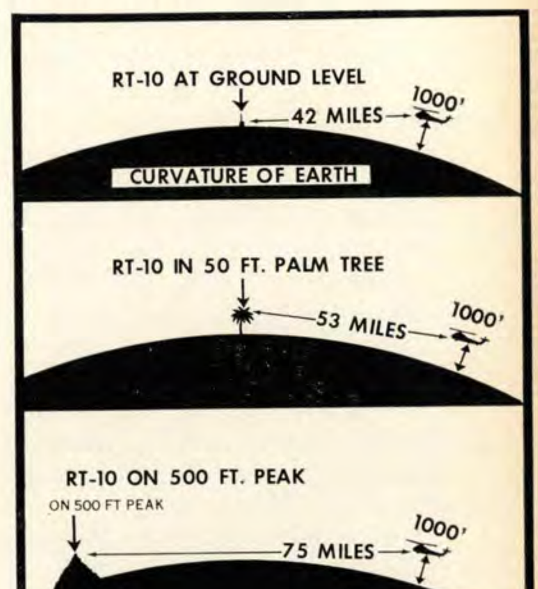
To prevent such occurrences, Air Force is rushing through a decal to put on the radio saying: "Keep Antenna Straight Up," but a decal isn't much help in the Stygian gloom of a Vietnam jungle! Training, familiarity, and practice are the answers.

Since the URC-10 (RT-10) is a UHF transceiver, its signal pattern is *line of sight* (Figure 2). Other factors being equal, the downed airman betters the chance of someone's picking up his signal by increasing the height of his antenna. For example, with the rescue bird at 1000 feet, transmission from the ground has maximum contact range of 42 miles; with an antenna height of 50 feet, the contact distance stretches to 53 miles; at 200 feet, the range increases to 62.5 miles. These distances are based on maximum battery power but they emphasize the value of increasing the height of your transmitting location in contacting rescue aircraft.

In survival there is an old axiom about "according to the situation" which certainly is true here — but, if you don't want to compromise your concealment, your secure location, etc., it is best to find high ground, perhaps even to climb a tree. Remember, you can buy roughly another five miles of transmitter pattern with every 50-foot increase in antenna altitude!

Two other major factors influence your transmitting range: battery power and the physical conditions under which you are transmitting. Radiating power of the URC-10 is 200 milliwatts minimum. At this power, you can expect at least 50 operating hours at 80°F (when alternately transmitting half-an-hour and receiving half-an-hour). Your preflight check should include assurance that the battery is fresh. *Within two years of manufacture* is the current criterion but the Air Force is now rushing procurement of Battery Tester, TS-2530/UR, which will give an accurate reading of remaining useful battery life. Temperature affects battery power; cold decreases battery life. That is why the URC-10 has a separate battery and a three-foot cord, so the battery can be kept warm inside the flyer's clothing in a cold weather survival-rescue situation. If you have an RT-

SHOWING "LINE OF SIGHT" TRANSMISSION



10 (battery; built into back of radio) and are downed in cold weather, you can get better radio performance (and longer useful battery life) by keeping the entire set warm or slipping the battery out and keeping it warm before you use it.

If the signal's having to pass through solid or partially solid objects, transmitter power (and range) will be decreased. This is called attenuation by the electronic experts, which means dilution. Perhaps the most common factors affecting a downed airman's transmitting range are trees, vines, foliage. In Vietnam, for example, the jungle can consist of three layers of almost impenetrable foliage. The effect of this cover is not yet fully known but the best educated guess of the survival and electronics experts is that the deepest jungle decreases your transmitting power by one-half. This could mean that your range from ground level is decreased to 21 miles with the aircraft at 1000 feet.

All this adds up to the possibility that the best place to hide may not be the best place to transmit. When you add that it is also not the best place to get picked up, well, it means you should begin to exercise your skill and training to improve your survival situation.

A final factor which you must understand is: On "sweep tone" your transmission is more quickly identified by the receiver, more easily recognized as a distress signal, and much more easily "homed in on." A rule of thumb is: Use "sweep" until you have the rescue bird in sight.

The Air Force places a high value on your survival and, for this reason, usually gives you "belt and suspenders" in survival radios. Currently, the Radio Beacon Set, AN/URT-21 (or equivalent), is located in your parachute and activates automatically in bailout. Excellent! But remember that this beacon operates on the same Guard channel as does your URC-10 or RT-10. If you dispose of your parachute for any reason, be sure to activate or destroy (dependent upon the situation again) the transmitting ability of this beacon if you plan to use your survival radio. The beacon's transmission can block or garble your voice and seriously affect your sweep tone.

Finally, and we hope you never need to apply this information, we must discuss how best to dispose of the URC-10 or RT-10 radio in case your need for it ceases or if your capture is imminent. In our last paragraph we will discuss how very resistant this little radio is to applied destructive force. To effectively damage it with bare hands is practically impossible. Simple tools such as rocks, heavy limbs, or hammers, can do the job but will take you a while and you'll make plenty of noise, usually too much if your situation is critical. Also, as you've been taught in survival schools, you must always think of escape if you are captured. Therefore, separating the radio and battery is the best step to take. Bury each separately in a manner and relationship to each other that only you know. Try to orient yourself so that you can locate one of the spots again. It may be only a remote hope but *hope* will be your most valuable mental asset in the difficult time to come.

If time does not permit planning, separate the battery and radio, break off the antenna of the radio as close to the case as possible, and dispose of the battery and radio sections separately by burying, submerging in the largest pools of water available, or flinging them in opposite directions. Any and all effective means must be used to eliminate the possibility of the enemy's compromising the radio for disastrous use against your buddies.

The URC-10 (RT-10) has been built to take it. Parachute opening shocks, hard knocks, and scramble evasion tactics should not impair its operation. (In your training you should have seen the set with its back off and observed its components embedded in foamed plastic.) Still, some care should be given the unit, as reports from all over the world say that, next to the parachute, this radio is your most valuable survival tool. Take care of it and it will take care of you.

(In addition to the points made by Lt Colonel Destiche, we'd like to add these: There have been reports of antennas breaking or being damaged during parachute landing when the antenna was pulled out in the survival vest. Also, there have been reports of antennas being broken during the E and E scramble.

There have also been reports of damage to the base of the antenna housing caused by aircrew or PE techs slamming the antenna back into the radio with too much force. This could occur right after a radio check prior to flight. Then you are stuck with a malfunctioning radio. One other thing you should know. With both antennas attached, range will decrease. We suggest you remove the flexible antenna and save it for an emergency in case the telescoping antenna gets broken. — Ed.) ★

Personal Equipment Notes

P. E. TIP. Captain L. King, Equipment Manager at Andrews AFB, Md., writes that a "Personal Equipment section had discovered the foam plastic liner is being removed from the HGU-2A/P helmets, for the installation of the AF HGU-2A/P62 foam liner assembly. This is not in accordance with the instructions issued by Cal-Mil Plastic Products, Inc.

"These instructions state: 'Remove all sizing pads. Remove communication earcups and attaching hardware leaving only the earphone motors connected to the headset cord wires.' Removal of the foam liner decreases the protection offered by this helmet. Personal Equipment activities should re-evaluate their procedures for installing the AF HGU-2A/P62 foam liner assembly."

This one really threw us for a loop. After many phone calls we found that the "HGU-2A/P62" is a manufacturer's part number. The correct nomenclature for common use is HGU-17/P helmet liner insert. This insert does not replace the foam liner, but is in addition to it.

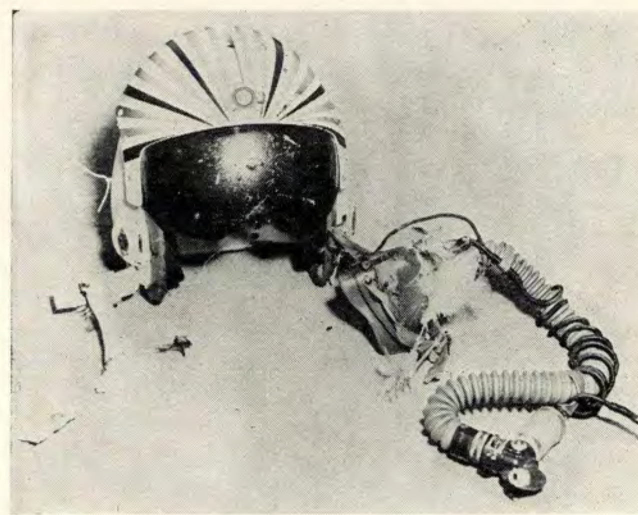
This is a timely letter in that these liners are going to be hitting the field in increasing numbers. Don't make the same error. T.O. 14P3-4-72 is in publication now and should be out shortly.

EJECTION NORMAL, however here's a new preflight item for clipboard users. An examination of the pilot's mask after a recent successful ejection revealed a sizable mark caused by a blow from some object.

In another no injury ejection, the pilot's visor was broken by some object. The objects were finally identified as the pilot's clipboard. During the first cited ejection, the strap and metal piece which holds the strap onto the clipboard broke. It was discovered that the strap and metal pieces were worn excessively prior to this occurrence and, therefore, could not take the stresses during ejection. In the second case the top half of the clipboard was the culprit.

The potential hazard is obvious. Moral of the story: don't use old or worn equipment.

Maj Michael G. Filliman
Directorate of Aerospace Safety



HELMET VISOR DOWN definitely prevented major injuries and loss of aircraft when, during low level navigation, a hawk struck and shattered the front canopy. Bits of glass and bird were all over the cockpit. But the aircraft commander was unhurt, although, as photo shows, his helmet was shattered. The pilot in the rear cockpit didn't fare so well. His visor was up and he sustained cuts and bruises by chunks of bird and glass.

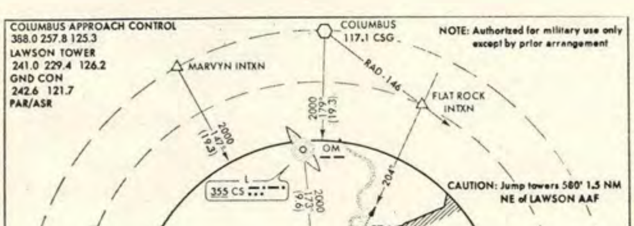
BIRDSTRIKE WAS NOT BLAMED for a recent incident involving a T-38 but here again the result emphasizes the importance of having your visor down even though you might be flying at a bird-free altitude. The canopy shattered spontaneously in flight and bits and pieces of jagged plexiglas showered the crew. Fortunately both pilots had their visors down and were not injured. Unfortunately FOD to both engines forced their successful ejection.

the I.P.I.S. approach

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

STUDY THAT PROFILE

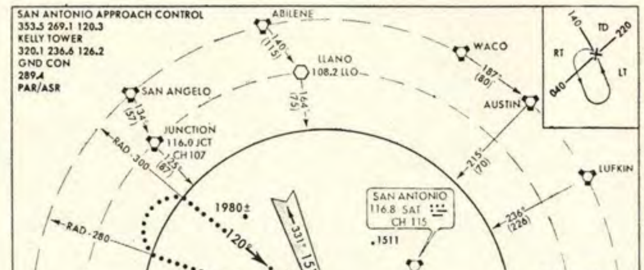
How good are you at interpreting an approach chart? We have observed that most errors made in executing a published instrument approach procedure involve the *profile view*. Either the pilot misinterprets the profile or he fails to observe *critical* descent or course change requirements depicted on the profile. In most situations a thorough study of the entire approach chart, integrating both the plan and profile view depictions, would have prevented the error. The following are three examples of profile view depictions which could be misinterpreted if not carefully studied.



EXAMPLE 1

Example #1 depicts an ordinary low altitude ADF approach utilizing a procedure turn. No problem here unless the pilot fails to note the 10-degree course change from 032 degrees to 022 degrees for the final approach.

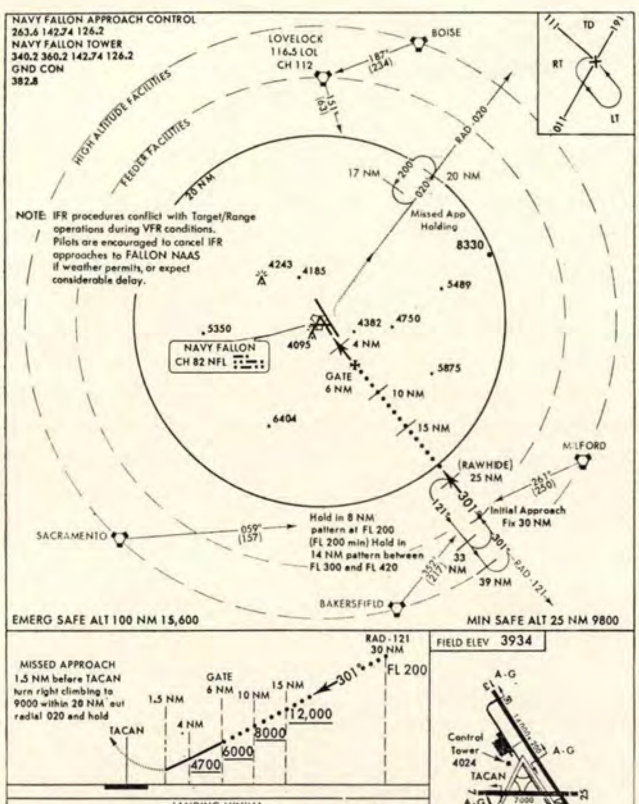
Normally, the minimum altitude depicted at the



VOR/ILS RWY 15

EXAMPLE 2

outer marker on combined VOR/ILS or TACAN/ILS approaches is associated only with the ILS approach. This altitude merely identifies the altitude at which the aircraft should be when passing the OM on glide slope. Therefore, when executing the VOR or the TACAN final approach, this OM altitude can normally be disregarded, and descent to minimums can be started after crossing the final approach fix (VOR station or TACAN gate). However, this is not always true. Example #2 depicts a VOR/ILS where the OM is also the final approach fix for the VOR approach. Note the asterisk indicating the altitude restriction until crossing the OM and the Time Distance Table, which indicates the RBn/OM as the FAF. Starting your descent to 1190 feet at the VOR might bring you *surprisingly* close to a 1210 foot obstruction located between the VOR and the OM. Also, premature timing will leave you approximately four miles short of the runway.



EXAMPLE 3

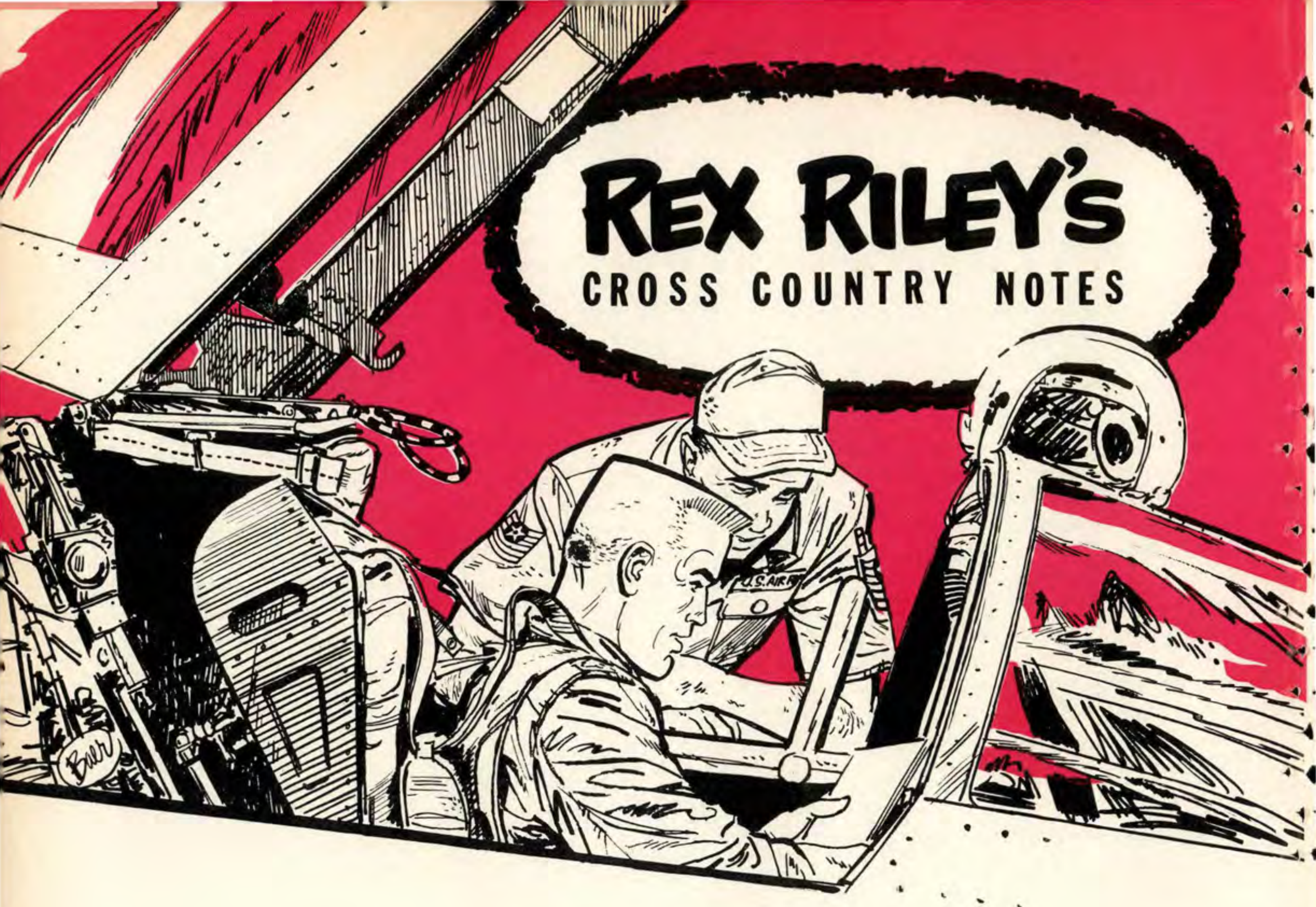
Example #3 depicts a simple straight-in TACAN approach. Imagine what might happen though if you misread the *8000* minimum altitude at the 10NM fix for the minimum altitude at the 15 NM fix. Can't happen? Well, this error was given as the probable cause in the crash of a civil airliner while executing a VOR/DME approach in a light snowstorm in mountainous terrain. All 29 persons aboard perished in this 1964 crash.

The capability and desirability of ATC to provide radar enroute descents to a precision approach handoff point has resulted in most of us flying fewer and fewer *published* instrument approach procedures. It follows that the less we use approach charts the less familiar they become. Add to this diminishing familiarity the growing use of TACAN procedures which have greatly increased the *variety* of chart depictions, e.g., straight-in, off-set, arc, teardrop or "you name it." It seems apparent, therefore, that most of us should spend more time studying the entire approach chart prior to starting an approach. Failure to include any one section of the chart could prove fatal – *especially the profile.*

The need for a word of caution pertaining to use of the ILS glide slope indicator has recently become apparent. The widespread use of radar vectors and enroute descents has resulted in situations where pilots have attempted to "fly" ILS glide slope signals prior to intercepting localizer course and/or at excessive distances. Glide slope usable distance is flight checked to at least 10 to 15 miles, depending upon equipment type. There is no guarantee of usable signals beyond these distances unless the published procedure depicts a glide slope intercept point at a greater distance. The ILS glide slope should not be flown until the aircraft is inbound on the localizer, i.e., less than full scale CDI indication. In addition, if the glide slope is flown prior to the glide slope interception point, pilots should insure that:

(1) Altitude restrictions associated with the approach are not violated, and

(2) The glide slope warning flag is not visible. ★



SAFETY is seldom a funny subject, but a bit of humor quite often is the clincher that gets the message across. A good example, I think, is the following item on C-130 birdstrikes taken from the Safety Bulletin of the 64th Troop Carrier Wing at Sewart AFB.

"So far this year, C-130s assigned to the 64th TCW have emerged victorious from three major engagements. The score to date is:

	64th TWC
Chicken Hawk	(1) Confirmed Kill
Black Footed Albatross (Gooney Bird)	(1) Probable Kill
Unknown (probably Gooney Bird)	(1) Probable Kill
Starlings	(40) Confirmed Kills
	BIRDS
C-130s	(4) Inflicted damage classed as less than minor.

"It would appear that at our present kill rate we should eventually sweep the enemy from the skies. Unfortunately, because of his vast numerical superiority, and the ease with which he produces new models, our efforts have had little total effort upon his operations. We, however, are finding ourselves in short supply of our two most formidable anti-BIRD weapons: leading edges of wings and pylon tanks. Until such time as a more easily replaceable anti-BIRD weapon can be procured, all aircrews of this Wing should avoid engagements with the enemy whenever possible.

"To facilitate implementation of this policy, the following intelligence is provided:

A. Although occasionally sighted at relatively high altitudes, most BIRDS are low level types; rarely operating above 3000 feet.

B. Many of the larger, more effective types are water based. Therefore, increased activity can be expected in the vicinity of rivers, lakes, ponds, swamps, and islands.

C. BIRDS conduct operations year round, but in temperate climates activity is heaviest in Spring and Fall, as most units rotate north and south with the seasons.

D. BIRD tactics are unpredictable. However, reports indicate that DUCK type BIRDS usually dive to avoid collision. Anticipate this and do not dive with them.

E. Special Note: A large unit of Black Footed Albatross (Gooney Birds) is stationed at Midway from November through August. This type is especially effective. It has up to a seven-foot wing span and may weigh 20 pounds. Expect intensive and determined activity over and near Midway during the above months. Activity is usually very low level. Local sources report few contacts or sightings above 100 feet.

"It is hoped that through increased aircrew vigilance and improved intelligence, further battle damage can be eliminated until such time as more economical weaponry than aircraft components can be procured.

"UNHAPPINESS IS: Being in the first Herky Bird downed by a Gooney Bird."

Come September, *Aerospace Safety* will mark its 20th Anniversary. The editors have asked me to help gather suitable materials for that issue — such as pictures, comments or reports from pilots about the airplane they were flying 20 years ago. And, please don't overlook the ol' Gooney Bird. This airplane was airworthy and in business before our outfit became the U.S. Air Force, and is still in business in Vietnam as "Puff the Magic Dragon."

Any material sent to the Editors by 15 July will be appreciated. Photos will be returned.

THEY'RE THERE TO HELP YOU! Another classic example of the pilot-controller aid society in action came across my desk the other day. The growing number of midair collisions and near misses makes this one particularly worthy of note.

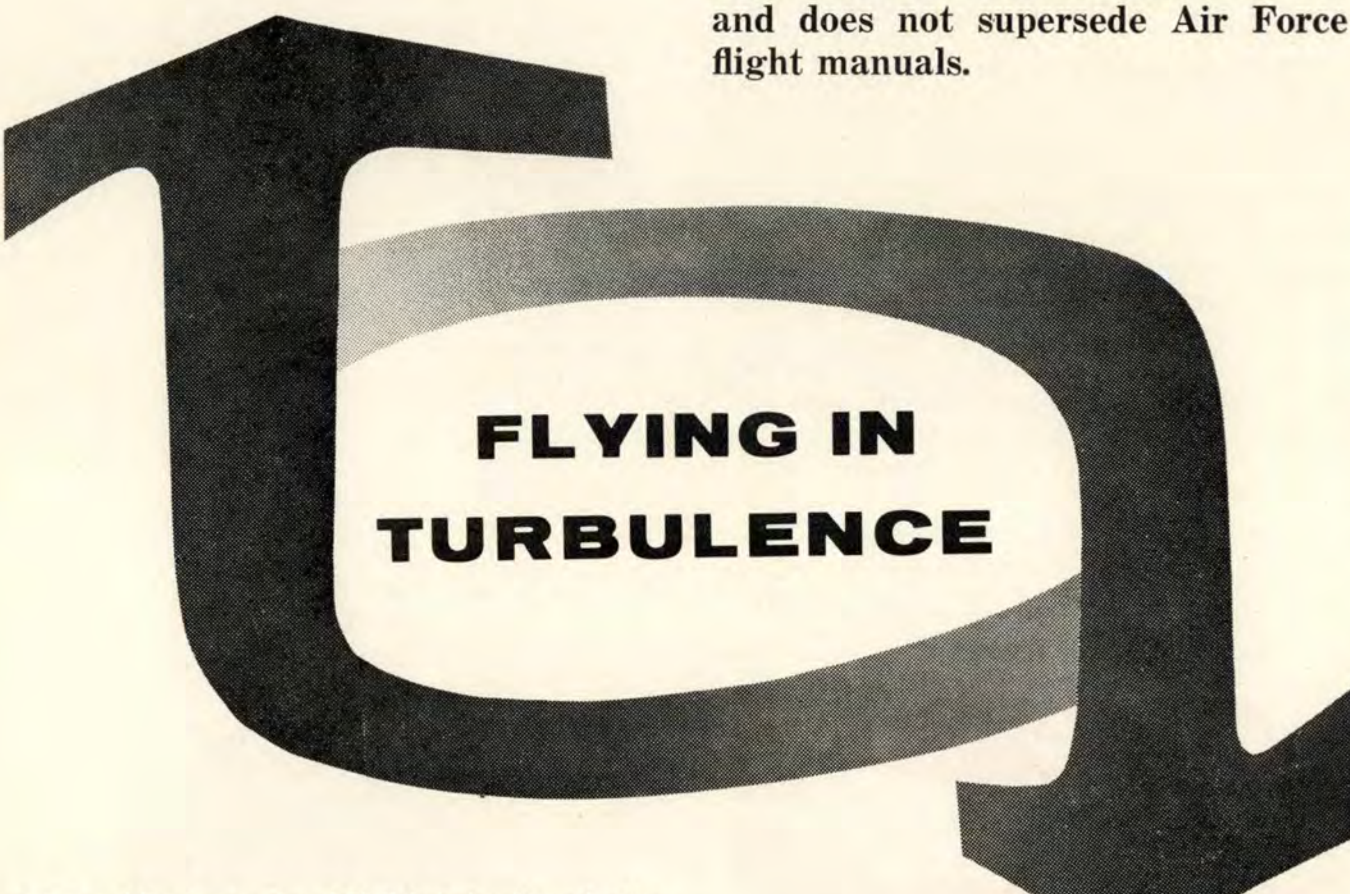
A C-141 was cleared cross country on stateside airways intending to maintain flight level 330. During level-off at FL 330 the elevator artificial feel light illuminated, the pilot's airspeed, mach, and altimeter started increasing, and the overspeed warning sounded. The pilot's airspeed, mach, and altimeter increased to maximum tape readings and remained there. While this was happening the copilot's airspeed, mach, and altimeter readings became erratic and started a general decrease. Maintaining VFR on top the pilot requested a chase aircraft.

Working together, two Centers requested that an F-101 intercept and assist the stricken aircraft. With assistance from Center, the intercept was completed at flight level 380, evidence that the C-141 pilot had only a very rough idea of his actual altitude. A short time later the Center elected to change chase aircraft to a T-39 because its approach speed capabilities are much closer to the C-141 than those of the F-101. While descending from 15,000 to 12,000 feet, information from both the pilot's and copilot's flight instruments returned to normal and the aircraft completed an uneventful landing at the nearest suitable airfield to ascertain the cause of the malfunction.

Water in the pitot static systems apparently was the culprit because 10 to 13 drops were extracted with the aid of a compressor. The fact that instrument readings returned to normal when the aircraft descended through the freezing level was further proof of the cause factor. The Centers had a chase plane for the pilot just a few minutes after his request. How's that for service?

A SALUTE to Lt Col (Doc) Richard M. Chubb, who has received the Harry G. Moseley Award, the highest award in the field of safety given by the Aerospace Medical Association. (Col Harry G. Moseley was chief of the medical safety division, this Hqs, when he was killed in a T-33 crash, in 1958.) Prior to Dr. Chubb's present assignment as commander of the AF Dispensary at Danang Air Base, he was a member of the medical staff of the Deputy Inspector General. During his tour here, he participated in many accident investigations, authored several articles for *Aerospace Safety*, was active in human factors engineering projects, and represented USAF safety programs as medical monitor during several manned space flights. Congratulations, Doc Chubb! ★

Turbulence and its effect on aircraft in flight is a subject of continued research and concern to both civil and military aircraft operators. The author discusses some of the problems associated with turbulence, from aircraft design to operation. This article is presented for its educational value and does not supersede Air Force flight manuals.



FLYING IN TURBULENCE

T. F. Laughlin, International Civil Aviation Organization
(from ICAO Bulletin, October 1966)

Recently there has been a great deal of attention focused on the problems associated with flight in turbulent air. This has resulted from a number of reported incidents experienced by large jet transports where loss of control has occurred during flight in rough air. These incidents have brought about a re-examination of airplane characteristics at both high and low speeds, as well as a re-evaluation of turbulence penetration speeds and techniques.

For many years, the major problems associated with flight in turbulence were considered to be physical discomfort and the ability to continue flight at a speed compatible with airplane design strength. Many tales have been related of aircraft "tossed like a leaf in a storm . . ." yet very little definitive data were available. Gust intensity data were meager, and little or no knowledge existed with regard to the phenomenon of "clear air turbulence." The introduction of the commercial jet transport with its relatively high speed and altitude operating regime has accelerated the development of forecasting techniques, yet until quite recently, recognition of some of the problems associated with flight in this environment has lagged. A number of incidents, some serious, pointed out the need for a re-evaluation of flight techniques, cockpit instrumentation and turbulent air penetration speeds.

Historically, turbulence has always been associated with visible phenomena such as thunderstorm of frontal activity and flight over mountainous areas. Generally, the solution to flying in these conditions was to avoid the area if possible, and with the widespread use of weather radar, encounters of this nature can be held to a minimum. There are, of course, situations where the avoidance of turbulent areas is impossible, or impractical, and it is to these situations that this article is addressed.

Turbulence is experienced throughout the earth's atmosphere, over land and sea, and during night and day. The majority of turbulence can be expected to occur at the low altitudes. This is understandable since the very causes of turbulence, clouds and gusty winds, occupy this area of the atmosphere. At the higher altitudes the existence of clear air turbulence is typical of the jet stream and mountain wave activity.

AERODYNAMIC CHARACTERISTICS VERSUS DESIGN

There are certain aerodynamic characteristics of the airplane that have a direct bearing on the aircraft structural design, since they define the loads that the airplane must withstand. If an airplane is in steady level flight, the wings must support a load equal to the airplane weight, and if the airplane is subjected to a pull-up or a banked turn, the wings must support a greater load depending upon the angle of pull-up or bank. This ratio of the actual load to the airplane weight is called "load factor." When the load factor is the result of a pull-up, push-over, or turn, it is referred to as a "maneuvering load factor." When it is due to a vertical gust, it is known as a "gust load factor."

It is generally assumed that since the acceleration is the same for all parts of the airplane, all the structure is subjected to the same load. This is not precisely true, since if there is severe rotational acceleration, pitching, yawing, or rolling, the loads applied to various components will increase as a function of the distance from the airplane center of gravity. This, in its simplest terms, accounts for the rougher ride that passengers experience when seated in the rear of the airplane.

Severe loads can be applied on all parts of the airplane during maneuvering. Some decisions must be made as to the severity of the anticipated maneuvers to which the airplane will be subjected and a limit load factor must be established. This is done during the early design of the detail specifications or commercial airworthiness regulation.

The limit load factor will obviously be quite different for various aircraft, but are lowest for transport aircraft where deliberate maneuvers are rather mild. Once these limit load factors have been determined, it becomes necessary for the pilot to fly the airplane in such a manner as to avoid exceeding the limit load factor if damage is to be avoided. The aircraft designer often tailors the control system in such a manner as to make the achievement of the limit load factor physically difficult from the standpoint of pilot effort required on the controls to develop a given load factor.

Although the pilot can exercise precise control on the development of a given load factor due to a deliberate maneuver, there are some airplane accelerations that are, relatively speaking, not under the direct control of the pilot. These occur during flight in turbulence and are associated with gusts. These gusts are in turn associated with vertical and horizontal wind velocity gradients in the atmosphere.

The horizontal gusts produce a change in dynamic pressure on the airplane, but cause a relatively small change in the flight load factor. The major changes are due to vertical gusts, which effectively change the airplane angle of attack. The combination of airplane velocity and vertical gust velocity causes a change in angle of attack, and consequently a change in lift and thereby in the flight load factor. Also, the gust load increment varies directly with the equivalent sharp-edged gust velocity, since this is directly related to change in angle of attack.

In the design of an aircraft, response to gust is determined by the dynamic characteristics. The response is therefore dependent on the gust wave length. Calculating the response of an airplane in turbulent air requires information pertaining to the gust disturbance which distinguishes between gusts of various scale or wave lengths. This information is available in terms of power spectral density.

A complete description of atmospheric turbulence requires the measurement of the variance of the three rectangular components of air motion (horizontal component along the mean wind, lateral component perpendicular to the mean wind, and the vertical component) as a function of frequency. This is the power spectrum. Research is presently being conducted in the USA on methods of applying the power spectrum approach to the determination of design loads in turbulence rather than using the discrete gust approach as described previously. The aerodynamic characteristics of the airplane have a powerful influence on the gust load increment. The slope of the lift curve is a measure of the airplane's sensitivity to changes in angle of attack. A high aspect ratio straight wing has a high lift curve slope and therefore is quite sensitive to gust. Less sensitivity to gust is apparent for the low aspect ratio and swept wing aircraft.

Gross weight, or more properly wing loading, has a large apparent effect on gust load factors. If, for

instance, a given vertical gust is encountered at a constant airplane speed, but with the same aircraft at two varying gross weights, the gust will appear to be stronger with the airplane at the lesser weight. This is because even though the combination of gust and forward velocities results in the same change of angle of attack, and thus lift, for both cases, the lift change acts on a lighter mass in the case of the light airplane and the resulting high accelerations and inertial forces tend to magnify the impression of the magnitude of the turbulence.

Since the pilot senses the degree of turbulence by accelerations and inertial forces, this is often misleading. The effect of increased or decreased airspeed is apparent by examination of the slope of the lift curve and can be related to passenger comfort by converting the data into a parameter of load factor/degree change in angle of attack. This is merely another manner of depicting the airplane's sensitivity of gusts.

STRUCTURAL ASPECTS

Operations at speeds in the area of the accelerated stall can impose high dynamic loads on the aircraft and should be avoided. Operation at speeds in excess of the design dive speed are apt to cause damage to the airplane structure by imposing high torsional loads on the wings, or by necessitating high balancing

loads on the horizontal tail to offset the increased pitching tendency of the airplane. Other airplane components, landing gear doors, cooling flaps, windshields . . . (items affected by high dynamic pressures) are subjected to increased loads at the higher speeds. Flight at speeds in excess of the design speed can also subject the airplane to other adverse effects, such as flutter where the airplane surfaces experience large vibratory loads.

EFFECTS OF AIRPLANE LOADING ON STRENGTH

In order to maintain adequate airplane strength during all operations, it is necessary to follow the instructions provided in the airplane flight manual with regard to loading. The maximum loads on the wing will depend on the most adverse combination

of the all-up weight, payload, and weight of fuel carried in the wing.

Fuselage loads, on the other hand, depend not only on the magnitude of the payload, but its distribution. Thus adherence to the recommended loading schedules is mandatory to avoid excessive structural loads. Where the maximum wing loads occur in combination with the carrying of maximum payload, the addition of fuel has a profound effect on the actual wing loads experienced in flight. The weight of fuel carried in the wing acts to relieve the wing bending caused by the airload. This emphasizes the requirement of adherence to the recommended fuel loading and management as defined in the applicable airplane flight manual.

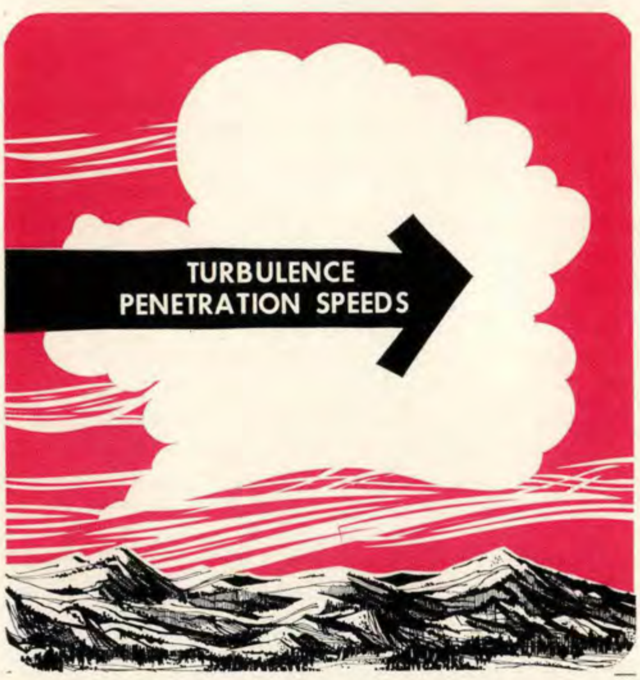
Although an airplane is limited to a given load factor by its design, fuel management procedures are developed which further increase the margin of safety to which the airplane is designed. It is not practical to specify these subtle changes in allowable load factors, but to retain them as factors of operational conservatism.

The term "maximum zero-fuel weight" is often misunderstood, but it is of sufficient importance that it should be reviewed. Simply stated, it is the maximum permissible gross weight of the airplane without any fuel in the wing tanks. To illustrate its importance: consider the wing airload in level flight at a given gross weight of the airplane. The airload is supporting the airplane weight and is acting as a load applied to the wing.

An increase in gross weight results in a higher airload necessary to support the increased weight. If the added weight is in the form of fuel carried in the wing, it acts in a manner to relieve the added airload. If, however, the extra weight comes from adding payload within the fuselage (increasing the operating zero-fuel weight), none of the added weight acts to relieve the increased airload. For this reason, the maximum zero-fuel weight is generally a design condition for some parts of the wing, and exceeding the specified value will result in exceeding the design loads of the wing. Wing loads are materially affected by the amount and distribution of fuel, and are designed to a specific fuel management schedule. For this reason, the fuel management procedures specified in the airplane flight manuals should be used, since to deviate from these may result in reduced airplane capabilities during maneuvering flight or when flying in turbulence.

TURBULENCE PENETRATION SPEEDS

In early flying, weather was a major factor in flight planning. Most flights were conducted in or below the weather. They were rarely smooth and were often



canceled. As aviation progressed with faster and higher flying aircraft, flight states became longer and often alternate routes could be selected to minimize the exposure to bad weather. Higher altitudes were attainable and areas of bad weather could be topped, and the increased wing loadings resulted in smoother rides when turbulence was encountered.

The concept of a recommended rough air penetration speed came into being at the end of the Second World War with the advent of the latest — for then — transport aircraft. These speeds were chosen to minimize structural risks associated with penetration into areas of severe turbulence. Coincidentally, much thunderstorm research was under way, and as knowledge increased, many of the earlier fears and legends about thunderstorm activity were dispelled. However, they still command respect (and avoidance).

There are two major concerns that a pilot faces when the necessity for operating in severe turbulence arises. One is the imposition of excessive structural loads on the aircraft, while the other is that the airplane attitude may reach undesirable extremes. Both of these justify concern. However, the classic treatment of turbulence penetration has tended to place too much emphasis on the structural aspect. Flight at a high speed through a given gust will produce a rougher ride and higher load factors than would be experienced if the turbulence were penetrated at a more moderate speed. The long standing admonition to slow down to the rough air penetration speed of the past when encountering turbulence has emphasized this argument.

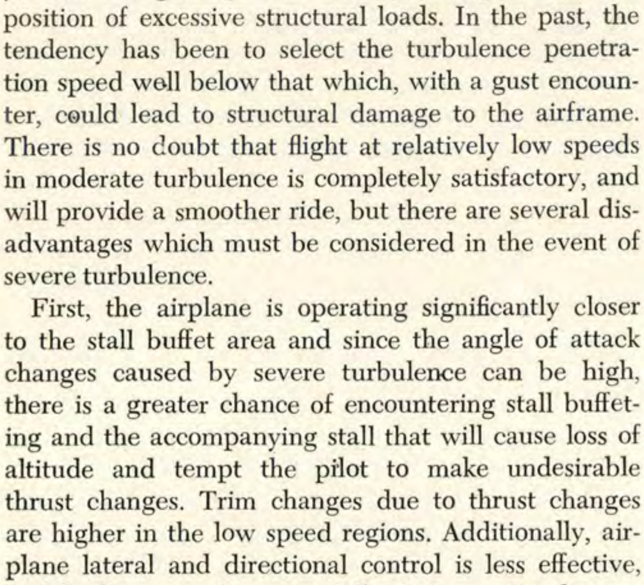
This concept had a valid basis for its general acceptance. Engineering methods for determining the effects of turbulence on structural loads are well known, and as a result, the classic discussion of the rough air penetration problem has tended to focus on such calculations and place the emphasis on the structural significance of high speed entry into rough air.

Less attention has been given to the more obscure prediction of the extreme attitudes that could result from attempted flight in turbulence at too low a speed. There is a strong suspicion, and some direct evidence, that almost every structural breakup that has occurred in extreme turbulence has been preceded by a severe loss in altitude, with the breakup being brought about by the attempted recovery maneuver in combination with the severe turbulence. For this reason, the simple calculation of the minimum safe speed, to avoid the region of the accelerated stall with the imposition of a given gust experienced in straight and level flight, may not be representative of the real problem. In fact, the magnitude of the speed margin provided above the aforementioned minimum speed has become increasingly important in defining operating speeds in severe turbulence.

Gross weight has a drastic effect on the buffet boundary, lowering the boundary as weight increases. An increase in load factor, whether by maneuvering or by encountering turbulence, has the same effect as increasing the gross weight. Two important items

must be considered in the determination of a turbulence penetration speed. The chosen speed must be high enough to protect against a gust-induced stall, yet low enough to protect the airplane against the imposition of excessive structural loads. In the past, the tendency has been to select the turbulence penetration speed well below that which, with a gust encounter, could lead to structural damage to the airframe. There is no doubt that flight at relatively low speeds in moderate turbulence is completely satisfactory, and will provide a smoother ride, but there are several disadvantages which must be considered in the event of severe turbulence.

First, the airplane is operating significantly closer to the stall buffet area and since the angle of attack changes caused by severe turbulence can be high, there is a greater chance of encountering stall buffeting and the accompanying stall that will cause loss of altitude and tempt the pilot to make undesirable thrust changes. Trim changes due to thrust changes are higher in the low speed regions. Additionally, airplane lateral and directional control is less effective, and finally, control is more difficult since trim changes due to airplane speed changes are greater in the low speed region than when operating at higher speeds.



Aircraft structural criteria and turbulence penetration speeds can be determined with the available gust and turbulence information, but it is quite difficult to relate the severity of turbulence encountered because of the widely varying pilot reports received.

OPERATIONAL TECHNIQUES

Although there are recommendations available for flight in turbulent air, in the final analysis the judgment of the pilot provides the overriding influence in the operation of the aircraft. The information set forth in this section is not meant to be a set of specific instructions or recommendations, but is supplied as material for consideration in the determination of operating procedures and techniques to be used in turbulent air.

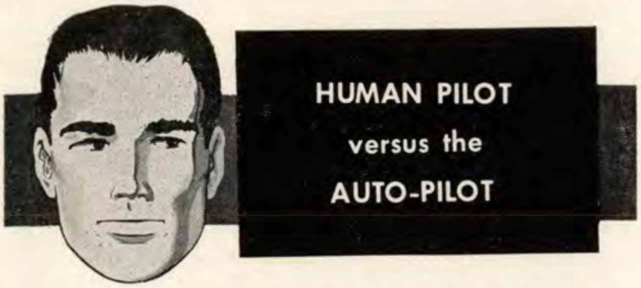
Obviously, it is fundamental to be well prepared in advance for an encounter with turbulence. If sufficient warning is available the airplane should be flown at the recommended speed, with the power adjusted, and the airplane trimmed for level flight. Seat belts and shoulder harnesses should be fastened. If the encounter is unexpected, the trim and power should be adjusted in such a manner that there is no rapid deceleration with a resultant out-of-trim condition, since it is felt that it is better to be slightly fast rather than significantly out of trim. Speed should be reduced if necessary in an orderly manner.

There has been a great deal of controversy with regard to the procedures to be used to achieve the optimum flight control in rough air. It is felt that the best advice is to concentrate on airplane attitude, and ride out the changes in speed and altitude. The natural stability of the airplane will tend to minimize the loads imposed by turbulence, and overcontrolling should be avoided. Elevator control inputs should be minimized. However, wings-level flight should be maintained by use of whatever aileron control that may be required.

The basic airplane stability often leads to a confusing situation when encountering a strong sustained draft. In a sustained down-draft, for example, the airplane will initially pitch nose-up, yet the altitude will decrease. The natural stability of the airplane will manifest itself in a (long period, phugoid, oscillation in pitch axis unless the motion thus started is controlled. This oscillation is easy to overcome.) However, since the magnitude and direction of the next gust is unknown, it is often best to allow some excursion in pitch attitude rather than to try to control it precisely. In any event, the suggested elevator control applications will not permit precise pitch control. Essentially, the optimum technique tends to permit the airplane to follow a mean flight path.

The airplane will tend to return to stable trimmed flight as soon as the disturbance that caused the deviation is eliminated. This return to stable flight will have commenced before the pilot will have recognized the departure, discriminated, and acted. It then becomes highly possible that the pilot's control input will merely reinforce the airplane's tendency to return to the original condition and provide sufficient power that the airplane overshoots the required attitude. This results in an oscillation about the desired flight path.

For this reason, control inputs in the pitch axis should be smooth and moderate. The reaction time of the pilot tends to provide a certain amount of damping, and although the attitude may vary somewhat, the vertical loads applied to the airplane will tend to be reduced over those that would be applied if rigorous flight path control were possible. A suggested flight technique is to apply elevator control smoothly in a direction to resist motions away from the desired



attitude, and remove the control input as soon as the airplane begins progressing toward the desired attitude.

HUMAN PILOT VERSUS THE AUTOPILOT

Consider the function of the autopilot in this situation. There is no set rule for operation with the autopilot on or off in turbulent air, but there are some considerations that should be weighed in regard to the final decision as to its use in rough air. Quite obviously since there are a number of airplane/autopilot combinations, each type should be considered separately. Let's consider some of the arguments.

The autopilot has an advantage over the human pilot because it does not rely on the ability to read and interpret instruments prior to application of corrective control. It has a much lesser reaction time than the human pilot. It is not bothered by shaking instrument panels. It is not easily distracted by lightning or hail pounding on the aircraft. But there has been some concern exhibited that the autopilot, by virtue of its rigorous pitch axis control, will add to the effects of gusts and thereby increase the structural loads to the aircraft—at least to an extent.

There is no doubt that the autopilot control can couple with a gust and increase the airplane load factor, but so can an input from the human pilot. Moderate, gentle control inputs are desirable from the human pilot, but the autopilot control inputs are also limited. Either the autopilot or human pilot can add to the gust load factor, but neither can be considered more apt to do so. Remember also: the autopilot is "force-limited," while the human is not.

If the autopilot is used in turbulence, it is important to monitor the pitch trim. If the airplane experiences a sustained up or downdraft, the pitch attitude will change. The autopilot will resist the change with the application of elevator trim. If this application persists, it is possible for the airplane to be significantly out of trim when a draft in the opposite direction is encountered. Obviously since the rate of autopilot trim application is very low, it is easy to monitor the trim to prevent excessive trim application.

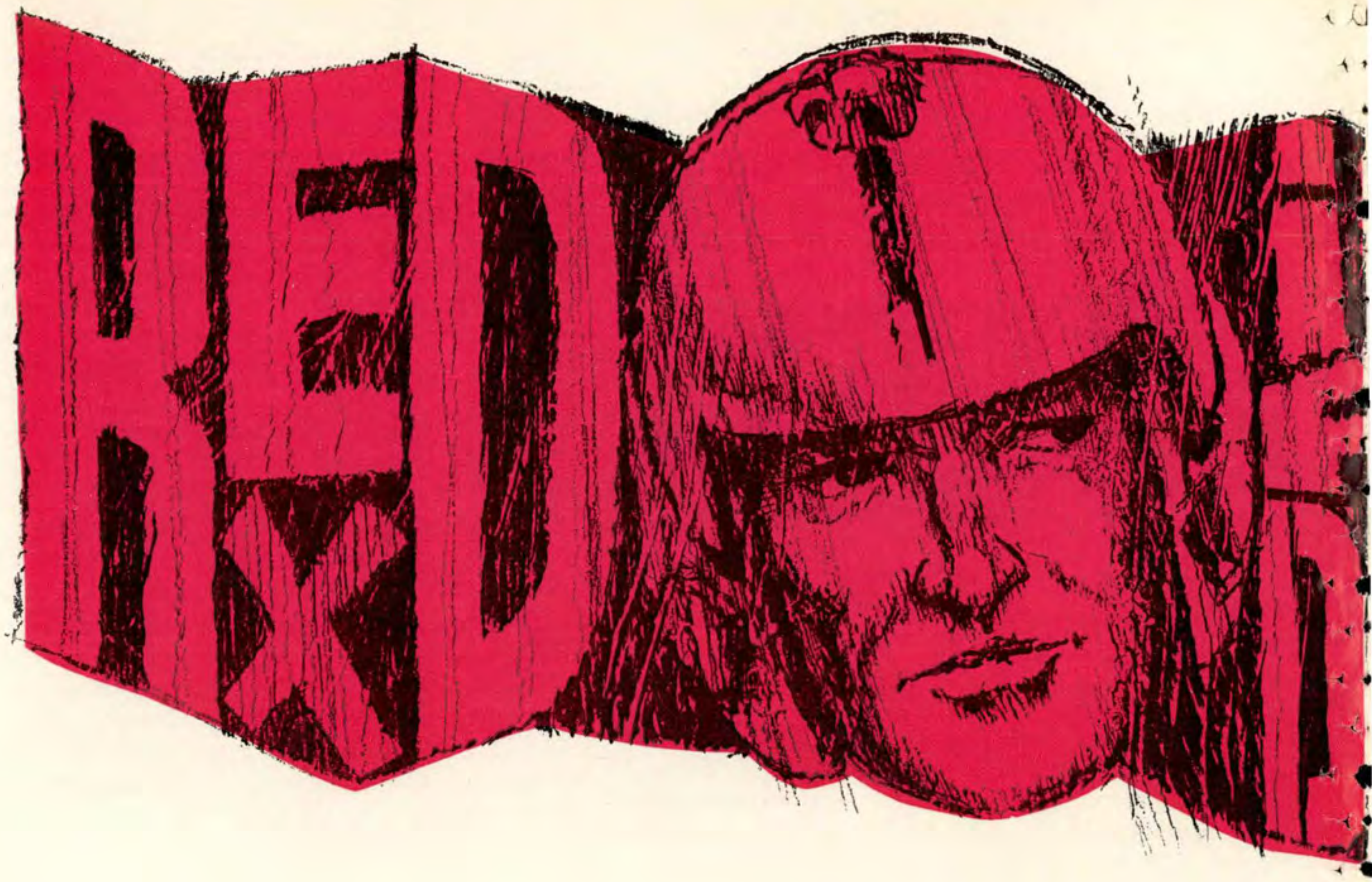
Disengagement of the autopilot at an inappropriate time is considered to be a problem, but not any more so than the failure of a number of equally important airplane components that we rely on during all flight regimes. If the autopilot is provided with a limited rate of control, and will not abruptly disengage without warning, it can probably do an excellent job for the pilot, since it is not easily distracted and need not rely on instrument reading and interpretation for its actions.

This all leads to the conclusion that there is little doubt that the use of the autopilot in moderate or less turbulence is desirable. It also appears that continued use of the autopilot is acceptable in greater turbulence provided its limitations are known and understood, and its operation is monitored. It is neither necessary nor desirable that the autopilot be turned off in turbulence, since it can provide greater control than would be possible if it were not used. Finally, use of the autopilot frees the pilot to more adequately monitor the operation of the airplane, which alone is an important safety factor.

RECOMMENDED PROCEDURES

At the present time, the weight of evidence is against the use of the altitude hold function of the autopilot in turbulence, since to do so would mean maintaining altitude rather than attitude. It is therefore best to leave it off. A summary of some of the recommended procedures for flight in turbulent air are as follows:

- Avoid turbulent areas if possible.
- If the area must be entered, prepare the aircraft, passengers and crew beforehand. Fasten seat-belts and shoulder harnesses and secure any loose articles.
- Enter the turbulence using the recommended penetration speeds contained in the applicable aircraft flight manual.
- Keep the wings level and use smooth, moderate elevator control to maintain the pitch attitude.
- Don't chase airspeed. Severe turbulence will cause large and rapid variations in airspeed.
- Don't chase altitude. Sacrifice altitude (within reason) to maintain airspeed and attitude.
- Don't change power—except in the case of extreme continued airspeed variation.
- If the autopilot is being used, monitor attitude, airspeed and altitude, in that order of importance. In addition, monitor elevator trim and be alert for an inadvertent autopilot disconnect. ★



Lt Col Thomas B. Krieger, Directorate of Aerospace Safety

Have you ever watched a pilot browse through a Technical Order library? All too frequently, there is an expression of amazement at the number of volumes that line the shelves. Among the many volumes, he usually finds what he is looking for by consulting the NCOIC and asking him to locate the information. The point is, outside of the Dash One of the aircraft a pilot flies, the only T.O.s some pilots see are those specifically brought to his attention.

Dash One T.O.s plainly bear the statement on the cover page "Commanders are responsible for bringing this manual to the attention of all personnel cleared for operation of affected aircraft." However, there are other T.O.s vital to safe aircraft operation that do not bear such a notation. Technical Order 00-5-1 states, "Organization components as designated by each commander will assure that assigned personnel are conversant with each T.O. pertaining to their individual responsibilities and functions." But, there are occa-

sions when the word does not get down to the flying troops.

From recent visits to the field, it is evident that some pilots either have not read T.O. 00-20-5, or have read it and do not understand it. This Tech Order, with the ominous title of "Aircraft, Drone and Air Launched Missile Flight Reports and Supporting Maintenance Records," will never replace the comic book for recreational reading but it can save your life, and that should be incentive enough to read it. Its purpose is to prescribe policies and procedures for use of aircraft flight reports and supporting maintenance records. In other words, it tells a pilot how to read and fill out the AFTO 781, Aircraft Flight Report and Maintenance Record.

Portions of T.O. 00-20-5 that should be thoroughly understood are those that refer to the color red. Everyone knows red is a universal danger signal. When you see red, you exercise caution or stop until you are certain it is safe to proceed. The same ground rules apply when reading the AFTO 781. From the time they begin flying, all pilots become familiar with the basic red symbols used to record warning signals in aircraft forms. The Red X, circled Red X, Red Dash, and Red Diagonal are old hat to the pro, but stop here a minute and ask yourself a simple question like, how many of the 17 listed circumstances that call for a Red X can you identify? If you are not satisfied with your test score, remember the pilot designated as aircraft commander will be responsible before takeoff to specifically note the "Status Today" in Block D, and the remarks as reflected in the discrepancy blocks of the AFTO 781A, or recorded on the AFTO 781B. Sounds a little mumbo jumbo, but if you don't understand it how can you sign the exceptional release on an aircraft, certifying that in your opinion the aircraft is safe for flight? A sharp eye in catching an item entered as a diagonal that should be an X, to insure proper supervisory inspection, could mean the difference between flying a safe or unsafe aircraft.

There are two additional places on the AFTO Forms 781 series where red entries should be particularly noted by the pilot:

First, in the servicing section of the Part II (block H) to indicate either fuel or oil has been drained from the aircraft. Without belaboring the point, if either has been drained, it's comforting to know the aircraft has been reserviced or the onboard quantities are sufficient for the flight. When you see red in the servicing block, take time to check into it.

Second, the red line drawn under the last entry on the AFTO Form 781A to indicate what outstanding items are covered by the exceptional release. If the pilot signs the exceptional release, he must place his initials in the left-hand margin to indicate his understanding of what items are covered by such a release. It was the absence of this red line on numerous forms examined in the field that prompted this article. In many cases pilots had not placed their initials by the line and in other cases the red line itself was missing. Remember, before flight critically examine the 781 and be in a position to question any irregularities.

The pilot and the crew chief are teammates in safety. Each depends on the other in their shared responsibility to properly maintain the AFTO 781 series forms. If you have not read 00-20-5 lately with "Red is for Danger" in mind, try it so you can carry your share of the pilot-crew chief team. ★

THE WEED...FITNESS...AND YOU!

Lt Col David E. Langdon, USAF, MC
Andrews AFB, Washington, D.C.

Your trusty old flight surgeons are getting laryngitis lecturing on the subject of smoking and the importance of physical fitness as part of your preventive maintenance program. Many have even stopped smoking. Fifteen years ago 85 per cent of physicians smoked cigarettes; now a recent survey indicates that only 40 per cent are still puffing smoke. When you see a smoking physician, give him credit. It takes a lot of stamina to read medical journals, to see the plethora of chronic lung disease on the hospital ward, and still smoke.

Here is another pound of data to tip your balance. A recent article discussed the effects of exercise and smoking upon the incidence and survival from heart attacks. The incidence of first heart attacks was twice as high in the quarter of the population studied who had the least activity compared to the quarter of the population with the most activity. Similarly, once one had a heart attack, that quarter walking the most survived twice as well as low walkers. Those doing high general body building, non-walking exercise doubled their survival compared to those having low non-walking quotients. In other words, walking coupled with general body building — felt to produce backup collateral blood supply — gave four times the margin. What happened when smoking was cranked in? The incidence of heart attacks was twice as high in smokers regardless of their exercise status.

Another article presented causes of death among a large population of generally non-smoking male Southern California Seventh Day Adventists — as compared to death rates in other Southern California men. The figures were rather frightening: The non-smokers had one-nineteenth the number of deaths from cancer of the mouth, esophagus and larynx; one-sixth the number from cancer of the lung (eight of these nine Adventists dying were smokers); one-twelfth the TB death rate; one-fifth the chronic bronchitis-emphysema rate; and only one-third as many deaths from pneumonia and influenza. These statistics plainly document again that smokers are more susceptible to complications from any respiratory illness that happens to come along.

As a flyer you take oxygen by mask. Smoking is comparable to taking air pollution by mask. We have all heard and read the proclamations of cigarette companies and a few physicians (probably four packs a day variety), "Well, it is not *proven* that cigarettes cause cancer of the lung." But, at the same time, one cannot deny that the effect is a whopping additive to the other factors involved in such cancers. Drugs are removed from the market for far less. The situation would be sweet if cancer were the only problem, but the above studies are simply representative of many others.

It is easy to put off such a decision, because as the ads say, *you enjoy it*, you're hooked. There is no use cutting down. You simply spend all day fighting with yourself — moving the afternoon cigarettes into the morning and so on. It takes the same effort to stop. When you do, never put another cigarette in your mouth. A "cured opium addict can't play around with one more shot of heroin." Neither can an ex-smoker with tobacco.

Similarly, it requires a decision to start an exercise program ending body rot. Do it to your favorite television or any other time, but do something and do it regularly. After all, if you are sedentary, you will occasionally have to whip your heart to do the unexpected — pushing your car out of a snow bank, carrying your wife out of a burning home, packing that deer out of the mountain; or for those sudden maximal bursts of more enjoyable energy — you should be in shape so that small hurdles are not lethal mountains.

You were selected for your career in part because of fitness, a career which prizes personal discipline, so tomorrow morning look at yourself in the mirror and make the decision to take yourself out of the high risk group. ★

CAUSE: PILOT FACTOR

Maj Roger Budd, Jr., Directorate of Aerospace Safety

IN a pilot's world, "pilot factor" is a nasty term. Most pilots, at one time or another, have suspected that "pilot error" was the accident board conclusion whenever they could not identify a specific cause. Would you believe "scapegoat"? Be assured that some of our best talent goes into each accident investigation and if the cause is not established, it is reported as undetermined.

Let's take a look at the record. In 1965, the major accident rate of one of our larger aircraft went from one to two per 100,000 hours. The pilot-factor-caused accidents went from three to seven for the year. Here are briefs of those seven:

- Aircraft hit high tension lines . . . the aircraft commander failed to maintain control of the aircraft in terms of altitude and attitude. There was no evidence of aircraft malfunction. (Day, 5000-foot ceiling.)
- . . . pilot failed to maintain adequate separation with the terrain during go-around. (Night, 2000 foot scattered.)
- Major damage . . . pilot failed to properly interpret the symptoms of hot brakes and continued to operate aircraft in mistaken belief that he had only a weak brake.
- Major damage . . . pilot failed to maintain sufficient airspeed and altitude on final – landed 170 feet short.
- Aircraft hit the water one-half mile short of the runway . . . aircraft commander elected to continue a VFR approach in IFR conditions.
- . . . pilot elected to take off with known malfunctioning engine and failed to abort upon loss of directional control.
- At 1500 feet from brake release, aircraft rotated to approximately 70 degrees attitude and penetrated the clouds (600 feet). Shortly, it emerged in a diving attitude and struck the ground . . . pilot allowed the aircraft to become positioned in such an attitude and altitude that safe recovery could not be effected.

These are human factor errors and they happened to full time professional Air Force pilots. The 100 hour-a-year part-time jockeys have a story all their own. There is no intention here to explain why these accidents occurred. Rather, the intention is to impress pilots to "beware," it very well could happen to you.

Of course, the pilot's world is a large and complex one. There are a multitude of things for him to learn, and he must learn them so well that they become second nature to him. After hundreds of flying hours as a student, he discovers that the learning does not stop. Aircraft and their associated equipment go right on becoming more complicated. Traffic control gets tighter. Even his personal life gets more involved and time-consuming. There are a million reasons for becoming lax, and at least one, his life, for keeping up.

Dr Raymond L. Besplinghoff, President of the American Institute of Astronautics, says that the prime responsibility for aeronautics and space progress is technological innovation, and "I cannot escape the feeling that the enormous potential of the airplane is still not fully appreciated." The SST and B-70 Jumbojets, and the X-15 are upon us, already presenting pilots with additional complexities. If anyone thinks he can catch up when things slow down—he has a long, long wait. Scientists, designers, educators, and effective management of resources have played their part well in developing the mightiest military force in history, and the momentum will not be stopped.

Wilbur Wright's remark is equally true today, "It is not necessary to look too far into the future; we see enough already to be certain that it will be magnificent." You're right, Wilbur, it has been, it is, and it will be. We cannot allow ourselves to get behind the power curve. ★

USAF AERO CLUBS WIN SPECIAL FAA AWARDS. These aero clubs received the FAA Flight Safety Award for completing a full year of flight operations in 1966 without a single aircraft accident. Presentation of award was made by William F. McKee, FAA Administrator.

Base Aero Club	Command	Base Aero Club	Command
Adair AFS	ADC	Randolph AFB	ATC
Hamilton AFB		Reese AFB	
Oxnard AFB		Sheppard AFB	
Otis AFB		Vance AFB	
Perrin AFB		Webb AFB	
Richards-Gebaur AFB		Maxwell-Gunter AFB	AU
Selfridge AFB		McGuire AFB	MAC
Suffolk County AFB		Orlando AFB	
Tyndall AFB		Scott AFB	
McClellan AFB	AFLC	Travis AFB	
Arnold AFS	AFSC	Beale AFB	SAC
Edwards AFB		Castle AFB	
Holloman AFB		Vandenberg AFB	
Patrick AFB		Westover AFB	
Space Systems Division		Whiteman AFB	
Seymour Johnson AFB	TAC	March AFB	
Shaw AFB		Eielson AFB	AAC
Bitburg AB	USAFE	Kadena AB	PAF
Wheelus AB		Albrook AFB	USAFSC

FILMS—Listed here are films now available through your base facilities, otherwise—and if you are stationed in the ZI (except Alaska and Hawaii)—you should forward your requests to the AF Film Library Center, 8900 So. Broadway, St. Louis, Mo. 63125.

AFP 1943 MOODS IN SAFETY Color 22 min. Moods impinge on safety. The use of color distortion within this film portrays attitudes (moods) affecting safety and common sense behavior. Sequences involve a bus driver, a maintenance chief, and a lieutenant who preaches one thing and practices another. Film is highlighted by an F-4C pilot who believes "if you can get away with it once, why not again," finds out it doesn't work.

TF 5720 FOUR LINE PARACHUTE CUT Color 15 min. Demonstrates new and revolutionary parachuting technique to USAF crewmembers. Basically, this involves severing four of the rear shroud lines (three designated) during descent which provides for a maneuverable parachute.

TF 1-5352 CENTURY SERIES RATE OF SINK Color 20 min. Covers flight characteristics of F-106 aircraft; discusses thrust, lift and drag curves, angle of attack and aircraft attitude. Shows how these performance factors affect aircraft's rate of sink. Points out difference in method of handling straight-wing aircraft and delta wing aircraft.

TF 1-5355 EXTERNAL LOADS ON CENTURY SERIES AIRCRAFT Color 14 min. Shows how aircraft carrying external loads such as missiles react to the laws of aerodynamics. In discussing handling a clean aircraft vs. one with external loads, covers longitudinal stability, directional stability, lateral controllability and adverse yaw.

FR 272 THE HELICOPTER IN LOCAL BASE RESCUE B&W, 15 min. Indoctrinates qualified commanders and staff officers in the capabilities and limitations of the helicopter. Covers history of development, theory of flight, capabilities and limitations of current USAF helicopters; operational procedures for search and rescue; high altitude; strange field operations, hot and cold weather, etc.

TF 6113 WAKE TURBULENCE Color/sound. 16 min. (FA-610)

HELICOPTER OPERATION—Recently a Navy H-3 exceeded anti-torque rotor authority during a zero KIAS climb from a hover to 1400 feet. Application of very high torque resulted in what appeared to be anti-torque failure. The helicopter made approximately four 360-degree turns to the right while climbing the 1400 feet. There was negligible rotor RPM droop. Minimum observed by the pilots was 98 per cent NR. Directional control was regained after torque was lowered from a maximum of about 125 per cent to the normal range.

During a conference of military and manufacturer representatives it was concluded that H-3 pilots believe the helicopter will continue satisfactory anti-torque response even when flown in an overtorque condition. This belief is in error under certain circumstances of very high torque or right wind component. Therefore, it is recommended that the engine to rotor torque limitation also be regarded as the limit of tail rotor authority until such time as more accurate performance data can be determined.

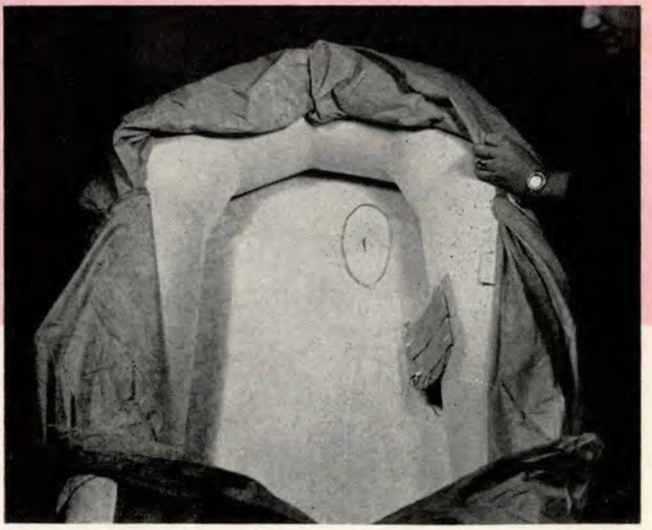
Review of H-3 mishaps with anti-torque rotor malfunction indicated as a cause factor discloses circumstances similar to those listed above. Documentation of loss of anti-torque rotor authority where it was regained without mishap was virtually non-existent. Accordingly, it is requested that the widest possible, dissemination of the above information be made, and reports of similar occurrences be forwarded for evaluation.

Lt Col Robert E. Englebretson
Directorate of Aerospace Safety

PUNCTURED RAFT—When a Life Support NCOIC removed a survival kit from the back seat of an F-100F, he discovered the kit in the condition shown at left. The two-inch cut sliced through two layers of the container and the bottom of the life raft.

For want of a raft. . . .

4510 CCTW, Luke AFB, Arizona



Fallout

LETTERS TO THE EDITOR

POWER LINES

I enjoyed the article "Choppers and Wires" in the November, 1966 issue. When I was in Switzerland I noticed their electrical power lines had a large colored ball attached midway between poles. My curiosity got the best of me so I inquired in Geneva as to their purpose. They told me it was to warn pilots so they wouldn't collide with the lines. Why don't they do that here in this country?

I lost a very good friend in the Marine Corps Aviation. His plane hit power lines stretched across hills near San Diego and crashed in Lake Hodges. Yes, wires are a hazard but like so many hazards, people discuss them in safety meetings but do not do anything positive to remove the menace.

MSgt Carl Lindsay, Jr
USAF-Res. 619 Sulphur St
Houston, Tex, 77034

A splendid suggestion. Let's hope some influential people will read your letter and become interested in the problem.

FAA has recommended a solution to the problem. Overhead wires that are determined to be obstructive to air navigation in accordance with FAR Part 77 are required to be marked with markers spherical in shape with a diameter of not less than 20 inches in accordance with the FAA Obstruction Marking and Lighting Manual, OAP 7460.1.

At Ft. Bragg, N.C., the Army effected a do-it-yourself solution by tying ribbons on wires strung across roads on the reservation because choppers use the road as a navigation aid to and from the various ranges. This doesn't follow the FAA specification but is certainly better than no fix at all.

When compared to the massive expanses of the United States, tiny Switzerland hasn't much of a problem, but maybe Yankee ingenuity will find a satisfactory solution. In Maryland, for example, a bill was introduced this year to prohibit construction of above-ground power lines and require that present lines be put underground by 1972.

MOTORCYCLE SAFETY

Your November 1966 issue has just come into our possession, and on pages 6-9 we find a most interesting and significant article on motorcycle safety. Since this subject is presently uppermost in the minds of members of our industry and of many legislators, we would appreciate receiving five or six copies of this particular issue. * * * * *

Thank you.

BUTLER & SMITH, INC
160 West 83d Street
New York, N.Y. 10024

CROSS CHECK

Concerning your comments on the letter entitled "Cross Check" in the February Fallout, I would like to offer a few comments or corrections of my own.

The "wings level" feature in the F/RF-4, when activated upon autopilot (AFCS) engagement, does not always bring the aircraft back to wings level, as you mentioned. The autopilot will roll the wings level as long as the aircraft is within the ± 70 degrees pitch and ± 5 degrees bank limits. The aircraft will maintain the engaged bank attitude if the engaged bank attitude is more than ± 5 degrees, but less than ± 70 degrees.

Also, as a supplement to your comments about the autopilot being maintained at peak standards, we believe that any system installed on an aircraft is there because a pilot may need it. Two instances when the AFCS can and has been a great asset in controlling the aircraft are: (1) runway pitch trim, and (2) a ruptured feel bellows. Consequently we believe the system should be maintained at peak efficiency.

We run a fairly high AFCS utilization rate in our three squadrons, and maintain a 98 per cent system reliability rate.

Most of our jocks aren't afraid of the system. They know "George" is always ready.

A1C John R. Stum
AFCS Shop, 81 A&EM Sq
APO New York 09755

Thanks, John, obviously you know your business.

TRADEMARK STYROFOAM®

We noted the mention of our trademark STYROFOAM in the March 1966 issue of AEROSPACE SAFETY. It should be noted that in addition to the nondistinctive printing of our trademark, it was misrepresented twice. (In two Rex notes, pages 14 and 15.)

The plastic foam cups are not made of STYROFOAM brand plastic foam, nor is the molded foam pad inside of the helmet. Also, STYROFOAM brand insulation is flame retardant.

STYROFOAM is our trademark for a special type of extruded rigid polystyrene plastic foam *boards* and *billets*. The primary use of this material is for insulation purposes. Other uses include buoyancy and decorative applications. Plastic foam cups are made of a polystyrene plastic too, but they are manufactured by a molding process, not by extrusion as is STYROFOAM brand plastic foam. STYROFOAM brand plastic foam is not applicable to cup molding or any other molding process. In addition, STYROFOAM brand insulation is flame retardant according to Federal Specifications HH-I-524 "Type II Class 2 Self-Extinguishing (fire retardant)" and Military Specification MIL-P-40619 "Type I Class 2—fire retardant." It is true if a match is held to STYROFOAM brand insulation or it is placed into a fire, it will burn, however only so long as a direct flame is applied to it. Flame retardant means it will not sustain combustion.

* * * * *

The treatment which our trademark received (pages 14 and 15, March 1966 issue) is very detrimental and, in our opinion, should be corrected.

* * * * *

James F. Joines
Marketing Services &
Public Relations Manager
The Dow Chemical Company
Midland, Michigan 48640

Unfortunately when a product becomes so familiar that its name becomes a household word—like STYROFOAM—that word is occasionally used erroneously. Apparently we have mistakenly used this word in reference to a foamed plastic material other than your product. This error is regretted and we appreciate your calling the matter to our attention.

☆ U. S. GOVERNMENT PRINTING OFFICE 1967 251-217/9

WELL DONE

CAPTAIN JAMES C. WARREN, JR.
CAPTAIN KAYE M. HARDEN

4758 DEFENSE SYSTEMS EVALUATION SQ (ADC) HOLLOMAN AFB NEW MEX 88330

Captain James C. Warren, the pilot, and Captain Kaye M. Harden, the electronic warfare officer, returned from a routine ECM mission in an EB-57A and entered normal traffic for landing. The gear handle was placed in the down position on the downwind leg and the main gear indicated down and locked. However, the nose gear indicated up and locked. After cycling the gear two complete times, Captain Warren was still unable to obtain any indication other than main gear down and locked, nose gear up and locked. Hoping to aid the hydraulic system, Captain Warren insured the star valve was closed and tried to use the emergency hydraulic hand pump. The handle would not fit all the way into the pump socket, but by using downward force while pumping, he was able to use the pump successfully. The resistance encountered indicated that the system was pressurized properly as had been shown on the hydraulic system and brake pressure gages throughout the flight. A visual check by the tower confirmed that the nose gear was indeed up and locked. Captain Warren declared an emergency at this time and began to accomplish the checklist emergency procedure for landing with the nose gear retracted. While he was using the emergency hand pump, the nose gear suddenly went to the intermediate position. Captain Harden then installed his seat pin, unstrapped from the back seat and crawled forward to help with the pumping operation. He managed to complete approximately 100 strokes despite the pump's resistance. Then attempts were made to shake the nose gear down by porpoising the aircraft. No change was noticed in the existing condition. On advice from the tower Captain Warren made two touch and go landings, hoping to dislodge the nose gear. Mobile Control advised that the gear had moved but was obviously not down and locked.

Captain Harden again left his seat and tried to hammer the handle into the emergency pump socket with the crash axe. This helped some, but the force on the handle broke out one side of the socket. The fuel level was now down to 900 pounds and Captain Warren decided that he had to land. The runway was foamed and emergency equipment was standing by. A long, straight-in approach was set up and touchdown was made on the two main gears. Captain Warren held the nose off until the speed was down to about 80 knots and then lowered it slowly onto the foam. Steady but light brake pressure was used until the aircraft came to a stop. There was no fire and the aircraft was evacuated without incident.

The teamwork and knowledge of Captains Warren and Harden enabled them to overcome a potentially disastrous situation and bring the aircraft home with an estimated 37 manhours damage. WELL DONE! ★


BEWARE THE SUMMERRISK!
Summerrisks are in season from 26 May thru 4 Sept.