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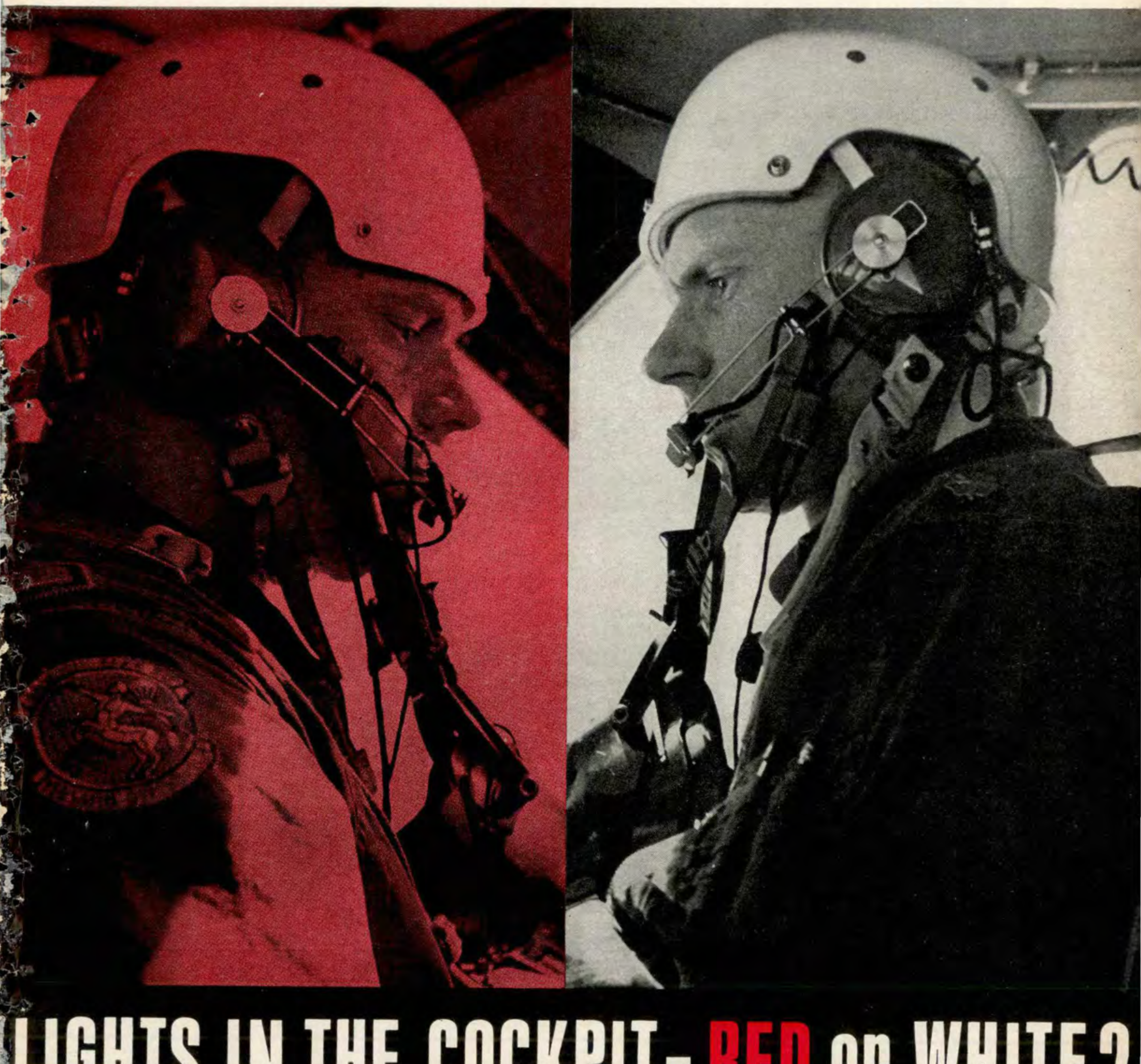
Aerospace SAFETY

THE MAGAZINE DEVOTED TO YOUR INTERESTS IN FLIGHT



LIGHTS IN THE COCKPIT - RED or WHITE?

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SPECIAL FEATURES

REGULAR FEATURES

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PREFLIGHT

Many aircraft today have white lighting in the cockpit, something that would have horrified pilots only a few years ago. Red lights used to be the thing because, as we were carefully taught, red lights would not impair visibility outside the cockpit. Some of us remember sitting in a "dark" room lighted only by an eerie red glow prior to a night mission. This was to adapt our eyes to seeing in the dark.

White lights, then, must have come as a shock to many pilots. But there is a case to be made for both red and white. For a full discussion read "Red or White Lights in the Cockpit" beginning on page 5.

Would you believe that midair collisions can result from pilots being too efficient at flying precise instruments even in clear weather? The author of "Simulator Syndrome," page 2, speaks out on a subject that has bothered a lot of us for a long time. As an experienced airline captain, he speaks from a wealth of experience. The requirement for maintaining almost perfect speed, attitude and directional control means that pilots must concentrate almost entirely upon monitoring instruments in the cockpit. As with almost everything in aviation, this means a tradeoff—in this case sacrificing concentration outside the aircraft for riveting one's attention inside. What's outside, another aircraft, might kill you if the pilots don't see each other in time to avoid a collision. The problem is no doubt greatest when one least expects it — during clear weather — because of the number of uncontrolled aircraft from which your IFR clearance guarantees no protection. This well written article deserves every pilot's attention and we suggest you read it carefully.

WHY OHRs?

Capt David D. Wilson, FSO, Lockbourne AFB, Ohio

AT lunch last week I heard the comment, "Why should I turn in an OHR? What good would it do? Someone will file it in a trash can, and I'll never hear about it again!"

Statements like this indicate the need for a few words on Operational Hazard Reports—OHRs. Of all the methods available to the crewmember or maintenance man to get action, the OHR is, in my opinion, by far the most effective. It can move the immovable or change the unchangeable. During a recent visit, the TAC Safety Survey Team Chief said that the three keys to an effective safety program are good safety management, a working aerospace safety council, and an active OHR program.

In the world of command and management certain principles must be observed to insure efficient, and therefore safe operation. Prime among these principles is a channel for information feedback to the commander. With this channel open, the commander can effectively detect and correct problems before they occur, or at least before they result in that most inefficient of all operations: an accident. When the channel is closed, so are the commander's eyes and ears on the line. I wouldn't presume to imply that an OHR is the commander's only means for gauging the efficiency of his command. But, it is one way you as a crewmember or maintenance man can insure that the commander of a unit other than your own will get the word.

"So," you say, "I can get to a commander. So what?" Well, have you ever had someone put his hand over your civilian tie and ask you what color it is? Or have you ever had some extra time on your hands in base ops and "discovered" the surprising and interesting charts, maps and poop sheets on the walls? You've seen them a thousand times, but never read them. Sometimes, we get so familiar with a place or operation that we miss the details. Your OHR can have the same result on the commander as that guy with his hand on your tie has on you. At first you don't know the color. Then you're almost sure, but you're never positive. When he moves his hand, you know for sure and will probably know the color of every tie you wear for the next several months.

Your OHR will focus the attention of the commander, through the safety officer, on its subject. By the time the investigation has been completed and mulled and worried over by the appropriate staff agency, and briefed to the working troops, the whole unit will be as sensitive to this area of operations as you were to the color of your tie after that guy moved his hand.

This all sounds good. But, does it really work this way? According to AFR 127-301 it does. An OHR has one of three places to go after you have written it: your squadron safety officer, the safety officer at a TDY base, or a higher headquarters safety officer. *You* start the ball rolling. Now, rather than discuss each case as to what happens next, let's examine an OHR that goes to a squadron flying safety officer.

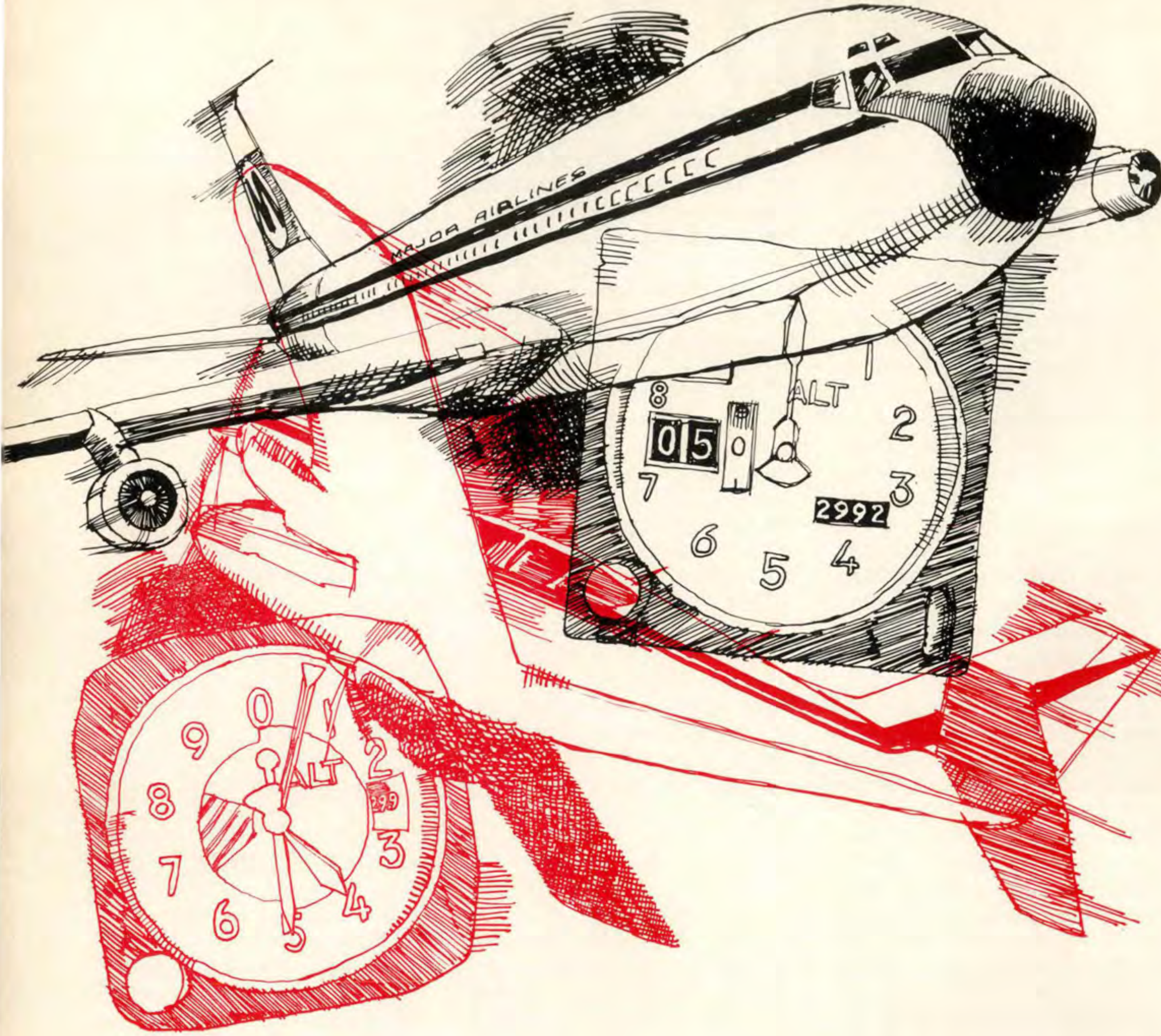
His first step is to perform his own investigation using any resources available. He then makes his recommendations and submits the OHR to the action agency, that is, the unit commander who has primary responsibility in the area reported on. The action agency evaluates the investigation, considers the recommendations, and takes corrective actions. Once the corrective action is entered on the OHR, the form is sent back to you.

If the OHR is beyond the squadron flying safety officer's capability to investigate, he sends it through safety channels to the level of command best able to handle it. The flying safety officer at that level then picks up the ball and completes the procedure.

The return of the OHR to you is far from the last step in the procedure. Every OHR is briefed to the staff at our Aerospace Safety Council. Corrective actions are discussed at flying safety and maintenance safety meetings to insure the word gets to the troops. The TAC Commander is briefed twice a month on OHRs that arrive at TAC for investigation, action or information. By the time your OHR has made it to its final resting place in the OHR file, it has been cussed and discussed at every level of command from you to the commander of the parent unit of the action agency.

"So," you say, "it's been cussed and discussed. So what? What did it accomplish?" Well, in our wing alone, OHRs have been responsible for improvement in quarters at two TDY bases, a major change in a TAC Manual that the OPR said couldn't be changed, new radio procedures on the DZ/EZ/LZ, and several changes in local flying regulations. Command decisions brought about by OHRs in this wing were made in TAC, SAC, ADC, AFLC, AFCS and the Air National Guard. Most important of all, at last count the 317 Tactical Airlift Wing OHRs had exposed, publicized, or eliminated 34 operational hazards.

OHRS SERVE YOU — KEEP 'EM COMING! ★



This article, written by an airline pilot for airline pilots, applies directly to the military pilot. Most Air Force flying is done IFR, regardless of the weather. We preach and practice instrument proficiency, but of what use is it if in so doing we expose our aircraft to midair collisions simply because the crews have become slaves to a lot of gages? This is not to deprecate the need for instrument proficiency. But where IFR and VFR traffic are mixed, as they are in the vicinity of many USAF bases, common sense demands that pilots use a combination of instrument procedures and VFR head-out-of-the-cockpit scanning. Somehow or other, "the best instrument pilot in the world" doesn't seem a fitting epitaph on the tombstone of the man who was put there by a midair collision on a clear day.

THE SIMULATOR SYNDROME

Paul Felton, United Air Lines
Reprinted from Air Line Pilot, June 1968

IT was a typical VFR day at Megalopolis Airport, U.S.A. The late afternoon sun slanted through a stagnated air mass stirred only by a light breeze. A haze made from equal parts automobile exhaust and industry smoke, with a few million human exhalations thrown in, diffused the sunlight until the city appeared in shades of brown. Megalopolis Airport tower advertised the weather as clear and four miles visibility, haze and smoke. Approach control recommended ILS 36 approaches, but would readily give a contact approach to any aircraft. Uncontrolled VFR traffic was normal for late afternoon. One controller considered it a bit light since he could count only seven unknowns on his scope.

Major Airlines Flight 373 had experienced a tedium-filled flight to Megalopolis. Aside from one hilarious joke by the captain over Fort Wayne, the four-plus hours had been mind-dulling routine. Now, descending through 8500 feet, 373 was well above the Megalopolis haze. All three crewmembers were forward in their seats, straining to find that glint of sunlight or ink-dot silhouette that would mean unreported VFR traffiic.

The pilots of Light Plane 42U were also scanning the sky around them for traffic. Their route from Megalopolis Suburban to the mountains was a familiar one. They normally filed VFR, but were proud of their instrument ratings and their ability to handle any IFR condition within reason. Their aircraft had a full panel, including DME, and they planned to install a transponder in the immediate future. A weekend in hills where the air was not brown beckoned happily ahead as 42U leveled at 4500 feet westbound and held a course safely outside the outer marker of Megalopolis Municipal.

When Major Airlines 373 checked out of 5500 feet, approach control gave the flight a final vector, cleared them to descend to 1700 feet and intercept the runway 36 localizer, told them to contact the tower at the outer marker, and called slow-moving non-beacon traffic at ten, two and three o'clock. Three crewmembers peered more intently into the brown haze, checking the clock codes called by approach control. Their scan was momentary however, for there were required instrument procedures that took precedence over merely looking for unknown VFR traffic. As 373 passed through 5000 feet the captain set his heading bug on the new radar vector, checked his approach plate for the inbound ILS course, turned on his flight director and briefly monitored its operation, looked and reached back to flick on the aural for the outer locator, and after checking the flap position indicator called for more flaps. The copilot's hands and eyes flew about the cockpit almost as quickly as the captain's. The second officer watched as the copilot switched from the omni to the ILS frequency and identified it, set the inbound ILS course on his bug, turned on and checked his flight director, visually checked the movement of the flap handle to conform to the captain's order for more flaps, selected ADF on his navigation selector switch and monitored the needle, and reached back to turn on the aural for the outer marker.

The pilots of light plane 42U knew they were dead when the shadow suddenly fell across their instrument panel. Their eyes registered a flash of silver wing. The airplane disintegrated at impact and its myriad pieces fell almost straight down. A ground witness said that he thought one wing took almost a minute to flutter to the earth.

Major Airlines Flight 373 shuddered only slightly at impact. By sheer strength and professional skill the captain and copilot kept the airplane flying for an estimated 25 seconds. Then the nose dropped sharply and 373 rolled steeply to the right. The Megalopolis skyline vanished. In its place a stinking salt marsh filled the windscreen. The mud and slime spewed by the crash covered the jagged pieces and jumbled humanity of Flight 373.

The accident described is strictly imaginary and has not yet happened —but it will. We are training for it with a deliberate intensity. The primary criteria for pilot training and evaluation have become a knowledge and use of the sophisticated navigation and approach instruments installed in today's jets. And no matter how beautiful the weather, every instrument is utilized on each and every approach.

The aid for this instrument training, the simulator is a wonder to behold. There it sits on the hangar floor, a computerized cockpit of the applicable airplane complete with all the sounds and instrumentation of its flying kin; so realistic in simulated flight that a knock on the cockpit door brings instant expectations of a stew with coffee. It is in this instant airplane, run by electricity instead of jet fuel, that a pilot becomes familiar with his new aircraft. Surrounded by opaque windows, so no external stimuli may intrude, the trainee can concentrate fully on his cockpit world. It is here, based on his instrument procedures, his exacting flying of the navigation or approach aid, his smooth instrument flying, that a pilot is judged ready to step forth and fly the passenger-carrying version of his new aircraft.

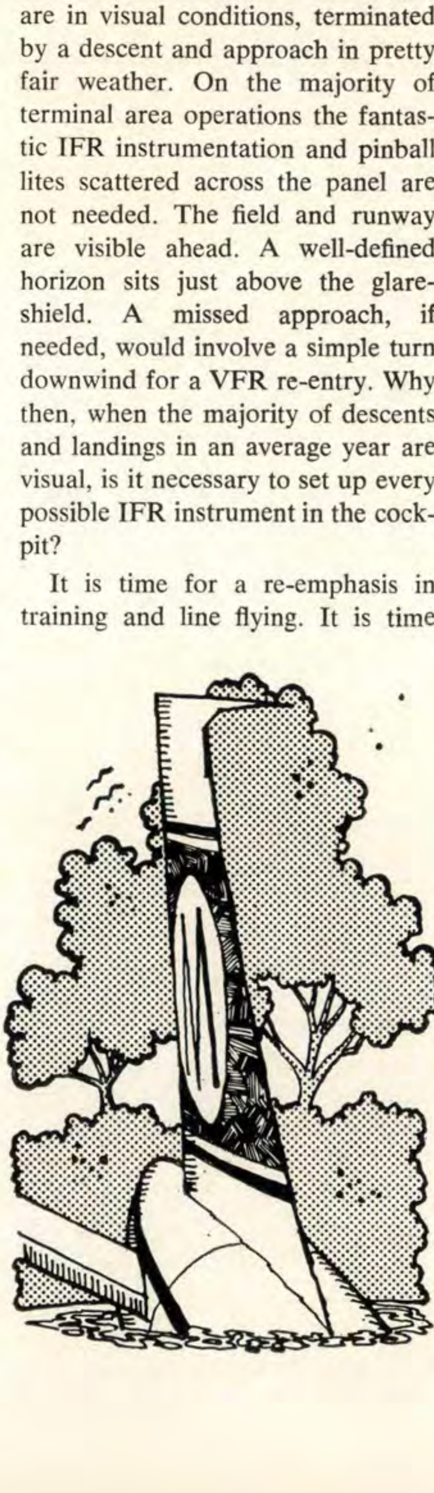
Because the simulator is so very good at playing airplane, the transition to a cockpit that tows a pair of wings and a tail along is remarkably easy. The criteria for judgment of the pilot in the airplane are the same as for the simulator; nice smooth flying, airspeeds within a knot or two of the climb/descent speeds, exacting adherence to headings and altitudes, approaches right down the localizer and glide slope. Upon completion of this intensive training a pilot can fly the new aircraft almost perfectly on instruments; and if awakened some early morning from a deep sleep and posed an involved question about instrument procedures could immediately recite the appropriate SOPs. The pilot's indoctrination in the art of mid-air procedures is finished, and another IFR-oriented, use-the-instruments, concentrate-on-the-instruments-all-the-time man, is pumped out of the training phase.

The excellent training carries over to line flying. Every descent and approach, no matter what the weather, is made with full IFR procedures. Tune this. Identify that. Stay right on speed. Track perfectly. Fly the localizer. Set up the missed approach navigation aids. SOPs flash by with relentless precision. The instrument procedures execution is heart-warming. The midair potential is heart-rending.

What has happened to the heads up descent and landing approach? Why, in the past few years, has a centered needle or flight director bar become more important than a decent traffic avoidance scan? Where is the sweaty armpit, buttocks-tightening fear of uncontrolled VFR traffic that should pervade the cockpit at lower altitudes? The emphasis has shifted alarmingly from a "U see um" descent and approach to a full instrument approach.

Consider an average year of flying on the line. True, there are days when every terminal seems to be just above limits and it is ILS after ILS. But admit it, most of the flights are in visual conditions, terminated by a descent and approach in pretty fair weather. On the majority of terminal area operations the fantastic IFR instrumentation and pinball lites scattered across the panel are not needed. The field and runway are visible ahead. A well-defined horizon sits just above the glareshield. A missed approach, if needed, would involve a simple turn downwind for a VFR re-entry. Why then, when the majority of descents and landings in an average year are visual, is it necessary to set up every possible IFR instrument in the cockpit?

It is time for a re-emphasis in training and line flying. It is time



to recognize the most dangerous situation in air line work; an approach through VFR unknowns. Right now, today, it is imperative that some new criteria for air line flying be adopted. It is time to sacrifice a few knots of airspeed, a few feet of altitude, a dot or so of navigation, and hearken back to one very basic, life-saving precept of flying: the VFR scan.

Be it military or civilian flight training, one of the first techniques taught a fledgling airman is the art of driving an airborne machine through the skies without ramming trees, mountains, large birds, or other aviators. The technique is simple: spend about 80 per cent of the time outside the cockpit and 20 per cent inside. Develop a collision-avoidance scan that sweeps from left to front, to inside the cockpit, to front, to right, to front, to inside the cockpit, and continues in this cycle from start to taxi until the aircraft is shutdown and chocked. Recognize that the eye tends to focus a few feet in front of the aircraft (which is fine if you are only interested in who you hit) and train the eye to focus at infinity. Scan by sectors since visual acuity drops alarmingly if the eye is not looking directly at the distant traffic.

These simple precepts have somehow been deleted from air line flying. They have been sacrificed on the altar of constant instrument practice. Join me in an effort to bring back the full utilization of the best collision-avoidance device yet developed, the human eye; or join me soon at the church of your choice to mourn a perfect instrument pilot and the innocents who were along for the ride. ★

In an early issue Aerospace Safety will present an article on "seeing," based on factors involved in a mid-air collision. Look for it soon and read it. It might save your life. Ed.

LIGHTS IN THE COCKPIT.......RED or WHITE ?

Walter F. Grether, Ph.D., Senior Scientist
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Red or white? That seems to be the sixty four-dollar question about cockpit lighting. If you look into the cockpits of the Air Force's newer jet flying machines, such as the C-141 or the F-5, you'll find the instruments all integrally illuminated with a pleasing white light. The color is about the same as that of a warm-white fluorescent lamp over your desk. If you're flying commercial, and the hostess lets you peek into the pilot house, you'll also see white lights. Chances are, however, that the color will be the more yellowish light of incandescent lamps.

The Army and Navy, on the other hand, insist that they need red lighting in their aircraft, and they can give you good arguments in their favor. Why this disagreement? If white lights are best for the Air Force and the commercial airlines, why should they not also be best for the Army and Navy? Why do discussions of this issue always seem to end with good arguments for both sides, and with everyone sticking to his original convictions?

Which is most important at night—reading your instruments, or seeing things in the dark void outside the cockpit? If you can answer this question, then the choice of color for your instrument lights comes more easily. The best choice is white if seeing things inside the cockpit takes top priority, and the only things outside that really concern you are brightly lit, such as runway lights and collision lights on other aircraft. On the other hand, if flight safety or the success of the mission depend on seeing very dimly lit objects on the ground or in the sky, a good case can be made for red lighting. The reason for this is that red light is most favorable for dark adaptation, that is, the adjustment of the eyes to seeing in the dimmest light. Just how much advantage can be obtained from red light will be covered later.

Before digging deeper into the visual problems of a pilot at night, let's take a look at how the eyes shift from day vision to night vision. Obviously, as the pupils of the eyes get bigger, they let in more light, but this accounts for only a small part of the adjustment of the eyes for seeing at night. Figure 1 shows a scale of the brightness range through which the eyes can adjust, which extends from about .000001

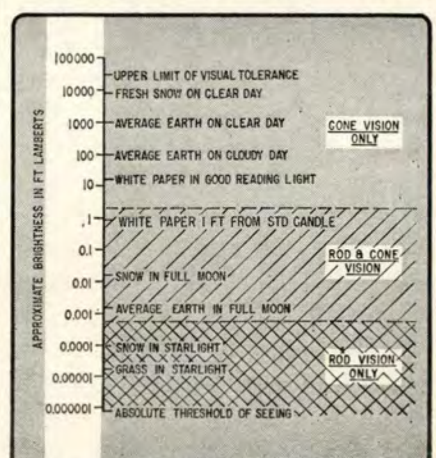


Fig 1

to 10,000 or more foot Lamberts. A foot Lambert is a common unit for describing the amount of visible light reflected from an object or surface, and relates it in a simple manner to light given off by a standard candle.

At a distance one foot from such a candle, the illumination reaching a surface would be one foot candle. If this were a diffusing surface such as white tissue paper, and all the light were reflected, the brightness (or luminance) of this surface would be one foot Lambert. Ordinary paper reflects only about 80 per cent of the light, so with an illumination of one foot candle the brightness would be 0.8 foot Lamberts. So, in general, the brightness of a surface or object (in foot Lamberts) depends on the reflectance of the surface and the illumination (in foot candles).

The light sensitive part of the eye, the retina, contains two types of elements, rods and cones. As noted in Fig 1, the lower end of the brightness range is handled by the rods, which are sensitive to minute amounts of light energy. The cones are much less sensitive, and handle the upper end of the brightness range. In between is a brightness range where both the rods and cones are operating. The rods and cones have other differences besides their sensitivity to light. While the cones provide color vision and good visual acuity or resolution of detail, the rods are color blind and provide only very poor resolution for detail. In the adjustment from bright to dim lights there are three changes taking place, the enlargement of the pupil, the change from cone to rod vision, and the chemical changes in the rods and cones.

What happens to our visual acuity as we go from cone to rod vision is shown in Fig 2. As the brightness level drops to about 0.1 foot Lamberts, there is very little change in visual acuity. Below this value, and particularly below .01 foot Lamberts, however, cone vision is replaced by rod vision and visual acuity falls off very rapidly.

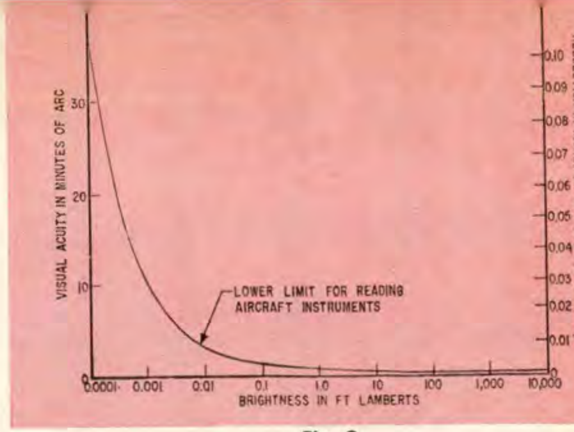


Fig 2

Now, keeping in mind the data discussed above, let's examine the visual tasks of the pilot when flying at night. Obviously, he must be able to read his instruments, markings on control consoles, and any other visual information in the cockpit. Most of these markings, particularly those that are critical, have been designed for reading in dim light. The letters and numerals are considerably larger than would be required under normal office lighting conditions, and the contrast is very high — white markings on a black background. Figure 3 shows what happens to the ability to read aircraft instrument dials as the lighting on the instruments is reduced. At brightness or luminance levels above about .01 foot Lamberts there are almost no errors in reading the instruments. Below this brightness, however, reading of the instruments rapidly becomes impossible.

From what has been said above, and the data in Figures 1, 2 and 3, it is clear that the pilot must use his cone vision for reading his instruments. Only the cones provide enough visual acuity for this task. Some of the things a pilot will need to see outside, though, will be too dim for cone vision, and can be seen only with the rods. This is particularly true in a combat zone where other aircraft will usually not have exterior lights, ground targets or check points will be unlighted except by the moon and stars, and landing fields may be unlighted.

For seeing as much as possible outside the aircraft at night, it is obviously desirable that the pilot's eyes be at maximum sensitivity. In other words, he should have maximum dark adaptation of his visual rods. But dark adaptation is a rather slow process, much slower than the reverse, or light adaptation. After leaving normal daylight conditions, such as when you go from outdoors into a movie theater, it takes about 30 minutes to reach complete dark adaptation. Chemical changes taking place in the rods account for most of this adaptation time.

The problem in night flying is how to give the pilot adequate light for reading his instruments and still have him dark adapted for looking outside. Here is where the red lighting comes in. Sometime before World War II, visual scientists discovered that dark adaptation is less affected by exposing the eyes to red light than to white or other colors. In fact, the greater the color deviates from red, the greater its affect on dark adaptation. Thus, blue and violet lights are more harmful than lights of other colors of equal brightness. Some typical dark adaptation thresholds are shown in Fig 4. After an initial exposure to light (pre-adaptation), the thresholds drop rapidly at first and then level off after about 30 minutes in the dark.

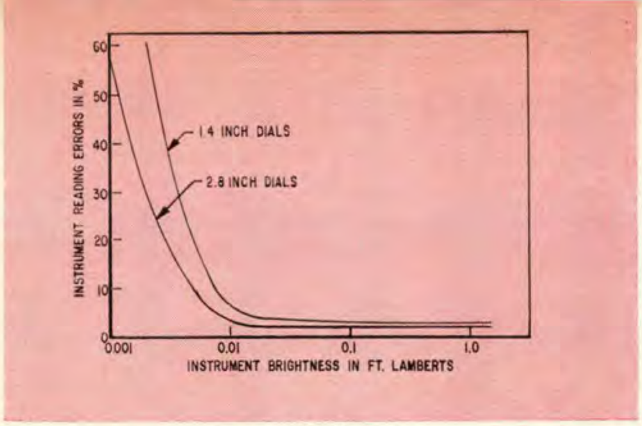


Fig 3

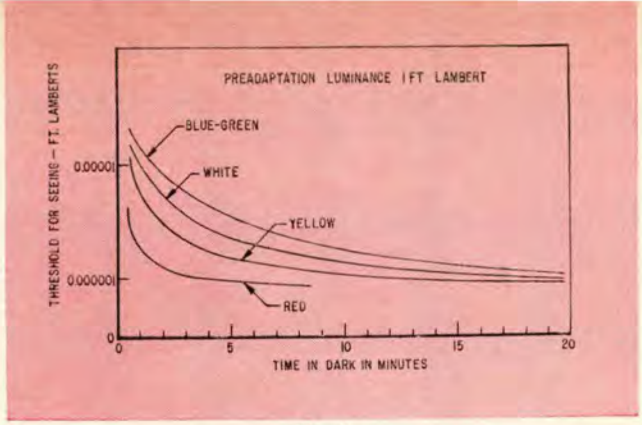


Fig 4

Note that after exposure to red, the thresholds are always lower than after exposure to other colors.

Visual scientists quickly applied these findings to many military situations where night vision was important. Thus crew ready rooms were equipped with red lights. This way the pilots could read or play cards in the ready room, yet when the gong sounded their eyes were prepared for a dash into the darkness to man their aircraft and take off on a night combat mission. The use of red lighting, for the same reason, was also applied to the lighting of instruments and consoles in aircraft. With red light the pilot has good visibility of his instruments. At the same time, his dark adaptation is protected for seeing things outside.

At first glance, this flying in a rose colored cockpit looks like an ideal solution, but it isn't. As is so often the case, the solution of one problem creates new ones. Red light is satisfactory for reading white instrument markings, but some of the markings are colored to provide color coded information. Such color codes can't be distinguished under red light, or any other colored light. With red lighting the pilot is, in a sense, color blind. So, either the pilot has to get along without the benefit of color coded information, or the information must be given to him in some other way.

For some pilots the use of red lighting can create another problem, namely, eye strain. In the spectrum of visible light, red has the longest wave lengths. To focus these wave lengths sharply requires more accommodation or adjustment by the lens in the eye than with white light. For pilots who already have some trouble focusing their eyes on the instrument panel, the use of red light will add to their problem. These are the older pilots, and those whose eyes have a tendency toward farsightedness. This problem of eye strain can, of course, be corrected with glasses for those pilots who are bothered. Consequently, this is a less serious problem than the loss of color discrimination with red light.

White light, then, is a better choice if reading the instruments and other information in the cockpit is our main concern. The only reason for using red light is to provide better vision for very dim objects outside. But how important is this outside vision in most modern flying? Aircraft all have flashing anti-collision and other external lights. *(FAA has no regulation requiring flashing anti-collision lights. Ed.)*

Spotting these lights at night is often easier than seeing the aircraft in the daytime. Further, more and more of our flying, particularly at night, is done under IFR clearances, with control from the ground which keeps aircraft out of each other's way *(except for aircraft flying VFR—Ed.)*. Also, our airports are well lighted with approach lights, runway lights and taxi lights. To see these doesn't require rod vision. Actually, for most of the flying today, the extra night vision that red lighting can give us is probably of no real significance. *(Considering the state of the art, the USAF cannot fully endorse this supposition. Current emphasis on the importance of the "see and be seen" technique must not be subordinated. Ed.)*

We are probably better off with white lighting for flying in peacetime conditions where all the things a pilot really needs to see outside the cockpit are well lighted. The situation can be quite different, though, in many types of military flying, particularly in wartime conditions. The Navy does much of its flying over vast stretches of very dark ocean. In the Army, much of the flying is in helicopters, which often must fly low and land in unlighted terrain. The Navy and Army, therefore, can make a good case of having a greater need than the Air Force for their pilots to have maximum night vision capability. But in wartime conditions, such as we now have in Southeast Asia, many of our Air Force pilots also find themselves needing as much night vision as possible. They often fly at night at very low altitude. They must try to navigate, find targets, and avoid collisions with the ground or other aircraft. For such activities, they obviously need to have their eyes as fully dark adapted as possible. Some pilots, I'm told, turn off all their cockpit lights under these circumstances, and fly without the benefit of seeing their instruments. But ignoring the instruments

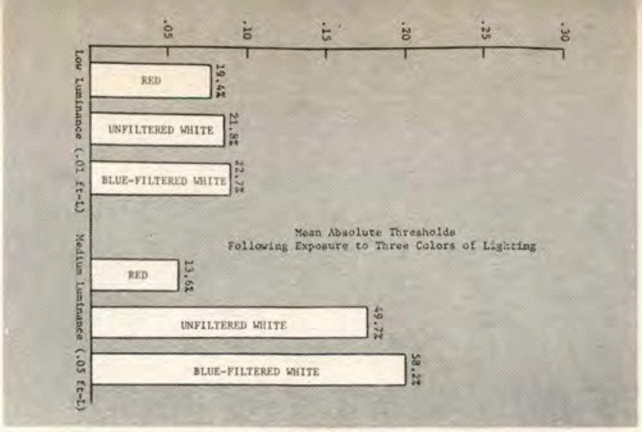


Fig 5

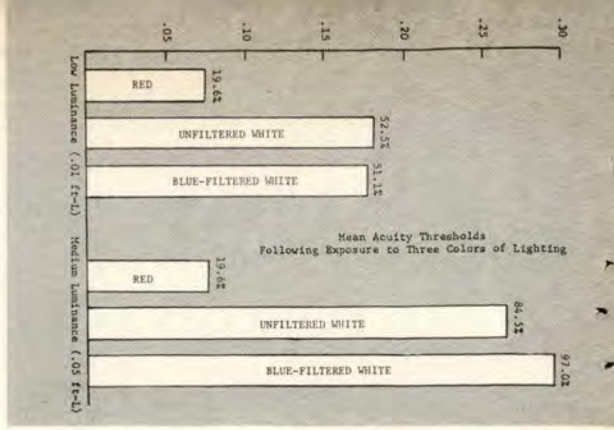


Fig 6

isn't conducive to living to a ripe old age either.

Although the data supporting the use of red lighting (such as in Fig 4) are well substantiated, there is still a question of just how much extra night vision red lighting actually buys for the pilot. Is the gain in night vision really worth the penalty of losing the color coding in the cockpit and causing increased eyestrain for the farsighted pilots? This is a question that Dr. H. N. Reynolds (1st Lt, USAF) and I set out to answer in some recent experiments.

Evidence for the use of red lighting had all come from laboratory experiments in which the eyes were adapted to much larger amounts of light than the pilot has in his cockpit. Therefore, the losses in dark adaptation were considerably exaggerated. In our experiments, Lt Reynolds and I used a simulated instrument panel of a T-38 aircraft. This was illuminated from the rear to look like a panel of integrally lighted instruments. The lighting color was either red, incandescent white (as used by some airlines), or blue-filtered white (as used by the Air Force). Also, two brightness levels were used. One of these, .01 foot Lamberts, represents the lowest level for safe instrument reading. The other level was .05 foot Lamberts, which is what most pilots would consider a comfortable level. After they had been completely dark adapted, we had our subjects scan the panel as if they were flying on instruments. Then we had them look away from the panel while we retested their dark adaptation thresholds.

We made two types of threshold measurements. One of these was the customary absolute threshold, or the dimmest patch of light that can barely be seen. The other was an acuity test and involved resolution of parallel black and white bars, each bar being 20 minutes of arc in width, as measured at the eye (about 3/8 in. at the 56-inch viewing distance). The subject adjusted the brightness of the white bars, located behind and above the panel, until he was just able to resolve the pattern of alternating black and white bars. This test resembled the task of a pilot when he looks over his lighted instrument panel and tries to see details on the ground ahead of his aircraft.

Our findings in this study agreed with all previous studies in demonstrating the superiority of red lighting in terms of dark adaptation. What they added to previous results was a realistic indication of the degree of this superiority for actual cockpit conditions. The results are shown in Fig 5 for the absolute threshold test, and in Fig 6 for the acuity test. All of these results are presented in terms of the increase in threshold over the same thresholds obtained in complete darkness.

Let us see what the results tell us. In Fig 5, for example, the red lighted panel, at the lowest brightness level (.01 foot Lamberts), raised the absolute threshold by about 19 per cent over what it was in complete darkness. This is how much brighter a large dim object, such as a pond, would have to be in order to be seen after reading red lighted instruments. At this level the white lighting had about the same effect, around 22 per cent increase in the threshold. At the higher instrument brightness level (.05 foot Lamberts) however, the white light caused a much greater elevation of the threshold, roughly 50 per cent.

Looking now at the results for the acuity test in Fig 6, we find that even at the lower brightness level the white lighting caused quite a noticeable elevation of the threshold, by comparison with red. For either of the white lights, the threshold increase was about 50 per cent, versus about 20 per cent for the red. At the higher lighting level, the effect of white lighting was considerably greater. In neither test was there much difference between the effects of incandescent white versus the blue-filtered white.

Taken as a whole, these results show that if the pilot adjusts his instrument lights to the lowest level at which he can still read his instruments (about .01 foot Lamberts), the advantage of red light over white light becomes quite small, possibly too small to be of practical importance. With white lights it is much more important than with red lights that they be turned down as low as possible. Increasing the red light from .01 to .05 Lamberts appeared to cause no increase in the dark adaptation loss, while the same increase in the white light had a considerable effect.

So, we end up about where we started. Red light is still the light to use if you put a high priority on dark adaptation and the advantage it gives the pilot for outside vision. On the other hand, for most modern flying, the emphasis is on seeing the instruments and other displays in the cockpit. For such flying, white light, either incandescent or daylight white, is the better choice.

Although the question of red versus white lighting has had the spotlight, this may be putting emphasis in the wrong place. There are other factors which probably do more to degrade vision outside the cockpit at night. Unless we can eliminate these causes the pilot will never realize whatever small advantage red light can give him. Some of these obstacles to seeing outside at night can be controlled by the pilot. Others can only be corrected by the aircraft manufacturer. Let's look at some of these other things that hinder night vision.

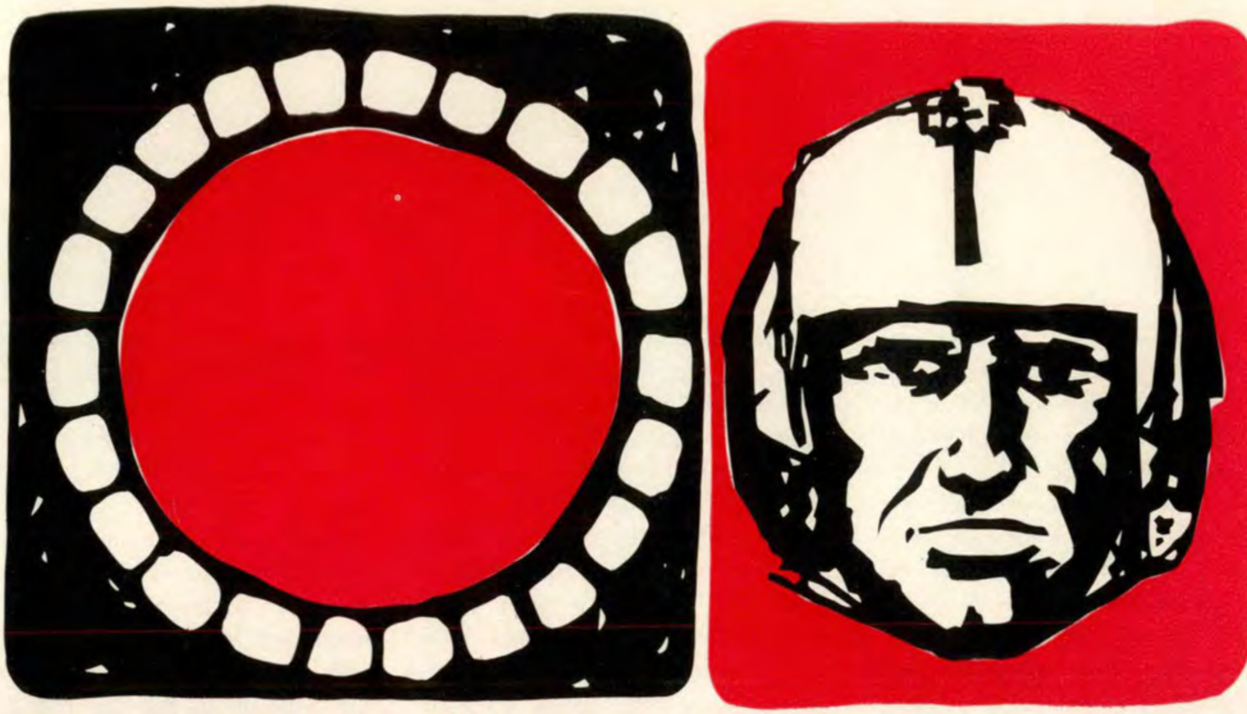
First of all, the instrument lights are not the only lights in the cockpit. There are also signal and warning lights, radar scopes, console lights, and others. There is no point to using red instrument lights and turning them down as low as possible, if, at the same time, there are other much brighter lights fouling up your dark adaptation. I've heard of some pilots having to put masking tape over cockpit signal lights to keep them from glaring in their eyes. So, unless these other lights are also turned way down, any benefits of red instrument lighting will be wasted.

Remember, also, that it takes about 30 minutes to obtain complete dark adaptation after being exposed to daylight, or other fairly bright conditions. *(For related information see the article on page 10. Ed.)* Even after exposure to fairly dim lights, it may take 10 minutes or more before again reaching maximum visual sensitivity. Any time you turn on your general cockpit lights, as for reading a map, your dark adaptation will be set back for quite a while. The same thing will happen if you look down at a lighted city, or at a magnesium flare. So, if you're trying to keep your dark adaptation and compete with the owls, you must avoid looking at any but the very dimmest lights.

Probably the most serious hindrance to good vision out of the cockpit at night is one that the pilot can't do much about. This is the effect of light reflections off the windshield and canopy. Such reflections may come from lighted instruments and consoles, or from light reflecting off the pilot's flying suit. When such reflections come from concentrated bright spots they are rather easy to recognize, and possibly eliminate. But when they cover large areas, you may not even notice them. Still, any such reflection from the windshield or canopy is a direct barrier to vision. It acts like a semi-transparent curtain between you and the outside.

The designers of aircraft, automobiles, and other vehicles have learned how to eliminate many of these reflections. They put a glare shield or shelf at the top of the instrument panel. This blocks the light path from the instruments to the windshield, but the reflections can still show up in the side windows. Also, the instrument lights can illuminate the pilot's flying suit or his face. These, in turn, may be reflected off the windshield, depending on the angle of the glass. Quite obviously, the pilot cannot change the angle of the windshield, but he can greatly reduce such reflections by wearing a dark flying suit. It's next to impossible, though, to eliminate all such reflections. The best we can hope for is to keep them to a minimum on the windshield where they interfere with forward vision.

In conclusion, then, red instrument lighting is only one of the things that can improve your ability to see things outside the aircraft at night. In fact, red lighting won't help you at all unless your eyes have a chance to get completely dark adapted, and then you keep them that way. This means avoiding exposure of your eyes to other lights brighter than your instruments. The benefits of red lighting will also be reduced if reflections off the windshield obstruct your outside vision. ★



SUNBATHING AND FLYING

POOR night vision may have an effect on one's susceptibility to spatial disorientation. This is another reason for enhancing dark adaptation. The following, extracted from a 7th Air Force Consolidated Aerospace Medicine Report, explains the effect of prolonged bright daylight on night vision.

"A pilot was lost to spatial disorientation or vertigo during an over-water two ship join-up on a very dark night. The lead pilot reported a barely discernible visual horizon. Medical review of the final accident report revealed that the missing pilot had spent several hours sunbathing on the afternoon of that day. A quote from McFarland's HUMAN FACTORS IN AIR TRANSPORTATION is pertinent: 'Exposure to bright sunlight also has an adverse influence on night vision. In a series of carefully controlled observations, individuals exposed to intense sunlight near the sea for only two to five hours have shown definite impairment in their night sensitivity. Dark adaptation thresholds rose on the average by about 0.2 log unit, indicating a loss of 30 to 50 per cent in visual function as compared with normal. This effect declines with time, but a 0.15 log unit increase in threshold was noticed five hours after exposure. Since the effect is cumulative, flight personnel who work or play in bright sunlight and are on call for night duty should wear suitable sun glasses to maintain their gross sensitivity. Exposure to intensive glare may occur during relaxation on the beach or when flying into the sun, about clouds, or over water or snow.'

"It is just possible that relaxation in the afternoon sun may have raised the man's dark adaptation threshold enough to have cost him perception of the dim natural horizon, leaving him blind to the one sure cure for spatial disorientation . . ." ★

the I.P.I.S. approach

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

CIRCLING APPROACHES

A circling approach can be a deceptively hazardous undertaking. Pilots may be required to maneuver heavy aircraft, at low altitude, in limited airspace, under marginal weather conditions. However, despite the potential hazards, there is no single procedure for accomplishing a circling approach. Weather, obstructions, and aircraft performance vary, and each circling approach is totally dependent on pilot judgment. Questions which most influence pilot judgment are discussed below.

Q Under JAFM 55-9 (TERPs) how much obstruction clearance and airspace are provided for a circling approach?

A The MDA will provide a minimum of 300 feet of obstruction clearance in the circling approach area. The size of the circling area varies with the approach category of the aircraft and airport design.

AIRCRAFT CATEGORY	OBSTRUCTION CLEARANCE RADIUS
A	1.3 NM
B	1.5 NM
C	1.7 NM
D	2.3 NM
E	4.5 NM

CIRCLING AREAS BY AIRCRAFT CATEGORIES

The limits of each category's circling area can be defined by drawing an arc of specified radius from the center of the threshold of each usable runway. With the extremities of the arcs joined by tangent lines, the enclosed area is the circling approach area. Pilots must stay within the prescribed area as no secondary obstruction clearance area (buffer zone) is provided. In addition, some airports may eliminate a sector of the circling area due to prominent obstructions existing in the sector. While approach planning, pilots should be alert for notes such as "circling not authorized west of runway 18/36."

Q When may a pilot descend below the MDA during a circling approach?

A Remember the MDA is a minimum altitude. If weather permits, a circling approach should be flown at the normal VFR traffic pattern altitude. However, the MDA should be maintained until the pilot decides that a VFR landing is assured, and descent from the MDA is necessary to place the aircraft on a normal glide path to the landing runway. Be aware of the common tendency to overshoot final from a lower than normal traffic pattern.

Q Is a pilot required to keep the runway in sight during a circling approach?

A Not necessarily. A pilot must remain oriented throughout his circling maneuver, and he should have an exact knowledge of where the runway is at all times. However, it may not be possible to keep the runway in sight. For example, a pilot in the left seat of large aircraft circling right would not be able to keep the runway in sight.

Q If, after starting the circling maneuver, a pilot is unable to continue the approach, how should the missed approach be accomplished?

A A pilot should be familiar with the missed approach procedure for the approach being flown. (For radar approaches use the lost communication instructions issued on final.) If a missed approach is required after starting the visual circling maneuver, initiate a climb from the circling MDA and remain within the circling approach area while maneuvering back to the vicinity of the missed approach point. Then, execute the missed approach. The importance of approach planning, orientation while circling, and coordination with ATC are evident.

As a pilot performing a circling approach, your first decision is the most important. After arriving at the circling MDA, if there is any doubt that the aircraft can be safely maneuvered to touchdown, execute a missed approach. ★

Programmed Texts are now available to supplement Instrument Refresher Course presentations. The texts are valuable for year-round review of subjects such as Nav Aids, Weather, Computer, and Flight Instruments. To get a copy contact your local instrument school or write to IPIS.

THE ability to navigate is one of man's greatest accomplishments. Only by knowing where he was in relation to where he wanted to go, and how to get back once he got there, was it possible for him to extend his frontiers across the entire world. And now he is nibbling at the fingers of infinite space.

Despite this wonderful ability, some people seem to be able to get lost within a few blocks of their homes where they have lived for many years. Are they deficient as navigators? Possibly. But in what way? Navigation is both an art and a science. Possibly a good navigator possesses an instinct that enhances his skill. Certainly some pilots seem to be able to get around quite well without any of our sophisticated electronic aids, even without charts.

But Air Force pilots can't depend upon instinct. In today's aircraft and the environment in which he flies, the pilot must depend upon certain gages, connected to black boxes that are driven by the aircraft electrical systems. Most flight planning, especially in the U.S. and over water, is done with charts that show no terrain features, that, instead, depict only electronic reference points. Our immediate tools, once we are airborne, consist of some needles on the faces of instruments and digital dials that permit us to navigate by the numbers.

This is a truly marvelous system, accurate — most of the time — efficient and relatively simple once one gets the hang of it. But once in awhile something goes wrong with this fantastically complicated electronic marvel. A VOR fails. Black boxes and instruments fail. A TACAN refuses to work as designed and gives the pilot an erroneous signal. A radar set fails to operate as advertised.

We know these things happen, we expect them, and we have alternate procedures and equipment to fill the gap when something fails. Nevertheless, on occasion, a pilot is unable to cope and his name is entered on that long scroll headed *Accident*.

Some occasions come to mind: A T-bird that flamed out and the crew had to eject because unexpected headwinds gobbled up their fuel. A crew that drove a transport all over the Middle West before finally running out of fuel and crash landing. Several aircraft in recent years that ran into mountains. Most recently a trainer that ran out of fuel and crashed when the pilot couldn't find his destination on a five-minute flight.

Now all of these pilots were skilled in their profession, some more, possibly, and some less, but nevertheless, thoroughly trained and experienced. Why, then, should they permit themselves to get into such predicaments?

Not too many years ago much of the emphasis in pilot training was on navigation. A great deal of time was devoted to dead reckoning and pilotage. The charts were maps of the earth's surface and we learned to navigate by both terrain features and electronic aids, combined with time, distance and speed. All of these, once the procedures had been assimilated, allowed one to keep himself oriented in the atmosphere, day or night and in weather.

But this system was not efficient enough for high speed aircraft that fly eight to ten miles above the earth at speeds near and above the speed of sound, above clouds that completely obliterate the earth sometimes for hundreds of miles. So, we acquired the electronic systems that we have today, along with long range systems and the time-honored celestial methods normally used only by the navigator crewmember.

One wonders, however, if in the process we haven't lost something that is pretty valuable—the ability to navigate by surface indicators, what we call pilotage and which we combine with time, distance and speed. We can't imagine any Air Force pilot that has not been trained in this kind of navigation. Even today student pilots receive four hours of pilotage in the T-37 and 5:15 in the T-38, plus classroom time, in addition to training in electronic navigation. So by the time a young man graduates and receives his wings he should be fairly proficient. But as he builds up time in an operational command he may have very little use for pilotage. Most of his flying will consist of driving from one VOR or TACAN to another until he reaches his destination where he will approach and land using other electronic aids. He may seldom see a WAC or Sectional chart. His flight plans look something like this: J56-VOK—J85-DEN—V17—LAX. ETE—3+30. He measures the distance between these invisible road signs, gets some wind from Stormy, rolls it into a computer along with the distance and gets a time factor. From the moment the wheels go into the wells until he touches down his only reference to the earth may be limited to what the needles on the panel tell him and what comes out of his headset.

Eventually something happens and he is forced to rely upon older, more crude methods of navigation. He could wind up in Vietnam and get lost, as one crew did, and land at the wrong base where an accident was almost inevitable because of the size of the runway. Or he might find himself in the predicament of the man on the five minute hop that we mentioned earlier. The VOR he was depending on was inoperative and he got lost. He was short on fuel and as a result had to bail out.

Most pilots, after a few flights, become well acquainted with their local area, so if anything goes wrong with their nav gear they would have little difficulty in orienting themselves, night or day, although weather could cause problems. But away from home things are different. One mountain may look pretty much like another. Is that the Mississippi river? Or the Missouri?

If you are flying one of those big four to eight-engine jobs, no sweat. You have a navigator and enough backup equipment to take care of almost anything. But we have a lot of one and two-engine birds manned by one lonesome Joe who will have a bagful of problems on his hands if he loses his electrical system. Then what? Complicate it a bit and put him in night weather. If he's in formation, then he has some help. But this isn't always the case.

What we are getting at here is that pilots should not let their pilotage skills get so rusty that they become virtually useless. Pilots should —and most do—keep pretty good track of where they are even though they are flying high and navigating electronically. They should know lost communications procedures. They should be aware of the fact that across this nation there is a huge DF net that, if they have one radio working, can locate them and get them to an airport. Any ARTCC or Flight Service Station and some military installations can provide this service. And, of course, there's radar available for vectors, if you have a radio.

Of course, *all* Air Force jocks know all this, so why waste the space here? Well, there are a number of accident reports in the files that tell us that *all* should be changed to *most*. ★

LIFE SUPPORT NOTES

WHAT HAPPENED TO THE CLIP? This is the question being asked by many crewmembers since the advent of the CRU-8/P and CRU-60/P connectors. The alligator clips on aircraft oxygen supply hoses have disappeared as the MC-3A type connectors have been removed. For the aircrew members who wear parachute harnesses with CRU-60/P support fixtures attached, the clip removal had no impact. For those indivduals who are required to wear the oxygen mask but not the chute, the removal of the clip on the aircraft hose presented a considerable comfort problem. To help this latter group of individuals, an oxygen connector adapter assembly has been developed (FSN-1660-973-4343; Sierra P/N 266-350A) which will allow the user to clip the CRU-8/P or CRU-60/P connector to his clothing. With this device, the weight of the connector and the aircraft oxygen supply hose is carried by the clip and not the user's mask.

UNAUTHORIZED MODIFICATION — Members of a fighter outfit on the East Coast turned up at a training center recently with the CRU-60/P safetied to the hose plug. It is true that most experts agreed to the validity of an existing option: disconnecting either at the harness or at the hose end of the CRU-60/P. However, there is a significant difference in the time it takes to disconnect at these two points. The single push, twist disconnect at the oxygen hose end requires much less time and effort.

In 1967, twenty-six per cent of our major accidents involved emergency ground egress. There were twelve fatalities which were directly attributable to ground egress difficulties. Speed is of the essence and practice helps make perfect, so many units now forceably encourage a practice egress after every flight. Reduce your time, disconnect at the simplest point, and don't let anyone make unauthorized modifications on your personal gear.

The "Four Line Cut," a method to dampen oscillations and provide increased steerability to a standard parachute, has become a common item since its adoption about three years ago. It has been particularly valuable in SEA, where the aircrewman who has to leave his aircraft needs the ability to steer his chute toward a favorable landing site.

Although this mid-air modification has been a good thing, there have been some problems with the method — cutting the suspension lines with a knife:

- An injured man may have difficulty cutting the lines.
- There is the danger of cutting the wrong lines, or too many.
- Psychological resistance to partial destruction of a good parachute.

Now, relief is on the way—a new method of releasing the lines. When this procedure is adopted, all the parachutist will have to do is pull two lanyards, one on each rear riser. Here's how it works:

The four proper lines are rigged to connector links through a "daisy chain" coupling and jettisoning lanyard, as shown in the photographs. The parachutist simply hooks his fingers through the lanyard loops and pulls. Release requires about a 6- to 8-inch pull with about 30 pounds of force.

The lanyard will be identified by a red loop on the inside surface of the risers at about arms length. Once the four lines have been released, the lanyards can be used for steering by pulling, which is said to be easier than pulling the riser straps.

Tests which included both drops of torso dummy weights and live jumps indicate the "daisy chain" coupled lines to be as strong as lines coupled in the standard manner.

Parachutes of latest design, or which will be modified with TCTO 14 D1-2-613, will have the jettisoning lanyards installed. Kits will be available about 15 September-1 October. ★

The *NEW* Four-Line Cut

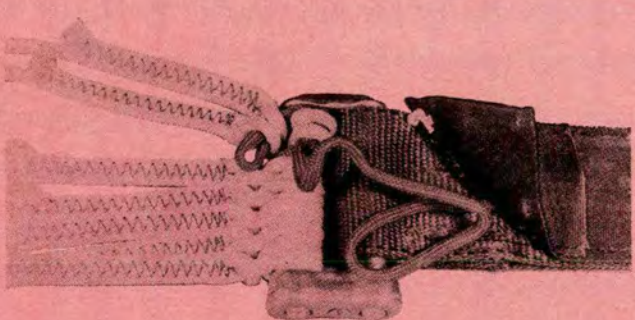
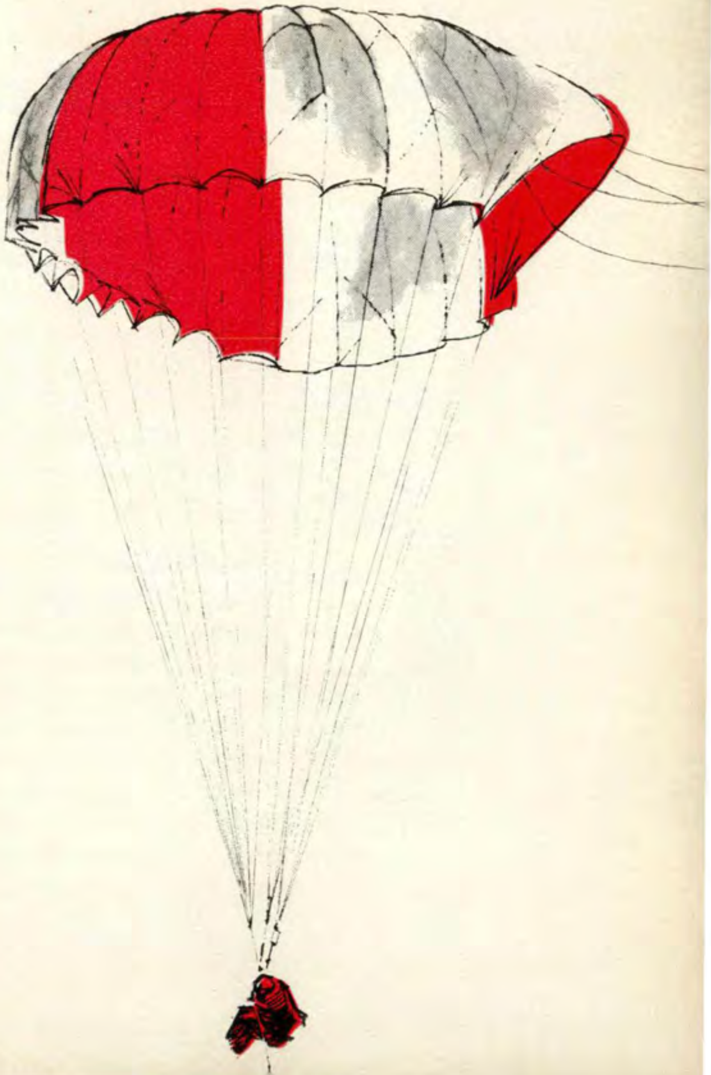
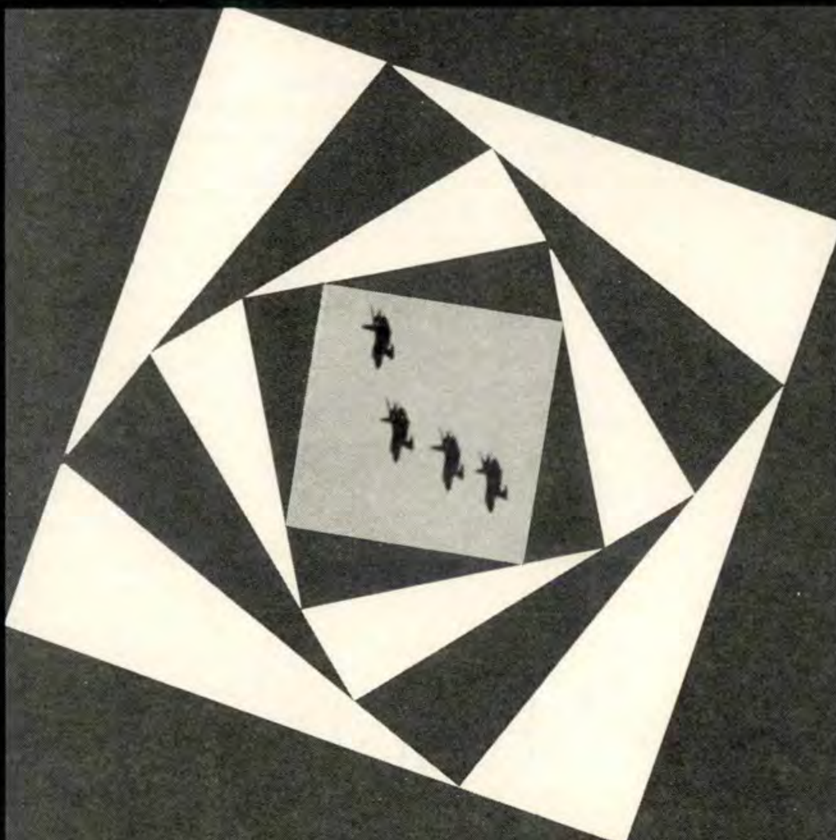


Fig. 4. Installing lanyard on link.

Fig. 5. Complete installation of lanyard.





LOST IN SPACE

This is the second of three articles on Spatial Disorientation. This series resulted from a roundtable discussion involving several members of the Directorate of Aerospace Safety. Participants were Colonel Thomas A. Collins, Chief of the Life Sciences Group, Majors Victor Ferrari and Charles Sawyer, all flight surgeons, and Dr Anchard Zeller, Psychologist in the Life Sciences Group; Major Robert Bond, fighter pilot and project officer; Lt Col Henry W. Compton, editor and transport pilot, and Bob Harrison, managing editor.

In the first instalment the group discussed the magnitude of the disorientation problem, some disorientation-producing situations and personal experiences in which disorientation was induced. A major theme was formation flying and disorientation.

Part II

Dr Collins I think formation weather flying is our number one disorientation problem area, but we certainly have a lot of others. One of them is the takeoff problem on a very dark night. This still kills people. Does anyone have any feel for this one? I guess this is strictly instrument training and staying on the gages because, otherwise, you are going to get fouled up.

Col Compton I know from my own experience, but not in a very high performance aircraft, taking off from Lajes and also Guam at night I've gotten into a no climb situation. This is why you always brief your copilot, if you are lucky enough to have one. When you are taking off into a pitch black place like that, generally off a cliff or high runway, you brief your copilot that, if you ever stop climbing, he's to sing out. I know that situation has killed people in even bigger airplanes, so think what it would be like in a fighter.

Major Bond I think it is more important—that type of a problem—in bigger planes because a lot of times you get into things like gyro precession. Gyros, normally, unless you are using fast erect mode, precess at a set rate—either they erect or displace themselves at a set rate. For example, a loaded C-135 takes about 45-50 seconds from beginning of takeoff roll to unstick. So they accelerate to a 350 knot climb speed. We are talking about acclerations on the order of two minutes. Two minutes, if it erects at 2½ degrees a minute, which is fairly standard for most attitude indicators, means we are talking about five degrees on an attitude indicator. The '105 and the '135 both have the same central attitude indicators, 2½ degrees per minute in a slow mode, and 11 to 14 degrees in a fast mode. In a fighter where you are using afterburner for takeoff, you accelerate quicker. But you can only precess so fast, so your precession is over quicker and the error is less in the system. These other airplanes that accelerate for a longer period have larger errors in the attitude indicator.

Dr Sawyer In this situation in the fighter, where you are accelerating rapidly, you are more likely to get changes in radio frequency and other things that take you off your instrument reference. The inputs can be incapacitating by themselves, so certainly from an experience standpoint, considering all cases where disorientation is involved, fighter aircraft have the highest incidence.

Dr Ferrari On the other hand, the performance characteristics of these aircraft allow for recovery from situations like this, whereas in larger aircraft you can get into situations from which you just can't recover. Say on the approach you have a visual illusion. In a large transport aircraft, you can set up based on what you see and get yourself into a position where you can't possibly recover. A fighter at this point is relatively light and with power you can easily recover, if you don't run into a tree or something. I think it would be useful to talk about takeoffs and landings on dark nights in the realm of visual illusion. In this we are dealing with specific geographical situations. If on a partic-

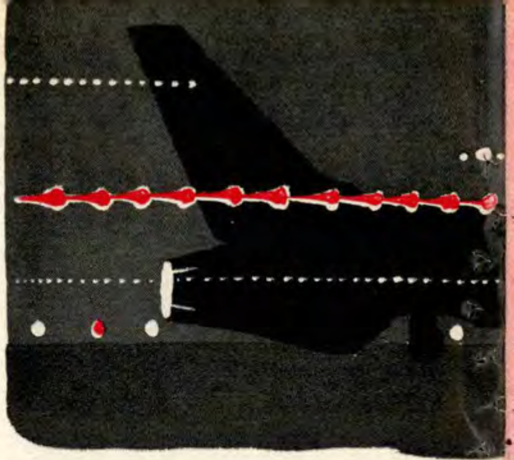
ular type of night, say off runway 05 out here, you are prone to get a visual illusion due to lights on the mountains, then you could set up an educational program, a geographic survey to evaluate the potential disorientation from visual cues that exist around each particular base. You could set up a program for reporting these things. They are not reportable now—very, very seldom are they reported. Sometimes you will get an OHR but not very often. But you could identify specific potential problems in an area and work through base ops to put a big notice on the board where people file that, *in this type of weather you are prone to get this on takeoff on this runway.* This would be a very positive approach to handling a visual illusion type of disorientation.

Dr Zeller It is very positive but it is not particularly profitable. That is the thing that is wrong with it. MAC tried to do this a while back. They asked us to go through all of our records of various types of landing accidents. We found we do not get repeat accidents of the same kind on the same runways. It would seem that you would get the same kind of an accident and the same type of reaction from a specific illusion, but our accident experience doesn't support this.

Dr Ferrari Might it be reflected in actual experience that didn't result in accidents?

Dr Zeller It well might but the only thing we can count is accidents.

Dr Ferrari I know, but you are just counting the only thing you've got. I'm saying that, if you want to be aggressive, let's not look at just dead bodies. Let's go out and survey and set up a program to encourage this type of reporting. Maybe in a year you'll find out that, on a good clear night on this runway, we've had five reported illusions. Our problem in safety here is that most of our pilots are so damn sharp at getting out of bad situations they really don't think much about it. It is just one of the occupational hazards, so they don't report it. I admit you probably couldn't document this thing in repeat accidents, but I bet you a dollar if you had access to this



other type of reporting you could document and pinpoint definite areas. I know one exists at Randolph. What do we do now? We generalize, we say, "Watch taking off on a real dark night into Balboa." Well, that's fine, but you haven't keyed this man as he lines up on the runway that here he is faced with that exact situation, right now. If you *could* key him to this thing, and he is expecting it, he will turn around to his copilot and say, "Watch this." Otherwise he might forget it.

Dr Zeller We have what we call spatial disorientation accidents, but to say this is like saying we have pilot error accidents. We haven't said anything. We are talking about a multiplicity of things. Dark nights, formation, getting lost. The point remains that spatial disorientation is not an entity. It is a composite of a number of things, and each of them has to be considered specifically if we are going to do anything about them. Illusions may or may not be a factor. The process of flying is learning to deal with illusions. That is one of the primary things pilots learn to do. We know some specific things that precipitate disorientation. We can do it in a chair, and we have no reason to believe there are people who are not particularly subject to this. Everyone has it, as Colonel Collins indicated earlier. We really have only two things—one, we have to identify the specifics, and avoid them in design and operational procedures, and then, we have to train pilots to recognize that this is a universal human phenomenon, like getting hungry and thirsty. That it is going to happen and teach them to deal with it. It isn't an entity that you can just talk about, you have to get down to specific points.

Mr Harrison We have pinned down things over the years, like radio frequency changes.

Dr Zeller That is what I was getting to—specifics.

Mr Harrison Then we went to single frequency for approaches. This is a concrete thing aimed at a specific that would cause a man to become disoriented.

Dr Collins What is the role of trim? I know it plays a role, but what is the significance of trim in this whole business? So often a pilot will fight an airplane all the way down to the ground once he gets disoriented, moving the controls every which way but never accomplishing anything effective. Whereas hands off early in this game might have precluded the whole event, if the airplane had been properly trimmed. Do you think we can do better than we are doing in difficult instrument flight conditions, as far as trim is concerned? When these people start to get the funny feeling that the gages aren't right, should they try hands off?

Major Bond I don't think we can go quite that far. But I think you are absolutely right, that trim is critically important. It has been my experience that people who fly a nice airplane fly a trimmed airplane. The man who flies a trimmed airplane doesn't get in trouble, because it doesn't depart from where he put it as rapidly. This is because he has trimmed it to the attitude he wants or to the maneuver he wants. So when he does get lazy and looks around, or glances through a letdown book, or digs out a sandwich on a long over-the-water flight, the airplane doesn't depart from that desired flight attitude or flight path. It doesn't happen that quickly is the thing. You teach the young stud not to grip the stick so hard, because he can't feel stick pressures. And you teach that when he trims he's got to turn it loose and trim all the pressure out and put it right where he wants it to hold the airplane.

Col Compton Coupled with cross checking, say your needle and ball.

Major Bond I didn't mean to imply that trim would fly the airplane.

Col Compton No, no, but I'm saying, though, that good use of trim does aid your reliance on your instruments. Trim comes together with the instruments in combating vertigo problems.

Dr Ferrari As for the role of trim, you've got to consider the aircraft type, because some airplanes have a positive trim. That is, if you trim the aircraft to a configuration, then you forcefully deflect from this attitude, not touching your power, the aircraft has a positive stability and will come back to the original position. Others have a neutral stability, so they will just sit there, but if you deflect it, it will just as apt sit right there, too, in its deflected position. In contrast to this some of them have a negative stability, where if you've got them trimmed and shove the nose down, for instance, it will automatically come back up, but it will go too high and it will compensate and come back down. These things

get wilder and wilder. So you've got to consider the individual aircraft.

Major Bond This point of training we were talking about, of education and training, recurring training. The identification of how they recognize the problem and what the corrective actions are really do apply to formation flying. I never thought about it as being applied to disorientation or vertigo. I've never said the words to myself. I know it affects other people but that has been an area, at least in the tactical business, which is normally passed on by word of mouth. We tell a guy, "Now if you get in close you are going to get behind his wing. The air is going faster, and it is going to lift that wing and you are going to carry aileron. As soon as you do that, mentally you are going to think you are in a steeper turn than you really are." When you are teaching a young jock who is just starting out in your flight, you tell him, "When you've got vertigo on the wing, you look at his airplane and trust his airplane, instead of looking at your instruments and trusting your instruments, but the sensations are very similar. You have feelings of confusion, uncomfortableness while really not knowing what is causing it. But you know something is not right." These are all sensations you have when experiencing vertigo on instruments. Things like trim; I had trim run away with me one time, on instruments, and a terrible case of vertigo. I realized it really wasn't me. I was holding a lot of stick in the airplane. It took me several minutes to sort it out. I was sitting there staring at that attitude indicator and trying to believe it. The needle and the heading weren't changing and I knew I was right side up. But it just wasn't right, because I could see the muscles and white knuckles, so I knew I was holding a lot of stick.

Col Compton Generally two things are going to induce illusion (vertigo or disorientation). Either your inner ear combats this thing because of a maneuver, or the wings are cutting across a cloud, or horizon, or lights or another airplane. So either one of those two things can induce disorientation.

Dr Ferrari There is a third one, as Bobby pointed out, and that is your muscle sense. You get in close and you know you are having to hold pressure to the left, when all the time you know you are banking to the right.

Col Compton So there are three things that could give you this trouble—muscle sense, inner ear differences, and something that makes you think those wings of the other aircraft that you are using as a horizon aren't true.

Major Bond When I was a big gold bar, on my third mission we plowed through a heavy overcast from about 800 feet to about 32,000. We were flying '86s with tanks on them. I kept running out of power climbing up, and Lead was about to send me home. I had never flown in any weather; we'd gone through Williams and Nellis, and I'd passed all the instrument checks but this was my first real weather. I was pretty well pumped up. We were running up north in Korea, but I was running out of power. Everybody else, of course, had the power way back waiting on me, and my flight commander was just ready to send me home. I really didn't want him to because he was going to send me by myself, and I wasn't that choked up with my ability to cope with going home and recovering that airplane at the time. He said, "O. K., if we don't break out here very shortly you are going to have to go back." Very soon we broke out and everybody was sitting there nice and straight except me. I was flying Nr 2, and I was sitting with the airplane cocked way over on the side. I was nervous and had got in too close. A little more air made me want to roll away from him so I was holding aileron into him, which normally would make me move closer. I was sticking in right rudder to keep me off him and aileron into him. I had no idea.

Dr Collins You probably flew a lot of weather, subsequently, over there. Do you think that, in reminiscing on this thing, you learned to suppress and actually did not feel as much disorientation after a lot of weather experience? Or do you think you always felt it the same but it didn't bother you as much because you knew how to deal with it?

Major Bond I felt I knew how to deal with it.

Dr Collins You didn't really suppress it even though you flew a lot of weather. It was there.

Major Bond No, I just recognized it.

Dr Collins I ask this because there are a lot of people who think if you practice this enough every day that you can actually suppress these disorienting feelings of vertigo. But I think you would have to be flying, if this is true, almost all day long and all night long.

Major Bond If you flew every day, I think you would subconsciously maintain the correct spacing and not get in there too close. Constant practice would remind you that it is harder for you to fly and it untrims the leader's airplane and makes him want to roll away from you. And you know that when he gets down he is going to bite you in the tail and say, "Will you kindly scoot out and not mess up my trimmed airplane."

Dr Collins That's right, you know enough about your flying ability to cope with the situation, but physiologically it is still there, the conflict between what the gages say and what you feel.

Major Bond I climbed out over Kadena one time with a flight of four '105s on a typhoon evac. We went through a thunderstorm and we'd been hit by lightning and all kinds of good things, at night. I had vertigo so bad that I leaned over and had my arm hooked under the sill to keep from falling out of the seat—I thought. It was just terrible.

Dr Ferrari Along with what you are trying to pursue there, some of these people seem to think you can train a man to the point that these sensations don't occur. I don't believe that ever happens. It might happen in an experiment, but you try to relate this to actual experience and I think what happens is that this man is having the same problems, the same sensations, probably as frequently. But through his increased proficiency he catches these things much earlier with his faster, more reliable crosscheck. With his better basic flying techniques, which include trimming the airplane properly, you just don't get these excursions. Therefore, these people think they don't get vertigo but they have the same sensations.

Col Compton You get rid of it so fast it doesn't have a chance to become an acute case of vertigo.

Mr Harrison What's the status of the disorientation trainer?

Col Compton Well, I was going to mention something in line with an accident not long ago, when the wingman was going in and out of the clouds in an F-4. He finally wound up in a screaming dive 4000 to 6000 feet off the ground in such an attitude and losing so much altitude so fast that they had to get out of it. One of his recommendations

was that they practice induced vertigo more often in a trainer. How do they practice that? Is this something that the simulator people know how to do?

Dr Ferrari I think you'd have to spend a lot of time in that trainer to actually decrease the sensitivity of your mechanisms in the inner ear, which is what you are trying to do.

Dr Collins That is one of its purposes, Vic, but in addition to that, it is a means of allowing a pilot to recognize the feel of disorientation, and for that purpose it is probably all right. I know I've flown missions in which the pilot attempted to get me disoriented. I'm not particularly resistant to it but he failed to do it on several occasions. This was part of the curriculum at Luke. They had the trainer down there for quite a while. It is a little gadget that runs around a track, you know, and you can't resist that. You feel it. There it is, you are turning a loop or something when you know damn well you are just running around in a circle on the hangar floor. They developed this thing with the idea of being able to have a man in it enough so that he could actually reduce his sensations and, therefore, would be less subject to the conflict of instruments versus sensation. I don't think that will ever work out. But I do think a trainer of some sort has a value. It would be a lot cheaper for sure than to go up and fly all over the sky and try to get a guy disoriented under the hood.

Mr Harrison Does TAC still fly those disorientation maneuvers, Bobby?

Major Bond Unusual positions? The last time I got them.

Col Compton When I was a cadet, and I can remember it vividly, unusual position bothered me a hell of a lot more than they bother me now. In my last instrument check in a T-29, he gave me some pretty wild unusual positions but they didn't really bug me like they did then. Maybe because it is a known quantity. I know about what he is going to do, no matter how wild he gets, whereas as a cadet you don't really know what to expect.

Major Bond You know there is a requirement to effectively combat vertigo and disorientation in an airplane so that you salvage the situation with some grace. The way to do it is to fly good instruments. I know puffy clouds are distracting and there are vertigo inducing things when you are flying the wing of an airplane, especially if the sun is a little bit wrong or there is anything between the two of you, or if he is rolling as he goes through—that will really set you up.

Col Compton What you are saying is that the quality of your instrument flying might be directly proportional to your ability to overcome vertigo.

Major Bond I should hope to shout. Absolutely.

Dr Collins I do think there are certain circumstances where even an experienced pilot may be distracted, or something happens in which he gets all of his semicircular canals going cattywampus, and he is going to get so badly upset that he can't even interpret his gages. I think there is this circumstance. In other words, if you are already disoriented, then you turn your head suddenly, you can go tumbling. Just as if you were in a centrifuge. You can't do very much with the gages under these circumstances. The point here is prevention again, education and training again, coming back to the fact that this true medical vertigo can happen to anybody who has a normal set of semicircular canals. So there is an inherent hazard that is above and beyond skilled instrument flying.

Major Bond I didn't mean forgetting vertigo, although flying good instruments means that you have a good crosscheck, and with a good rapid crosscheck in a trimmed airplane, your chance of getting severe vertigo is lessened. What I meant was, after you get vertigo, your ability to interpret your instruments is lessened. From several years in the standardization business, it is very obvious to me that, when we pass regulations like we have in effect today, where you can log time without some type of visual restrictor on the pilot, the training is decreased significantly. We had a '105 Wing where we flew and trained for blind, radar type night owl retaliatory deliveries. Preparatory to that we had started a program of giving everybody a hooded instrument check, just cycle them through. We found four or five pilots in that Wing who had logged more than the minimum number of approaches in the '105 in the past 60 days but who couldn't satisfactorily fly the airplane when you actually put them under the hood. Now they weren't flight commanders, but two of them were flight leaders and two more were element leaders, which means they would be expected to recover two airplanes with somebody on their wing. Instrument training programs, which we are not addressing here today, except as an added facet, really have to be thorough and the guy must really have the ability to fly the gages. I don't think we always recognize the man's capability before it gets impaired by vertigo.

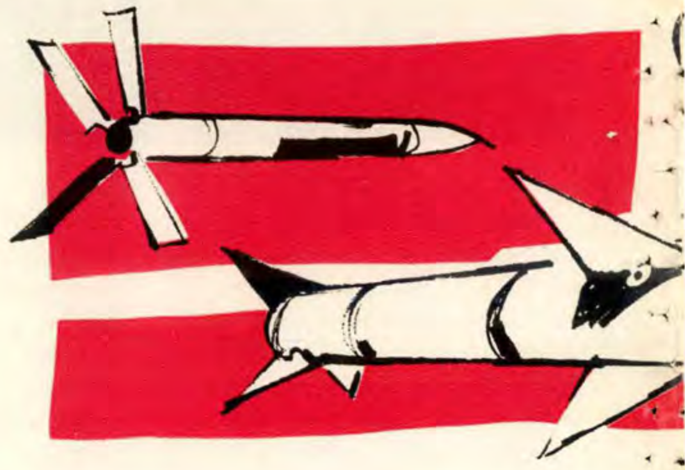
Dr Collins About this extensive training to be able to fly these night owl missions. There you've got your instruments; that is all you've got so, in a sense, as long as you know how to do it well you are in pretty good shape. I think a more difficult situation is when you have other visual illusions, because instinctively we all believe our eyes before we believe anything else. If you've got tilted cloud banks, you are really in much more difficulty than if you are in complete blackout.

Major Bond Of course this is under flares and you dive visually. You fly the instruments on base leg and after you see the flares, roll in.

Dr Sawyer Certainly one point that applies to this type of mission, and I would also apply it to formation penetration in weather, is that if you are lucky enough to have two pilots in the aircraft you had better have one of them on instruments. In this F-4 accident that we mentioned a bit ago, there were two birds and there was only one pilot of the four who had his eyes on the instruments. ★

(To be continued)

MISSILANEA



WILL YOU SURVIVE?—Have you jeopardized your life lately with complacency or ignorance? Recently reported failures of the self-activating canisters in the M-20 (Chemox) breathing apparatus have highlighted poor care and improper use some personnel give their protective equipment. Admittedly, some failures reported were due to deficiencies in manufacture of the canister. The Inventory Manager (IM) has taken corrective action. However, the majority of the "failed" canisters turned in by using agencies were not faulty when tested by the IM, Service Engineering and the contractor. Examination of the Chemox units and the associated canisters definitely proved that many of the canisters had been improperly installed in the Chemox unit. Also, organizational and field level maintenance were not properly performed. The neck of one canister was bent to such a degree that it could not have been properly installed in the breathing apparatus. An air space between the canister neck and the Chemox plunger caused the failure of another unit. Other units examined revealed such discrepancies as a leaking diaphragm and deteriorated face mask seals.

Attention to detail when performing maintenance on today's complex weapon systems is a necessity. Carelessness, especially when dealing with protective equipment, can be deadly.

Capt Walter S. Yager
Directorate of Aerospace Safety

THE MISSILE MISHAP INVESTIGATION PLAN —Despite all the Missile Safety Officer's efforts, the emphasis on use of tech data, safety directives, etc., there are occasional mishaps. And they occur suddenly, without advance notice or warning. The worth of the effort expended in pre-planning then becomes evident. This pre-planning is formalized in the mishap investigation plan, an important part of the mishap prevention plan. The plan should include all those items required to prepare for and expedite the investigation. Those actions required to cope with hazardous conditions, to return the missile/launch vehicle to a safe configuration or to minimize loss of life are contained in disaster control plans.

The mishap investigation plan differs in that it includes those urgent and immediate actions to prevent removal of evidence, identify witnesses, obtain statements, impound essential records, and activate the investigative effort. The disaster control plan must be compatible with the mishap investigation plan since some actions may be common to both functions, for example, security of the mishap scene. Other actions involving emergency teams under the disaster control plan may provide valuable sources of information to the investigators.

It would be difficult to develop one plan that would fit the needs of all commands, but the plan should include all actions required from the time the mishap occurs until the investigative effort is finished. The plan should be usable at every echelon that might incur a mishap and provide detailed guidance to the personnel involved. The plan should include procedures to:

- Alert key personnel.
- Insure all required reporting is accomplished. An aid to this would be sample or "fill-in" forms.
- Insure wreckage, debris, etc., are not disturbed except to save lives or to contain the disaster.
- Identify all persons involved in the mishap and the witnesses to the mishap. Statements should be obtained in as much detail as possible to prevent recall of these witnesses by the investigative board/officer.
- Impound and safeguard logs, technical data, training records, tape recordings and other documents essential for investigative action.
- Prepare a factual sequence-of-events briefing for presentation to the investigative board/advance party/officer.
- Designate a working area, arrange quarters, transportation, and alert other base support services of anticipated requirements.

The plan should be reviewed and exercised periodically to insure its adequacy. Major commands will establish the frequency of training and exercises. AFM 127-200 provides detailed guidance.

Capt Robert A. Boese
Directorate of Aerospace Safety

COMPATIBLE MATERIALS. The use of titanium in airframe and engine components of missiles and aircraft has increased greatly since the early 1950s. This increase was due primarily to the advantages it has demonstrated over other light weight alloys as related to its low density and high melting point. Although its oxide is quite stable, titanium is extremely reactive. It has the strength and hardness to perform as a good structural material. Research and development, primarily government sponsored, have resulted in converting this metal from a laboratory curiosity to a useful material.

Could there be any disadvantages to using such a fine structural material? A few years ago, during pressurization of a contractor's research and development liquid oxygen tank facility, an explosion and fire occurred at 150 psig pressure. One contractor employee, viewing the tank pressure gage from a distance of about 10 feet, was fatally injured. The tank was made of titanium alloy (Ti-6A1-4V) and had been pressure tested at 4500 psig and cleaned for LOX service just prior to incorporation in the facility. Subsequent testing of the relief valve showed it to be in good condition and operating at 1150 psig. A burst diaphragm, also provided to protect the tank, was tested and burst at 1200 psig. A careful analysis of the complete system, including the tank remains, failed to show the presence of any contamination. After an extensive investigation the most probable cause of the explosion was found to be a reaction between the liquid oxygen in the tank and the tank material (titanium).

This accident occurred in April 1964, yet the Defense Metals Information Center in a report (DMIC Memorandum 163) dated 15 January 1963 stated the following:

"Of all the metals studied to date, titanium exhibits the greatest sensitivity to impact when immersed in LOX. In fact, its sensitivity approaches that of many organic materials such as greases and oils."

Was the cause of this accident the reaction between titanium and liquid oxygen or was the true cause management error? The decision to use the available titanium tank belonged to management. They were responsible, through their engineering personnel, for designing a safe system. A review of technical data on titanium would have disclosed the incompatibility which probably caused this accident.

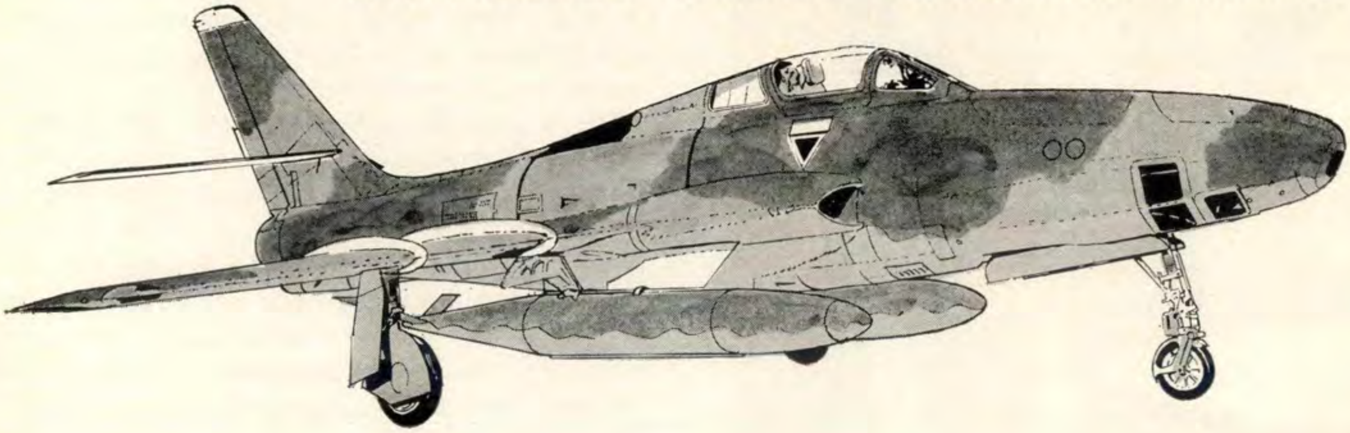
Another account for an unusual occurrence resulting from incompatible materials is contained in the Armed Services Explosives Safety Board (ASESB) Operational Incident Report Nr 112. It describes how, with Fluorolube being used as a lubricant, an aluminum bolt was being tightened into an aluminum block. The bolt seized and when pressure was applied detonation occurred. ASESB Potential Incident Report Nr 38 describes tests that have been run on fluorocarbon oils and states that they are known to explode when used with aluminum under high shear loads. This information had been published for several months when it was discovered that Fluorolube was being used with an aluminum fitting on a space vehicle at one of our ranges.

The purpose of this article is not to point a finger at specific instances. Most of us will probably make the same kind of mistakes if we don't take the time to think through all possible alternatives.

Managers are responsible for the safety of any operation. Insure to the maximum extent possible that *all* materials used in the system are compatible. It may take a little time to research available information, but this time may be well spent in saving your project and possibly a human life. ★

Lt Col Moses R. Box
Directorate of Aerospace Safety

REX RILEY CROSS COUNTRY NOTES



HERE'S A SLIGHT DEPARTURE from my usual subject matter that should interest all you troops. It is a very graphic example of what a fellow can do to himself, all by himself. He arose late and played a game of golf. After the game he had a beer. He then went bowling and had several beers. Later at the club he had a highball and departed to eat at a friend's home. On the way he bought a bottle of gin and had several martinis before dinner. He then had a couple more of the potent potions before departing for home and bed. While attempting to drive home he failed to negotiate a turn, was thrown out of his car and killed. Besides being legally drunk he had failed to fasten his seat belt. With the emphasis we put on the subject, an Air Force type would have to be drunk to forget his seat belt. Here is an excellent example of a hard living, hard drinking fellow who easily killed himself. Thank God he didn't take another Air Force man with him.

THE PILOT DECIDED TO CONTINUE IFR into a known thunderstorm area. Even though he deviated 20 to 30 miles south of course, he encountered hail and moderate to severe turbulence when he penetrated a light area of clouds. The leading edges of both wings and stabilizers had to be removed and replaced because of hail damage. It was the second time in a short period that this pilot purposely ran through danger areas. His command considered this action an apparent lack of good judgment and removed him from the flight schedule.

The day when a pilot can expect to get away with taking a chance on drilling through thunderstorms is long past. Get all the information you can, then use it. Here are the recommendations set forth in FAA Advisory Circular Nr 90-12:

• **Avoidance of Known Severe Weather.** Recent research has proven beyond any doubt that all thunderstorms are potentially dangerous and should be avoided if possible or penetrated only when the pilot has no other choice.

• **Forward Reports** to ATC of any severe weather encountered, giving nature, location, route, altitude and intensity. Pilots are also reminded to review Federal Air Regulation 91.125 pertaining to pilot reports.

• **Initiate Requests** to avoid severe weather activity as soon as possible being specific concerning route and altitude desired. Pilots are reminded to review the Flight Information Manual pertaining to "Detouring Thunderstorms" and "SIGMET Procedure."

• **Adjust speed** as necessary to maintain adequate control of aircraft in turbulent air and advise ATC as soon as possible.

• **Do not rely completely** on air traffic controllers to provide information or to initiate radar vectors to aircraft for avoidance of severe weather particularly when arriving at and departing from terminals or in holding patterns.

• **Plan ahead** to anticipate the need for avoiding areas of known severe weather. If necessary, delay take-off or landing, as applicable.

MEAS AGAIN—One of my June notes covered Minimum En Route Altitudes. Shortly after the magazine was distributed, I received the following letter:

"1. Reference Rex Riley's note on Minimum En Route Altitudes on page 15 of the June issue: The statement, 'The MEA is often higher than the minimum obstruction clearance altitude (MOCA), but in no case is it lower,' is quite probably correct in the U.S. and Canada. However, it is not always true in other areas. For example, Low En Route Chart Number Six (Pacific and Southwest Asia) depicts an MEA of 5000 with a MOCA of *8000 on A-61, north of Cebu, a common MAC route. The highest terrain within 22 NM of A-61 centerline is 6184 feet.

"2. If this is an error, would you kindly inform me so I can submit a recommendation for a change in the chart?

Lt Col, USAF."

The Colonel is absolutely correct; there are several exceptions in the Philippine Islands. In foreign countries MEAs are established by the controlling government. When our Chart Service wishes to pad these altitudes for obvious safety reasons they print the MOCAs with an asterisk (MOCA*) and an explanation in the legend. For all practical purposes, these MOCAs become MEAs for U.S. military pilots.

ALL WEATHER LANDING SYSTEM. USAF and FAA have been working on an all weather landing system (AWLS) for six years, and now it appears that true all weather operations will become a reality in the not too distant future.

Using a USAF C-141, FAA pilots made more than 500 successful landings recently during a month-long flight evaluation of an AWLS prototype. FAA will use the data from the C-141 and other tests to write criteria for CAT III landings. CAT III conditions are ceiling zero and RVR of 700 feet to zero feet.

Principal features of the CAT II equipment used on the C-141 included an improved autopilot coupler, automatic throttles, a radar altimeter, a flare computer, a rotation go-around computer, new flight directors, and a monitor system called a test program and logic computer. Major equipment additions for the CAT III system are a decrab and rollout steering computer plus a manual channel independent of the automatic system. The manual channel included a second radar altimeter, an additional flare computer, different attitude director indicators, and additional monitoring.

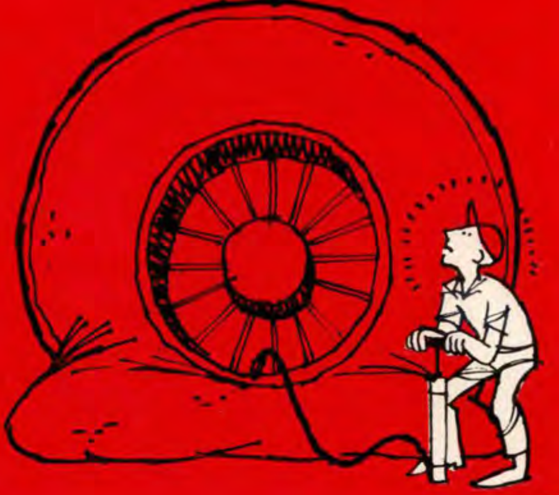
During tests approximately half of the landings were made while the pilot sat in the cockpit acting as a monitor with his hands off the controls. The remainder were made manually with the pilot taking over from the computers at a point just before touchdown.

AN OHR tells of a near miss which might have been a collision except for a procedure the crew of one aircraft used. This aircraft, a commercial airliner under MAC contract was on final approach at a foreign base. Approach Control cleared the pilot for an ILS and a change to tower frequency. Then Approach Control came back on with a warning that there was traffic directly ahead on a collision course.

The pilot made a violent turn and descent. He later estimated the miss distance to be about 75 feet. That he was able to take evasive action in time was attributed by the pilot to a procedure this crew uses. With two radios, when a frequency change is necessary one radio is left on the previous frequency. This permitted the crew to hear the warning even though one radio had already been changed to tower frequency.

This procedure seems to be a winner—if you've got the equipment. ★

AERO BITS



THE SOLO STUDENT WAS MAKING A FORMATION TAKEOFF in a T-38. He experienced control difficulties and decided to abort. The resulting barrier engagement was successful, causing only minor damage to the aircraft. When asked what the difficulties were like, the student pilot explained that "the left wing wanted to fly up," but he wasn't at all sure of his control inputs.

Investigation revealed that (1) the wind was not strong enough or coming from an angle that would cause any difficulty; (2) there were no aircraft mechanical malfunctions; (3) evidently the student let his aircraft drift behind and closer to the lead than the normal wing position, and (4) another possibility is that he inadvertently cross-controlled the aircraft (i.e., right aileron and left rudder).

The primary cause was operator factor in that the student pilot created a self-induced control problem during a formation takeoff.

REEL NEWS—The following Air Force films are available through local base film libraries or other film service activity. Bases without such service may order from the AF Film Library Center, an Aerospace Audio-Visual Service (MAC) unit, 8900 So. Broadway, St. Louis, Missouri 63125. Films are 16 mm and in color. The demand for certain films is heavy, therefore it is recommended that when ordering, alternate showing dates be indicated.

FR 851 BIRD/AIRCRAFT STRIKE HAZARDS, 11 min. Reviews birdstrike hazards to aircraft and aircrews. Shows canopy and fuselage damage to several aircraft and cites loss of several lives. Discusses ratios of given bird weight, aircraft speeds and pounds of impact pressure. Mentions critical geographical areas during migrating seasons and at certain times of day. Suggests ways to avoid strikes.

•

TF 5992 THE UNKNOWN THIRTY-SIX SECONDS —Aircraft Accident Investigation Board. 35 min. Describes organization and mission of aircraft accident investigation board. Depicts its painstaking inspection of plane wreckage to determine possible electrical, mechanical, structural or hydraulic failure. Probes likelihood of crew's showing symptoms of physical or mental disability prior to crash. Concludes with findings and recommendations.

•

TF 6075 THE VITAL LINK—Responsibilities of Communications and Electronics Officers. 24 min. Pictures role of communications and electronics officers in maintenance and operation of early warning systems. Stages breakdown of a radar site due to need for new part. Cites complex communications systems of today and development of more sophisticated systems of future.

THE CREW OF A LARGE MULTI-JET ran into moderate turbulence and St Elmo's fire while trying to dodge thunderstorms during an enroute letdown. Turbulence made it difficult to hold airspeed, or that's what the pilot thought, until he lowered the nose and increased power to get the airspeed indicator to read more than 190 knots only to have the indicated speed drop to 100 knots. Attitude was around 10 degrees nose down and the copilot's airspeed was bouncing between 100 and 250. The pilot alerted the crew for a possible bailout, picked up the speed brakes and leveled the bird using attitude and a fuel-flow setting that would provide sufficient power for a safe airspeed. He then changed his clearance and took up a heading out of the weather. About 20 minutes after flying into clear air both airspeed indicators returned to normal, and the pilot orbited his alternate until the weather improved to the extent that he was able to proceed to destination VFR.

There are two things to be learned from this incident.

First is this business of checking the pitot heater. Maintenance personnel are supposed to check the pitot heater during their maintenance preflight on most large aircraft. However, as you may have guessed, the heaters for both pitot tubes were inoperative on this particular bird. On smaller aircraft, the ground crew checks the pitot tube to see if the heater is working. This is done on signal from the pilot or copilot just prior to start engines. But watch around any flight line and you will not see very many crews bother to make this check. Also, on some birds the pitot tube is a little out of reach, particularly on big birds like the B-47 and B-52. Although this is a maintenance check on these birds, there is no way to make this check in the conventional manner without hauling out a ladder or stand. Some maintenance types watch for a change in load meter reading to check the heater. You can easily form the habit of checking the meter any time you turn on pitot heat, even though you follow up by having the crew chief warm his hands. Watching the load meter does not test both units on aircraft that have the pilot's and copilot's pitot heat on one switch, but it will insure that at least one heater is working at that particular time.

There is another aspect to this incident—knowing your aircraft. A pilot who really knows his aircraft should be able to establish airspeed within reasonable limits by power setting alone, at least for the more commonly used configurations and weights. At lower speeds, where things tend to get a bit more critical, he can crosscheck by using angle of attack, or aircraft attitude if the bird doesn't have an angle of attack indicator. Power and angle of attack are more accurate than many pilots realize but angle of attack indicators have their heater problems too. However, in calm air the discerning pilot of a smaller aircraft can actually detect a faulty airspeed indicator or an improperly computed approach speed through attitude alone—*if he has acquainted himself with the proper attitudes* for traffic pattern speeds. An ice accumulation can upset this somewhat if it has affected the shape of the airfoil section. But it will also affect critical angle of attack and airspeed computations. As long as the CG stays within reasonably close limits, weight alone will not be a problem when flying by attitude during level flight or while on an approach. This, because attitude closely parallels angle of attack during level flight and a bird stalls at a constant angle of attack for each configuration regardless of weight.

TAXI ACCIDENTS—There has been a rash of taxi accidents recently in which aircraft have struck parked vehicles.

One of these involved a forklift that stalled. The airman driver left to get help and a backing C-130 ran into the machine. This happened at night and the forklift had no lights because of a dead battery. The A/C had checked the area before backing and the loadmaster was stationed on the rear ramp. However, the aft ramp loading lights did not provide enough illumination and the forklift was parked after the aircraft commander had cleared the area.

The other mishap involved a C-141 taxiing behind a Follow-Me vehicle. A ground crew had parked a truck loaded with cargo while they serviced another aircraft. They left the lights on which indicated the truck was there. But the cargo stacked above cab height was olive drab and could not be seen in the darkness. The C-141 wing struck the cargo and was damaged.

Both of these examples occurred at SEA bases where operations continue around the clock. In neither case were wingwalkers used. Common sense indicates it's time we took a closer look at ground operations on the flightline in an effort to head off these aggravating, expensive and unwarranted mishaps.

At one of these bases solid yellow guidelines were to be painted for taxi guidance. Broken lines will indicate an area in which ground vehicles will be prohibited. Here are some other suggestions:

- All ground vehicles operating on the ramp should be prominently marked with reflecting tape (AFM 127-101).
- Procedures should be established for handling stalled vehicles. A portable radio could be used to summon help so the driver wouldn't have to leave. Or, if they aren't available, a flashlight with a red lens could be used to signal the tower or another vehicle driver for help. Maybe you can think of something better.
- Ground vehicle operators should be thoroughly indoctrinated with the hazards of parking vehicles on the ramp, especially at night, and the procedures to follow if such an event is necessary.
- For very busy bases a traffic movement supervisor who would direct all traffic, whether aircraft or ground vehicles, once they enter the ramp area. He could be equipped with a facsimile of the ramp and small models, something like the "shrimp boats" used by air traffic controllers. These could be spotted on the display to indicate the location of all vehicles and their movements. Control could be exercised in a number of ways.

These are some suggestions, not necessarily the best. We're sure enterprising safety, ops and maintenance people can come up with many good ideas tailored to the specific situation that exists at their base. ★

KUDOS: 16th TFS

The 16th Tactical Fighter Squadron Eglin AFB, Florida, has been awarded the USAF Flying Safety Award for Meritorious Achievement in Flight Safety during 1967.

Our squadron is very proud of this achievement but we are thoroughly upset with the glaring error on page 16 of the July 1968 issue of *Aerospace Safety*. We are *not* located at MacDill AFB. We are the 16th Tactical Fighter Squadron of the 33rd Tactical Fighter Wing, *Eglin AFB, Florida!*

We accept your apology and would appreciate a published correction of this mistake as soon as possible. For our appeasement to this great injustice, the pilots of the 16th TFS have agreed to gratefully accept a 15'x24', dark blue, indoor-outdoor carpet to re-decorate our pilot's lounge. Credit will be given to your publication in form of a donation plaque.

Maj Alfred D. Herring
16th TFS FSO, Eglin AFB

The staff congratulates the 16th TFS, and regrets the error. Incidentally, this publication is yours *too, you know!*

EMERGENCIES

The article "Ground Escape" by Major Ferrari and Mr. Shannon, and Ol' Tat's tale of "Cemetery Corners" (July) should certainly be thought of together. Personal equipment has long been chock full of those nasty bends in the road: the T-handle on the parachute is a classic that has caused single seat jocks almost as much woe as the radio frequency change turning to GCA final. And, think of the hundreds of cases where a pilot was unable to deploy the seat survival kit on the way down because, in the words of some desk-borne designers, "He didn't pull the lanyard properly."

All emergency systems have to be designed with one thought in mind: they are going to be used by a man who is under stress. He is probably going to follow what seems to be the most natural course of action. In my opinion the great amount of money and manhours spent on training our people to use their equipment is prima facie evidence that the equipment is poorly designed.

I hope you good people at DIGIS will keep a sharp needle aimed at those designers who sometimes try to engineer us to death.

Maj Walter I. Bostwick
Director of Safety, 7AF/13AF

DIRTY CONNECTORS

As Commander of the only organization launching Atlas boosters on the Western Test Range, I must protest the article in Missilanea titled "Dirty Connectors" on page 25 of the May issue. To say "Someone was careless. They disregarded the basic concept of 'do it right the first time,'" is to read quite a lot into the actual investigation and give a false impression.

Personnel error and supervisory error were not indicated. Cause was found to be materiel failure probably resulting in loss of fluid in the high pressure hydraulic system. Perhaps this failure could have occurred at a hydraulic fitting, but even this does not suggest that there was a "dirty connector."

I also agree many causes of contamination can be found by "eyeballing" the connector, but many can not. Therefore, to insure absolute cleanliness, we draw hydraulic samples where the Fuels Lab checks for particles in the 0 to 25 micron range, not usually detected by "eyeballing." Both pre- and post-launch hydraulic samples were well within limits, and are documented in the investigation.

I am very proud of the dedicated military and contractor personnel who make up the 6595th ATW/industry team. They have launched many ballistic missiles and space systems with an impressive record of success and safety. I feel strongly that their accomplishments have had far too little recognition and although they are not infallible, to find them "careless" in this case is a disservice to a fine organization.

Col Otto R. Haney
Commander, Hq 6595
Aerospace Test Wing (AFSC)
Vandenberg AFB, California

The author did not intend to cast aspersions on any particular outfit or its personnel. He merely attempted to glean as much preventive material as possible from the mishap. It is well established that fallout and side issues of significant importance often result from investigation and reviews. It is difficult if not impossible to pinpoint the exact cause behind many materiel failures.

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Major
Neil L. Eddins

4525 Fighter Weapons Wing
Nellis AFB, Nevada

Major Eddins was participating in a test mission in an F-105 configured with two 450 gallon tanks and six MK-117 bombs attached to the centerline station. The purpose of the test was to accumulate maximum time at speeds of 500-550 knots at 50-500 feet AGL to verify arming wire retention. When the 450 gallon tanks went dry, the excessive vent light came on. Major Eddins then selected main tank and allowed the internal fuel to feed down to 6500 before the venting stopped. A fuel check was made with the chase aircraft after 55 minutes of flight. The chase aircraft had 4600 pounds of fuel remaining and Major Eddins had 3500 pounds. Additional fuel checks indicated fuel quantity dropping at more than a normal rate. At 10,000 feet 1800 pounds remained. External stores were dropped and climb was continued to 18,000 feet.

An emergency was declared and a straight-in approach was requested. When he leveled at 18,000 feet, the aft boost pump light came on, followed immediately by a fuel low level light. At this time Major Eddins had less than 1000 pounds of fuel remaining. An idle power descent was initiated to Runway 21. At approximately 10 miles out, the inlet pressure light came on, plus all fuel boost pump lights. He continued his descent at 240 knots with gear and flaps lowered. At approximately four to five miles out, the engine flamed out due to fuel starvation. In an excellent position for an "engine out" approach and by "S"ing the aircraft he positioned himself perfectly for a flameout landing. Although the controls were somewhat sluggish due to restricted hydraulic power from the windmilling engine and the extended RAT, his excellent judgment and timing allowed him to safely touch down 500 feet down the runway. He deployed the drag chute and applied emergency braking to stop the aircraft.

Major Eddins' handling of this emergency demonstrated outstanding airmanship, courage and judgment in saving an F-105 aircraft. The return of this aircraft in particular was most valuable in determining the cause for fuel consumption problems plaguing the F-105 aircraft. WELL DONE! ★

Major
Jimmy W. Kilbourne

602 Fighter Squadron
APO San Francisco 96237

On 9 November 1967, Major Kilbourne led a large scale rescue effort in an attempt to save the survivors of three helicopters that had been shot down by hostile fire. Major Kilbourne arrived on the scene at 0330 local and was on-scene commander except when relieved to refuel. While flying at low altitude to locate the survivors and pinpoint enemy gun positions, several hits were taken by Major Kilbourne's A-1E, damaging a mini-gun pod and rupturing his external fuel tank. However, his aircraft was still capable of continuing the vital rescue mission. He and the pilot of another Sandy then screened the survivors from the advancing enemy with smoke, which enabled helicopter recovery of some of the survivors. However, the enemy soon flanked the smoke screen and started firing on the rescue helicopters. Major Kilbourne immediately hit the new enemy position with a strafing attack. Again his aircraft was hit, this time in the engine compartment and main fuselage. The A-C generator was damaged, knocking out the A-C electrical system; one propeller blade was pierced, producing airframe vibration; the internal fuel tank was ruptured by a bullet; the hydraulic system was rendered inoperative; the engine crankcase was cracked, and oil was leaking out the right side of the engine compartment. Loss of the hydraulic system rendered the aileron boost system inoperative. Without A-C electrical power all the navigation equipment was lost. Major Kilbourne nursed his badly damaged aircraft and remained in the area long enough to escort the rescue helicopter to a safe area and to brief the replacement Sandy pilot on the mission status.

The next problem was how to safely recover the crippled Skyraider. Approaching home base, Major Kilbourne found he had to use the emergency system to lower and lock the three gears. A controllability check in the landing configuration revealed that control was adequate but very sluggish, due to the heavy aileron control forces and the added drag of the damaged rocket pod and mini-gun pod. Fatigue also was a potential accident factor because Major Kilbourne had flown 10½ hours in several sorties on this rescue mission. A straight-in approach was flown, with the touchdown point planned and executed perfectly. Final damage assessment was 14 bullet holes, requiring an engine change, propeller change, generator change, and 630 manhours of labor.

Major Kilbourne's accurate analysis and control of a multiple emergency situation, his thorough knowledge of the aircraft and its capabilities, and his outstanding physical stamina and professional airmanship resulted in a valuable tactical aircraft being safely recovered. WELL DONE! ★

YOU'RE NOT IN THEIR PLANS!

Migratory birds travel on fairly well defined flyways, as shown in the accompanying chart. Travel is most intense from 1 March through 10 April, and from mid-October through November. During these periods pilots should be especially alert. Most birds migrate at night.

Remember, the numbers of these birds run into the millions.