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Aerospace SAFETY

THE MAGAZINE DEVOTED TO YOUR INTERESTS IN FLIGHT

A PILOT LOOKS AT VISIBILITY . . . have a good look

FOG DISPERSAL . . . USAF clears the atmosphere

LET'S TAKE THE DINGS OUT OF LANDINGS

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SPECIAL FEATURES

REGULAR FEATURES

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PREFLIGHT

Terminal weather, particularly that which restricts visibility, has been and continues to be one of the greatest challenges to aviation. For years men have sought ways of either dissipating fog—the primary offender—or operating in spite of it. Most of the successes, until very recently, have been scored on the side of *aids* to low visibility operations. Now Air Weather Service has demonstrated the feasibility of fog dispersal with successful tests in Alaska and Germany.

This issue of *Aerospace Safety* features two articles on this subject, one by an airline pilot that presents the problems and some requirements, the other, from AWS, describing tests of techniques used in dispersing supercooled fog. These tests were conducted during the past two winters and were eminently successful. See "A Pilot Looks at Visibility," page 4, and "Fog Dispersal," page 8.

Summer is here and with it comes an apparently natural human desire to make for the nearest body of water. Unfortunately, water sports are a serious contributor to accidents and fatalities among Air Force personnel. "Fun and Your Boat," page 1, points up some of the hazards and offers suggestions on how to enjoy a boat safely.

For some excellent tips on how to handle electrically operated items safely, we recommend "Do It Yourself Electrician," beginning on page 20. Bet you'll learn some practical things that you can use to avoid the hazards involved.

FUN & YOUR BOAT

Col Henry R. Howell, Jr., Keesler AFB, MS

Boating safety begins at home. It begins the moment you start planning an outing. One of your first steps should be an up-to-the-minute weather report for the area. A written "checklist" of Coast Guard recommended emergency and safety equipment is a must. If you plan to venture "out front" or anywhere beyond paddling distance, you must also include a supply of emergency rations, water, and motor spare parts. Enough food and water to last two days really wouldn't be overdoing it.

If you trailer your boat to a launching ramp your boating safety problem begins in earnest the moment you hook-up the trailer to the car. While in this state of locomotion, your boat is not a water craft at all. It's a vehicle and, as such, is subject to the motor vehicle laws of your state and the provisions of the insurance policy on your car. All the rules of personal and public liability come into play and carelessness can lead to arrest, a civil law suit, or even worse—DEATH. Essentially, trailers must be roadworthy, have a reliable hitch complete with safety chains, ample boat tiedowns, license plate with tail light, directional signals and liability insurance coverage when towed by your car.

Your car speed is perhaps the most critical aspect of your boating trip. The effectiveness of your brakes is greatly reduced when being pushed by the weight of a trailer. Further, road hazards such as dips, railroad crossings and other irregularities in an otherwise smooth pavement can

For water skiing, it is important to have an observer, in addition to the driver, in the boat. The skier should always wear a flotation jacket or belt, and know the proper signals for communicating with the tow boat. Never ski in shallow water, across sand bars, in unknown water, or at night.

The modern boatman is mobile, no longer limited to local facilities. Paying attention to safety precautions insures enjoyable and trouble-free boat trailering everywhere you go.

When two motorboats are approaching one another from opposite or nearly opposite directions, each must pass on the port or left side of the other. Each boat should alter course to starboard (right).

ruin your whole day by causing your boat to travel west while you continue on north toward the marina. Your trailer towing speed is the last real acid test of your judgment and self discipline before getting ready to launch your boat.

Until this point, you should have been concerned with customary automobile driver courtesy and discipline. But, starting at the launching ramp, a different brand of courtesy comes into play. Frequently, launching ramps are congested and disorderly with everyone trying to launch at once to get to where the action is as soon as possible. This is where your well made plans for the trip and your true sportsmanship, professionalism, and courtesy really show off and even pay off. Once you reach the launching ramp, your number one objective should be to launch as efficiently, safely, and quickly as possible to get out of everyone's way. This should be done using "checklist" procedures and assigning various tasks to other crewmembers. Every step should be done in sequence with safety and efficiency paramount.

The time consuming preparations for launching should be done well off the launching ramp driveway so the time on the ramp for actual launching should not exceed three and one-half to five minutes. This time limit is a real test of courtesy, discipline, judgment and professionalism. Those who err here will probably err throughout the day and are a likely boating mishap just looking for a place to happen. For there is little likelihood that the inconsiderate boat operator will suddenly change into a professional once he gets underway. On the contrary, when out from under the close scrutiny of his contemporaries at the dock, he is more apt to revert to a more primitive state of animation where he often finds himself when driving a car.

We all see many examples of this type operator on every boating trip. He's the one who creates a tidal wave within the marina. He fails to reduce his speed to 5 mph when passing within 100 feet of a fishing pier, boat dock, disabled boat, or anchored fishing boats. He pulls

water skiers without the required safety observer over 10 years of age, and he delights himself in playing chicken with marker buoys, fishing piers, and "McHale's Navy" (our Marina Fleet). He litters the waterways with beverage bottles and cans with the self assurance that they won't hurt "fiber glass boats." To show his real contempt at times, he is known to have played Cowboy and Indian with a double coal barge. (He loves to hear the tug boat's fog horn.)

When all these antics fail to attract sufficient attention, his last resort routine is to swim in the ship channel and fake screams for "help" or seemingly accidentally fall overboard from a fast moving boat and feign unconsciousness. He may not even be old enough for an automobile driver's license but his father turns him loose on the water ways with 160 H.P. Upon return to the launching ramp, he adopts a "pride of ownership" attitude and spends many cherished moments performing routine maintenance on his boat and trailer while others are anxiously waiting to use the ramp. To add to the family fun, his kids are all over the place climbing on boat, trailer, dock, under the car. On occasion they have resorted to a broadside salvo of oyster shell toward other boaters. This type operator is a menace to public safety and enjoyment. Are you?

With the rapid growth of boating and the resultant congestion of waterways and launching facilities, it behooves each of us to apply the same rules that we have been taught for so many years in driver safety.

If we are going to survive and enjoy boating as well as driving, we must be courteous, exercise self discipline, use mature judgment, and not only know the laws but comply with them to the best of our ability. To do otherwise brands us as irresponsible amateurs with accident prone tendencies which undoubtedly reflects in our military performance in the Air Force — or the conduct of our dependents in the military community. (Courtesy of *Accent on Safety,* Keesler, AFB, LA. ★

A Pilot Looks At

VISIBILITY

Capt Richard H. Beck, TWA

As Air Force bases are being equipped with transmissometers, reporting Runway Visual Range (RVR) rather than prevailing visibility is becoming standard practice. RVR represents the horizontal *distance a pilot should see down the runway from a moving aircraft,* not *slant range visibility. Since slant range visibility is generally less than RVR, it is imperative that all pilots recognize the flight problems associated with RVR reporting. Although some of the terminology is slightly different from that used by the Air Force, the following article reproduced from the September 1968 issue of "The Air Line Pilot" very aptly describes these problems.*

In the aviation industry, various means have been instituted to provide visibility values for the pilot and to give him an increased measure of approach and landing success probability. In order of increasing accuracy, they may be listed as follows:

1. Meteorological visibility is a number that gives a general picture of what a human can be expected to see, either in any direction around the compass, or in some designated direction. It is a prevailing visibility and it is a human observation involving human judgment that says a man on the ground can pick out certain objects or lights from his position. In the United States, it is usually specified on the teletype weather sequence report.

2. Tower visibility is what an airport control tower operator sees from his station in the control cab and is reported as such on the weather sequence. In principle, it is the same type of reporting as meteorological visibility.

3. Pilot visibility is what a pilot sees from some non-specific point in space, and is usually reported when he is either climbing out from an airport or making an approach.

4. Runway visibility (RVR) may be defined as the distance along an identified runway that an observer can see a moderate intensity light source of 25 candlepower at night, or the distance he can see dark objects against the horizon, sky or cloud background in the daytime.

5. In the United States runway visual range, or RVR, reported in the remarks section of the weather sequence is an instrumentally-derived value, based on standard calibrations, that represents the horizontal distance a pilot may EXPECT to see down the runway. The RVR consists of a projector that emits a beam of light, usually along a 500-foot path (a 250-foot path for CAT II), and this light is received by a photo-electric detector that measures the amount of light received as a percentage of the amount that would be received through a clear atmosphere. To compute RVR, three factors must be known. First, the transmissivity of the atmosphere must be measured by the transmissometer. Second, the brightness of the runway lights must be known because their intensity is related to the transmissivity measured by the transmissometer. Third, it

must be known whether it is day or night, since lights are visible at a greater distance at night. It therefore logically follows that, the higher the setting is at night, generally speaking, the higher will be the RVR reading, and this value will always be greater than runway visibility. In daytime, when visibilities increase, even a high intensity light will fade into the background brightness, and the substitution of runway visibility would be more representative.

But how accurate is this complex RVR measuring device, and most of all, will the information passed on to the pilot be reliable and will it be usable?

The instrument error is practically nil, but like our present-day computers, the accuracy of its information will be directly proportional to the data fed into it. Here are some of the pitfalls and problems involving RVR:

1. In a mature fog condition, the slant range visibility from the cockpit at the decision height will nearly always be LESS than the visibility reported at ground level.

2. When a non-homogenous fog exists, different densities of fog, or "blobs" of fog can be drifting across the runway near the site of the transmissometer, yet not be reflected in the RVR value.

3. When a fog is in its formative stage or is beginning to drift over an airport, such as a sea fog, completely different conditions may exist at any number of places on the airfield.

4. Landing into the sun in a shallow ground fog, that often forms around dusk or dawn, will raise the background brightness as viewed from the cockpit to such a degree that the reported RVR and cockpit visibility will be completely incompatible.

5. Delays in reporting representative RVR values to the pilot on an approach have not yet been adequately solved. Nor has there been any firm agreement, as yet, as to how often values are to be passed on to him. Although it is within the state-of-the-art to do so, no manufacturer has come up with a satisfactory device to give representative readouts in the cockpit.

6. Heat shimmer, bird interference, manufacturing and installation tolerances, dirty, misted, or frosted lenses are often not taken into account.

7. There is insufficient maintenance and checking on light bulbs whose filaments have deteriorated far below specified standards.

8. There is still no universal agreement on reporting RVR values in 100-foot increments in the lower visibility ranges.

9. The method by which an RVR value is obtained may vary with a particular country. In some countries, for example, it is determined by having a human observer sight down the runway and count the number of centerline or edge lights he can see. Many of these installations employ a system where the approach lights are more brilliant than the centerline or edge lights, and a pilot can easily be trapped into a situation where he has better visibility on the approach than he has for the flare and landing when his decision has already been made. Also, in many instances, there is often no specific or periodic check made on an observer's eyes to determine how well he actually can see, and whether he does or does not see what any other observer sees.

Thus, it can be concluded from the foregoing, that RVR can only be an indication to the pilot of what he *may* see when he reaches his decision height. Data gathered over a period of years has shown that RVR values are not representative of what the pilot sees from the cockpit on the average of about 20 per cent of the time. The problem is further compounded because there is no acceptable way to measure slant visual range (SVR), and this is of prime importance because it is what the pilot will see from the cockpit at his decision height.

In order to better understand the nature of some of these degraded visibilities, it is suggested that they be examined a little more closely. Since radiation, advection, and warm front fogs are the three phenomena that appear to adversely affect aircraft movements more than other restrictions to visibility, the greater emphasis will be placed on them. Other types of fog and reduced visibilities will also be touched on and their relationship to operations should become immediately apparent.

Since fog is really nothing more than a cloud formation that lies on or close to the surface of the earth, any remarks that follow will basically involve those conditions where visibility is restricted by fog of approximately 3000 feet or less with particular emphasis on the lowest region of Category II. From a pilot's point of view, of course, he is mostly concerned not as to whether a fog is shallow or deep, but with what he will be able to see at his decision height.

RADIATION AND ADVECTION FOGS

Traditionally, we think of radiation fog as a shallow fog forming at night at flat inland airports under stable conditions. And historically we have thought of advection fog as air that has been first cooled by a colder surface into fog and then is transported by the wind from one point to another, being most prevalent along coastal areas and near large, inland bodies of water.

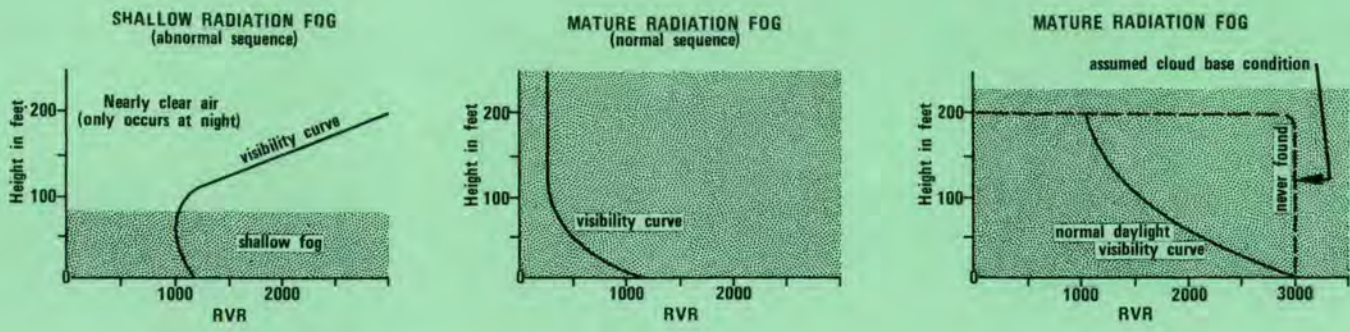

Fig. A Fig. B Fig. C.

Even though radiation and advection fogs are basically the same thing in principle, since they are caused by air being cooled by a colder surface, they will be considered each in turn.

Radiation fog usually forms under calm conditions at night due to ground cooling when a given amount of moisture is present in the atmosphere. Cloud cover will tend to slow down its formation by reflecting heat back to the earth, and the rate of formation will vary in proportion to the amount of total sky cover, the height of the cloud cover, the amount of moisture content, the wind speed, and the extent of nuclear particles present in the atmosphere.

In its first formative stages, radiation fog will evidence wisps and tendrils that are very thin and quite scattered—almost nebulous in appearance. Discounting the situation where fog drains into a valley, and using only a flat inland airport, the structure will build into the first stage of shallow ground fog, 50 to 80 feet thick. This shallow fog is defined as one in which visual contact is made above the decision height, yet is accompanied by a relatively low RVR. (See Figure A.)

The pilot will have a visual segment that is constant or very slowly decreasing. He will be confident to the lower altitudes since the slant visual range will not be low enough for a missed approach. At about 100 feet the slant visual range decreases and the rate of decrease becomes greater as he approaches the top of the fog. On penetration of the fog his SVR will be at a minimum and then will increase to the value of the RVR on the ground. In this situation, the pilot is in the beginning of the flare, and suddenly the world goes blank!

As the fog becomes more mature, the fog top rises, and the clear air above the shallow fog has now become more dense. The RVR will increase a little because of the blanket of fog holding in the heat, but the SVR may be constant with height up to well above 200 feet.

The mature fog, which is the usual fog structure, is where the fog density, or to be more specific, the slant visual range, is fairly uniform down to 100 feet. Below this there is usually a progressive increase in SVR down to touchdown. (See Figure B.)

Radiation fogs almost never dissipate by themselves at night, and the final stage is the clearing of the fog. This occurs almost always in daylight and the density is usually patchy.

In the United Kingdom, scientists who examined night fogs at flat inland airports over a period of 10 years where the RVR was 1500 feet or less, found that the fogs were shallow about 40 per cent of their life's cycle and that the visual segment faded to a minimum value at about 70 to 80 feet of altitude. The other 60 per cent of the time there would be a normal visual sequence with an increase in slant visual range as the altitude decreased toward the ground. (See Figure B.) They also found that if the RVR on the ground is reported at 1200 feet at night, the SVR from 100-foot head height would be less than 1200 feet about 70 per cent of the time. United States scientists at the National Bureau of Standards in Washington, D. C., have calculated that this SVR from the cockpit would not be greater than 810 feet. In the other 30 per cent of the time when the SVR was greater than that reported on the ground, the British found that it was due to the fact that the fog was shallow.

Most advection fogs occur when moist air moves over colder water or colder ground. Along coastal areas it is often called "sea fog." When cold water rises from the ocean depths, or when it flows in the form of a cold stream such as the Labrador Current, moist, warmer tropical air passing over it will cool and condense into advection fog. This fog bank may then move inland like a wall, and will deepen as the wind speed increases up to about 15 miles per hour. Wind velocities higher than this will tend to lift the fog into a layer of low stratus. This same advection principle is also involved when moist, warmer air flows over colder ground. Advection fog can also form concurrently with the production of radiation fog.

Depending on the moisture content, the amount of temperature drop that is incurred, and the nuclei and/or sea salt particles present in the air mass, advection fog can produce extremely low visibilities down to the ground. Since it is a cooling process that is occurring, advection fogs may persist until there is either a change in wind direction, a change in the source region of the air, or effective heating from the sun. This type of fog is very common along coastal regions and near large inland water bodies and aircraft operations under these conditions often have to be suspended.

Daytime fogs are usually in the state of clearing and may be somewhat patchy with varying visibilities. If they are in the mature state that is usually caused by an inversion, the slant visual range will usually follow a normal sequence where the visibility increases with lower altitudes. (See Figure C.)

In the case of the extreme inversion, the warmer air lying on top of the colder air next to the surface will only be heated by the sun's rays, making it even warmer and thus causing a greater disparity between the two air masses. Heat energy used up in this manner will then have less probability of penetrating the dense, cold air mass that is stagnating on the earth's surface with a resultant protracted period of fog conditions. Depending on the thickness of the cold air mass, its moisture content, its temperature, its stability, and the amount of foreign particles present such as smoke, dust, etc., such a condition as described above can cause fog to remain constant for long periods of time with extremely low visibilities down to the surface. Only a lessening of thickness, moisture content, or foreign particles, an increase in temperature, or a frontal passage will tend to alleviate this particular situation.

Referring to Figure C again, where a rapid increase in SVR is experienced as the aircraft descends in altitude, it should be noted that this may appear to give the effect of breaking through a cloud base. Actually it is a continuous change. During many years of study, Mr E. S. Calvert of the Royal Aircraft Establishment in Great Britain has never found a cloud base to exist when the RVR is reported as 3000 feet or less. He stated that one should think of a gradual "fade-in" rather than a sudden breakout.

If this visual distribution always occurred, the decision to continue with the approach would normally not be too difficult. Unfortunately, it has been found that when these daytime fogs are in the RVR bracket between 3600 and 1200 feet, they are non-homogenous or in a state of flux about 90 per cent of the time. And if the RVR on the ground is reported at 1200 feet, 95 per cent of the time the slant visual range from the 100-foot head height will be less than this value. When it is less than 1200 feet of SVR, approximately half of the time it will be greater than 700 feet, and the other half of the time it will be less than 700 feet.

WARM FRONT FOGS

This type of fog is caused by the addition of moisture to the air through the evaporation of rain or drizzle and can occur both when the precipitation is falling through the air as well as after it reaches the ground. This precipitation-induced fog usually forms fairly rapidly and can cover a widespread area. Visibilities can be quite patchy as well as very low, especially at night, and positive improvement usually occurs only with the passage of the frontal system. Its structure can be generally likened to that shown in Figure B.

UPSLOPE, STEAM AND ICE FOGS

Upslope fog occurs when moist air is cooled by being forced up a sloping land surface, and its continued existence is dependent on the upslope wind as well as the moisture content.

Steam fog, sometimes referred to as "sea smoke", occurs when cold air passes over much warmer water, resulting in rapid condensation.

Ice fog usually forms in moist air during extremely cold, near calm conditions. The temperature usually is below −20 degrees F and the triggering of the fog is dependent on the source of water vapor and the condensation nuclei.

The solution to the problems of restricted and reduced visibility is not going to be easy. Scientific establishments in the USA as well as in various other countries have been and are now involved in these studies. Whether research will be able to apply an economical dispersal system to both warm and cold type fogs, or whether visibilities can be permanently improved by a process of fog modification, there certainly must be a concerted effort made to supply the pilot with a representative slant visual range that he will see from the cockpit at his decision height. ★

(For what the Air Force is doing about the fog problem, see the following article which describes Air Weather Service programs for fog dispersal.)

fog dispersal

Col Jacob P. Accola, Director Physical Sciences, Air Weather Service, Scott AFB, IL

For the past two winters Air Weather Service has conducted tests of aerial techniques to disperse supercooled fog. This report describes these tests and the results. Follow-on articles are planned to report on ground based systems and warm fog dissipation after those tests are conducted.

Fig. 1
An AWS WC-130 Hercules, specially equipped with an airborne dry ice crusher and dispensing system, was used this past season in projects to dissipate supercooled fog at Elmendorf AFB, Alaska, and Hahn, Bitburg and Spangdahlem Airbases in Germany.

Terminal weather has always been a primary factor bearing on the safety and effectiveness of flight operations. The safe movement of air traffic through the critical landing and takeoff portions of flight, even with today's sophisticated electronic systems, still demands certain minimum conditions of ceiling and visibility at air terminals and will undoubtedly continue to do so for many years. The weather phenomenon most often responsible for restricted ceilings and visibilities at these terminals is fog.

For several years we have had the scientific knowledge to mount a serious attack on the terminal fog problem. Air Force has given Military Airlift Command's Air Weather Service the green light for operational implementation of promising fog dissipation techniques.

AWS was formally assigned responsibility for weather modification in support of Air Force operations two years ago in the spring of 1967. Last winter marked the second season of determined effort to develop operational systems for employment at USAF bases with high incidences of fog. Under the provisions of USAF test directive, Combat Cold, Air Weather Service conducted two major projects in airborne fog dissipation during the 1968-69 winter fog season. Both of these projects involved the dissipation of fog that occurs at temperatures below 0°C and is made up of water droplets. This type of fog is commonly referred to as supercooled or cold fog. Such fog is unstable and can be made to change form by the introduction of a catalyst to start the precipitation process.

PROJECT *COLD COWL*

The first project, *Cold Cowl*, conducted at Elmendorf AFB, Alaska, had immediate impact on current air operations. Project *Cold Cowl* was originally initiated on a test basis for the 1967-68 winter fog season at the request of the Alaskan Air Command. Its objective was to expedite the flow of air traffic through Elmendorf during periods when the terminal fell below minimums as a result of supercooled fog. Of primary concern was traffic bound to and from Southeast Asia. The initial project was so successful, resulting in 185 landings and takeoffs which otherwise would have resulted in delays or diversions, that AAC requested USAF to continue the project in a fully operational mode and on a permanent basis.

The technique employed on *Cold Cowl* thus far is an airborne one in which crushed dry ice is used as the reagent or catalyst. At Elmendorf crews of the 9th Weather Reconnaissance Wing's 54th Weather Reconnaissance Squadron, under the project direction of the 11th Weather Squadron of the 4th Weather Wing, flew the seeding missions with WC-130 aircraft (Fig 1). As the dry ice vaporizes it quickly cools the air in its immediate vicinity to a temperature approaching −78°C, thereby creating ice crystals in the supercooled fog. As a result of their lower vapor pressure, the ice crystals grow at the expense of the water droplets, eventually becoming large enough to fall out as small snowflakes. The process takes from 30 to 60 minutes to create a usable clearing.

Because of the time interval before clearing takes place, the seeding is accomplished upwind a distance equal to three-fourths of the hourly wind speed effective in the fog layer. A one-knot error in wind estimation can result in a one-half to one mile error in centering the pattern over the approach end of the runway. Therefore a broad pat-

Fig. 2

Example of a typical airborne seeding pattern employed during Project Cold Cowl at Elmendorf AFB, Alaska. This standard seeding pattern consists of five parallel lanes which are three miles long and one-half mile apart. A fairly broad pattern is seeded to compensate for the variability of the wind which is very critical to successful seeding operations.

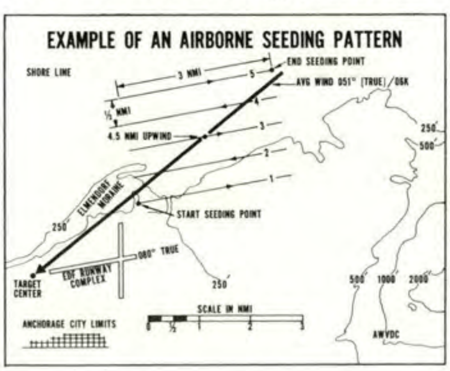

Fig. 3

Fig. 4

Fig. 5

Figures 3-5 depict results of a fog dissipation mission at Elmendorf AFB on 29 December 1968. The top picture portrays conditions about 15 minutes prior to the beginning of seeding. It was taken from the approach end of Runway 05. The runway is located near the middle of the picture and is aligned toward the foothills just to the right of the opening to the valley. The plume of the Fort Richardson heating plant is visible in the right center of the picture. Surface visibility at this time was one-fourth mile. The center photo shows how the seeded lanes appear approximately ten minutes after the seeding was completed. Note the heating plant plume. Four lanes are clearly visible. Forty minutes later surface visibility had increased to one and one-fourth miles, as shown in the bottom photo taken on final approach.

tern is seeded to overcome the vagaries of the wind. A standard seeding pattern consists of five parallel lanes three miles long and one-half mile apart (Fig 2). The seeding rates range from 15 to 25 pounds per mile. Ideally the seeding aircraft skims the fog top, but successful seedings can be carried out several hundred feet higher, if required by altitude restrictions. Typical results of a fog dissipation mission at Elmendorf are depicted in Figures 3-5.

Cold Cowl was even more successful this year than last. Between 15 November 1968 and 28 February 1969, AWS fog dissipation efforts made possible 180 arrivals and 155 departures. During this period the 54th WRS completed 61 individual seeding operations, flying 187 hours and dispensing 18,000 pounds of dry ice. During one short period beginning on the afternoon of 28 December and ending early the next morning, the squadron flew nine seeding patterns which accounted for the recovery of 35 aircraft.

As the seeding expertise of AWS scientists and aircrews improves and clearing authorities and aircraft commanders become more familiar with, and confident of, this new tool for terminal weather support, the number of aircraft which take advantage of the fog dissipation operations can be expected to markedly increase.

During the operations at Elmendorf tests were conducted using silver iodide materials furnished by the Naval Weapons Center. Silver iodide crystals are capable of triggering ice crystal formation in supercooled fog, since they have a crystalline structure similar to that of ice crystals. The silver iodide dispensing techniques involves the use of flares which are placed in ATO bottles attached to the exterior of the WC-130. These flares burn in place upon electrical ignition by the pilot.

Since silver iodide can be stored more easily and for longer periods than dry ice, it has some logistic advantages, but the technique has two disadvantages:

- It requires somewhat colder temperatures to be effective.
- The aircraft must operate in the fog or just above the fog top, since the crystals are too small to drop through the cloud in a reasonably short period of time when released at significant distances above the cloud top.

The silver iodide tests were successful in the relatively cold temperatures experienced at Elmendorf, and this reagent will be programmed for operational use along with dry ice in the 1969-70 *Cold Cowl* program.

Transmissometer trace from Hahn AB, Germany, December 7, 1968, depicts the effects of three seeded zones as they moved across the base. As the figures above the trace show, the ceiling broke and visibility rose to one mile as each of the three seeded zones passed over the base. The "blip" at the right represents a clearing produced by a single-lane seeding at the rate of 15 pounds per mile. Visibility rose above minimums for about 15 minutes. The middle "blip" shows the results of two parallel lanes, three miles apart, seeded at 30 pounds per mile. The third clearing effort was also a result of two parallel lanes, three miles apart, but seeded at 15 pounds per mile.

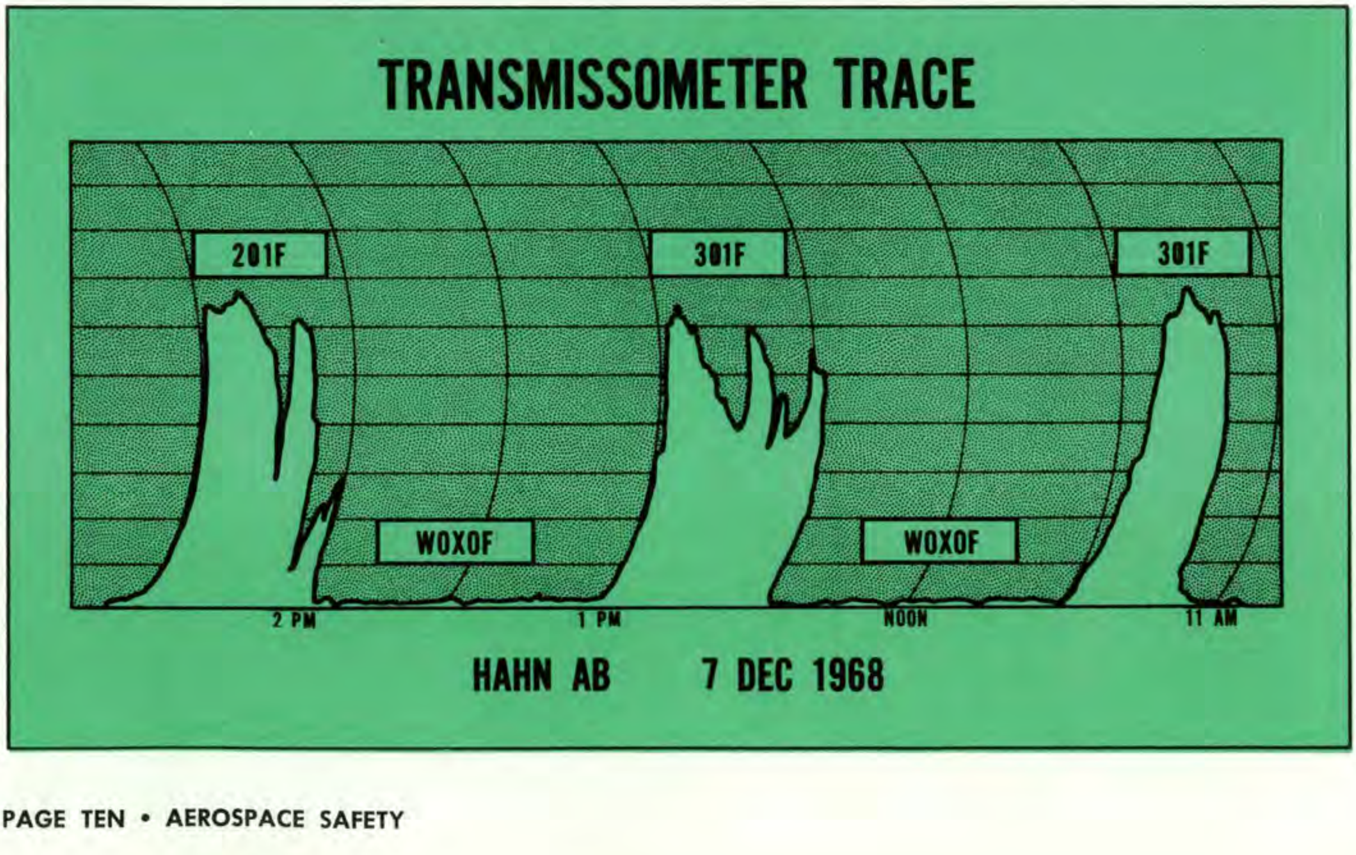

Fig. 7

Fig. 8

These pictures show the increase in surface visibility brought about by the seedings graphically depicted on the transmissometer trace of Figure 6. The first picture shows conditions which prevailed prior to the seeding. On the ground is a thick coating of rime ice over the uneven grass. The second picture was taken midway during the passage of the second pattern over the base. The trees in the distance are located approximately one-fourth mile from the camera.

Fig. 9

Fig. 10

These pictures were taken aloft midway through the transmissometer series. The first picture was taken immediately over the base ten minutes prior to the seeding of the second pattern. The second was taken as the final effects of the second pattern were passing over the runway. The seeded lane runs parallel to the runway and was seeded from a position ten miles off the lower right-hand corner of the picture.

PROJECT *COLD CRYSTAL*

A second airborne project, *Cold Crystal,* was conducted at USAFE bases in Germany by the 2d Weather Wing's 31st Weather Squadron with WC-130 support from the 53rd Weather Reconnaissance Squadron. Unlike Elmendorf the German bases experience the major share of their supercooled fog at temperatures only a little below freezing. Previous experimental work in the European area had indicated that successful seeding could not be routinely expected at temperatures above $-5°C$. Therefore Project *Cold Crystal* was set up as a test program rather than as an operational support program. The aircraft operated out of Ramstein AB and carried out seeding tests over Hahn, Bitburg, and Spangdahlem air bases.

Initially the seedings, which were with dry ice, consisted of single lanes flown various distances upwind of the target area. As the testing continued, multi-lane seeding patterns were flown. Toward the end of the project patterns such as those at Elmendorf were being flown in quasi-operational support.

The largest number of tests was conducted at Hahn where a relatively strong wind accompanied the fog. The effective seeding wind speed was generally on the order of 12 knots, requiring that the seeding lane or pattern be centered approximately nine miles upwind. However, while the wind at Hahn was stronger, it was less variable than that at Elmendorf and less difficulty was experienced in bringing the clearing over the runway.

Figures 6-10 show the results of seedings accomplished at Hahn AB on 7 December 1968. On this day surface temperatures were generally −4°C. Natural conditions throughout the day never exceeded a 100-foot ceiling and 110 yards visibility. The fog layer was approximately 800 feet thick. Five lanes were seeded, deliberately spaced to determine individual effects, not to provide continuous clearing. As indicated by the figures entered above the transmissometer trace, the ceiling broke and visibility rose to one mile as each of the three seeded zones passed over the field.

Tests conducted during December and early January conclusively demonstrated that supercooled fog in Europe can be effectively dissipated at temperatures as high as −2°C. Frequently when dense fog, thicker than 1000 feet, enveloped the runway at Hahn, the weather was lifted to above operating minimums. At least 28 aircraft operations were made possible during these tests.

On the strength of these encouraging initial results, Air Weather Service was tasked to provide *Cold Crystal* support to Exercises *Reforger/Crested Cap*. These were the joint AF-Army exercises designed to demonstrate the continuing commitment of US forces to the NATO alliance and the validity of the dual-basing concept. Two additional WC-130s with crews were placed at Ramstein during *Reforger/Crested Cap,* and one of the additional aircraft was retained for the USAFE training exercise, *Carbide Ice,* which followed immediately. Warm temperatures in the limited amount of fog which occurred during the exercises prevented airborne fog dissipation activities from playing an important role. However, the value of *Cold Crystal* operations was again demonstrated on 6 February when seedings at Bitburg and Spangdahlem expedited the departures of 18 tactical aircraft.

This picture shows how the clearing appearing in Figure 10 looked from the ground a few minutes before the previous picture was taken. The WC-130 seeding aircraft, which took the previous aerial pictures, can be seen as a bright spot between the antennas. The rime ice build up on the antenna structure occurred before the seeding.

WORK CONTINUES

In summarizing Air Weather Service progress in the development of airborne fog dissipation techniques during the past two years, it can be positively stated that airborne dissipation of supercooled fog has been highly successful and techniques for its dissipation can be considered altogether operational. Both dry ice and silver iodide are practical for use as reagents, although dry ice is effective over a wider range of temperatures. Dry ice can be effectively employed to disperse supercooled fog at temperatures as high as −2°C in the European area and probably elsewhere. The most serious problem encountered is that of determining the effective seeding wind, for errors of two knots or more in estimating the effective wind can be critical. Economically, airborne dissipation techniques will probably be practical at only the more important of the USAF bases plagued with supercooled fog. However, Air Weather Service is already deeply engaged in the operational testing of ground-based systems which, if found successful, will probably prove practical for bases with relatively limited amounts of supercooled fog. Weather modification promises to have a significant impact on terminal traffic in the next decade. ★

the I.P.I.S. approach

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

Q May the pilot of a Category E aircraft file to an IAF on a low altitude instrument approach procedure which does not have Category E minimums published?

A No. Using TERPs criteria, if an aircraft category is not listed on an approach, that aircraft category may not fly the approach. The IAF listed on a flight plan is the IAF of the approach the pilot is expected to fly in event of radio failure. Consequently, the pilot of a Category E aircraft should not file to the IAF of an approach which does not have Category E minimums published.

Q The lowest absolute weather minimums authorized (ceiling and visibility) for Category D and E aircraft are the same. This is true for both straight-in and circling minimums. When Category E minimums are not listed, why cannot the pilot of a Category E aircraft fly an approach to Category D minimums?

A This has been one of the most recurrent questions we have received. Category E aircraft obstacle clearance requirements are more restrictive than Category D:

a. The procedure turn obstacle clearance area required for Category E aircraft is greater than the Category D requirement.

b. The turning obstacle clearance area for a Category E missed approach is larger than for Category D.

c. The Category E circling approach obstacle clearance area is larger than the Category D area.

The larger obstruction clearance airspace required by Category E aircraft can dictate higher altitude restrictions that Category D aircraft do not need. If Category E minimums are not published, the pilot of a Category E aircraft has no way of knowing if he is properly protected. As stated in the FLIP, Special Notices: "Only those categories of aircraft authorized to use a given procedure will be listed on the approach chart."

Q A pilot experiencing radio failure in IFR conditions is required to maintain the higher of the following altitudes—last assigned or minimum for IFR conditions. Does the "Minimum altitude for IFR conditions" refer to the MEA? When the MEA is not the proper hemispherical altitude, should the first available hemispherical altitude above the MEA be used?

A The "Minimum altitude for IFR conditions" in controlled airspace is the MEA. An MEA cannot be the proper hemispherical altitude for all directions of flight. Nevertheless, a pilot with two-way communications loss is expected to maintain the higher of his last assigned altitude or the MEA—regardless of direction of flight. If a climb to a higher MEA is required, the climb to the MEA should be started at the time and place necessary to comply with the altitude minimum. Don't forget! After climb to a higher MEA, if subsequent MEAs along the route of flight are lower than the last assigned altitude, a descent back to the last assigned is required. Climbs and/or descents must be performed to constantly maintain the higher of the two altitudes. Each leg of the intended route must be evaluated separately.

One final note—if ATC has advised that a different altitude may be expected in a further clearance, the expected altitude becomes the assigned altitude at the time or place included in the expected further clearance. The pilot will be expected to maintain the higher of the new assigned altitude or MEA for the remainder of the flight.

POINT TO PONDER

When filing IFR STOPOVER FLIGHT PLANS, a flight plan VOID time is required. This VOID time is computed by adding the ETE for each leg and the total estimated ground time for all stopovers to the initial estimated time of departure entered on the flight plan.

NOTE: The ETE for each leg is the estimated flight time from departure to the destination IAF. However, when computing a flight plan VOID time, the pilot should also consider the time required for approaches and landings as well as ground time. ★

UNITED STATE

1968 Saf

Secretary of the Air Force Safety Trophy

AIR TRAINING COMMAND

Best overall accident prevention program of all major commands with a military strength of 15,000 or more personnel.

Air Training Command established a major aircraft accident rate of 1.4 accidents per 100,000 flying hours. It was particularly noteworthy that this record was accomplished while flying over one million hours in support of undergraduate pilot training. Additionally, the command overcame hazards inherent in a training situation as evidenced by the record of less than one major aircraft accident for every 200,000 landings accomplished. Strong command leadership and superior teamwork of aircrew, maintenance, and support personnel were responsible for conserving lives and materiel, thereby preserving the combat capability of the Air Force.

SOUTHERN COMMAND

Best overall accident prevention program of all major commands with a military strength of less than 15,000 personnel.

The aggressive accident prevention program of the command attained a zero accident rate in both the major and minor flight accident categories in addition to maintaining a zero accident/incident rate for explosives. The command has not experienced a ground accident fatality nor a civilian injury for the third consecutive year. Command emphasis on safety requirements and safety management throughout all echelons resulted in many achievements in accident prevention. In view of the environment in which operations in the United States Air Forces Southern Command are conducted, the record of accomplishments was outstanding.

Koren Kolligian, Jr., Trophy

MAJOR LeROY R. MULCH

The Koren Kolligian, Jr., Trophy is awarded to Major LeRoy R. Mulch in recognition of his outstanding feat of airmanship. On 20 September 1968, Major Mulch, while performing a heavyweight takeoff in a KC-135 at Ching Chaun Kang Air Base, Taiwan, experienced failure of an outboard engine at lift-off. This was immediately compounded by a fire and subsequent failure of another engine. Through extraordinary skill, Major Mulch averted a crash on takeoff that would have taken the lives of many innocent civilians residing near the airfield. By expertly judging his critically low airspeed and altitude and jettisoning fuel as he flew an emergency pattern, Major Mulch accomplished a perfect landing with only two engines functioning at a gross weight of 193,000 pounds.

Maj Gen Ben

Memor

The well defined
Pacific Air Forces
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AIR FORCE

ety Trophies

Chief of Staff Individual Safety Trophy

COL FLOYD WHITE

Colonel White as Commander, 12th Tactical Fighter Wing, Cam Ranh Bay, RVN, implemented a highly effective safety program. Under his leadership, the Wing achieved one of the most significant safety records in the Air Force as well as noteworthy accomplishments in combat. The wing routinely and effectively delivered ordnance in support of friendly ground forces in rugged mountainous terrain during torrential rains. The combat effectiveness of the organization under the hazardous conditions that existed attests to the outstanding leadership of Colonel White.

TSGT NUGENT REID

Sergeant Reid contributed significantly to the safety of personnel and equipment while serving as NCOIC of the Safety Division, Headquarters Pacific Communications Area. His outstanding ability and devotion to duty resulted in protection for tower personnel vulnerable to hostile action and revetments for essential communications and navigational equipment. Sergeant Reid's dynamic efforts were instrumental in safeguarding the vital aerial communications and navigational networks utilized by the Air Force in Southeast Asia.

ROGER G. CREWSE

As chief of the Analysis Division, Office of Safety, Headquarters Aerospace Defense Command, Mr Crewse contributed significantly to the safety effort of the Air Force through the application of his knowledge and understanding of air defense weapon systems to propose extensive aircraft modifications and changes to operating procedures. The adoption of these recommendations by ADC and the USAF has resulted in significant reductions in the command's aircraft accident rates with a corresponding savings of human life and combat potential.

jamin D. Foulois

ial Award*

PACIFIC AIR FORCES

aircraft accident prevention program of the fostered achievements that reflected a high vation. The command achieved an outstanding as well as noteworthy accomplishments in ntenance. It was particularly noteworthy that r aircraft accident rate was reduced 24 per cent erations primarily in a combat environment.

*adian Flight Safety Trophy

Colombian Trophy

21ST TACTICAL AIR SUPPORT SQUADRON

The Colombian Trophy is awarded to the 21st Tactical Air Support Squadron, Nha Trang AB, RVN, for meritorious achievement in flight safety during 1968. The squadron attained one of the most outstanding safety records in the Air Force as well as noteworthy achievements in operations and mission accomplishment. The unit compiled a record of almost 72,000 combat flying hours in 0-1 and 0-2 aircraft while experiencing one accident for a major aircraft accident rate of 1.39 per 100,000 flying hours. Despite difficulties imposed by a hostile environment, the unit played a vital role in numerous major engagements such as the battle at Duc Lap during which victory was assured by the tactical airpower directed by FACs of the 21st Tactical Air Support Squadron.

let's take the DINGS out of lanDINGS

If all runways were the same length and width, perfectly flat with 10 miles of flat terrain off each end, equipped with all the latest landing aids and so located that the wind always blew gently down the runway—would we still have landing accidents?

Assuming your answer was an automatic YES, let us proceed to the next question: Since such ideal runway environments do not always exist, are landing accidents not inevitable?

Now statistically, the answer has to be YES. But specifically, we can say NO—no, because some accidents can be avoided. The "It won't happen to me" syndrome is very prevalent among pilots, and rightly so. But we all know that sometimes it does "happen to me." This realization may come as a shock, and when we are talking about landings, it may come only at the last possible second when suddenly the ground seems to be coming up at the airplane at an alarming rate.

This is the situation that engenders the "stick back, cob it" approach to solving the immediate problem. Unfortunately, that may not be the solution. Or perhaps, at this point it may be too late for any solution other than "Our Father . . ."

Now, how does one get to this point where the number of options gets pretty thin? There are many ways, but one which continues to turn up as an accident cause factor is the illusion. This of course, causes the pilot to see something differently from what it really is, or to misinterpret what he sees. For example, there is an airport that the author used to fly into frequently that had a ravine off one end and rapidly rising ground on the far side of the ravine.

This meant that one found oneself either flying an awfully high pattern on part of the downwind or dragging the bird's tail through the cactus on base leg. The tendency was, when landing across the ravine, to climb with the terrain on downwind, which put the aircraft high on final. This inevitably meant landing long or frantic last minute attempts to get rid of some altitude on final.

Then there are those places where the terrain slopes down away from the end of the runway. If one isn't careful he can find himself landing short without knowing what is happening until it is too late. This apparently is what happened awhile back when a fighter jock put a T-33 into the dirt short of a runway. His attempts to salvage the situation caused the aircraft to porpoise and he ended up on the runway with a broken nose gear.

He blamed a downdraft off the end of the runway and he may have been perfectly right. The wind was blowing down the runway at about 18-20 knots and the ground sloped off, so there could have been a downdraft. The accident investigation board, however, found pilot factor in that he misjudged the approach and allowed the aircraft to touch down in a high sink rate, and got into a porpoise.

Unfortunately, this is not an isolated case.

Fortunately, this kind of accident is not as frequent as it used to be.

There were a number of accidents in Vietnam involving cargo aircraft which fit this pattern. This is certainly understandable, considering the strips that our crews have had to fly into. But the decreasing number of such accidents in SEA proves that we can learn to live with this kind of situation, even where no sophisticated landing aids are employed.

Here in the states there's really not much excuse for accidents of this type. There is almost always some sort of landing aid. VASI very possibly would have prevented the accident previously mentioned. But there wasn't any VASI. There was an ILS but for this VFR approach with ideal weather the pilot evidently thought he didn't need it.

There are some who believe that every landing ought to be out of a precision approach. We are not going to argue the pros and cons of that here, but we must admit that there is merit to the argument that a precision approach should, barring mechanical problems, at least get the bird to the runway.

Another factor in this accident, according to the board was a straight-in approach. Under the circumstances, an overhead approach may have been better in that the pilot's perspective of the runway environment would have been more accurate. When precision aids are not being used, a straight-in is normally more difficult, particularly at those places where the terrain may deceive the pilot. Where this is the case, pilots would be wise not to request VFR straight-in approaches and controllers should not issue them without some very good reason.

The landing phase—from the beginning of final approach until the aircraft leaves the runway—remains the most accident plagued area of flight. Recognizing this, we have developed both simple and very complex systems for assisting the pilot to a safe landing: radar (both PAR and surveillance), ILS, VASI, improved lighting, more sophisticated instrumentation, autopilot coupling, RCR, RVR, gear checks by controllers and probably some we haven't mentioned. These devices and procedures are designed to:

- Prevent accidents,
- Permit operations that would be impossible or extremely hazardous otherwise.

Even with all of these aids we still have accidents, but think of what the situation would be without these things. One is on pretty safe ground in saying that operations would be drastically curtailed or the accident rate would be out of sight.

Since human intelligence, motivated by necessity, has developed the means to guarantee safe landings almost all of the time, then why not use these aids to the fullest?—even when the weather is clear and a VFR landing is in order. This doesn't mean that pilots must make a precision approach every time. But the use of everything available seems to make sense when there are any difficulties, when the wind is strong and gusty or there is turbulence, when one is landing for the first time at a strange base or approaching a runway environment that is known to be deceiving.

It sure beats trying to explain a crunched bird. ★

REX RILEY'S CROSS-COUNTRY NOTES

A COUPLE OF SHARP TROOPS handled a sticky situation very well. While returning to base from a night combat mission the crew of a B-57B found themselves with a peck of trouble. The left engine flamed out and the UHF radio, which had been operating intermittently, finally gave out completely.

The crew declared an emergency and headed for the nearest suitable base. After the UHF quit, the navigator had made radio contact on Guard, using his RT-10 survival radio. A little experimenting and he found that by holding the radio inside his oxygen mask, both he and the pilot could hear over the interphone. Using this method they made a successful GCA recovery.

ON MY DESK are four reports describing cases of hypoxia that occurred in training aircraft. Although there were two men in the crew in each case, even if there had only been one man he presumably would have recovered safely, because each man who became hypoxic diagnosed his own condition. This is undoubtedly due to the excellent training the life support people are providing. Nevertheless, we can't get complacent on this problem or there will be some "mysterious" accidents.

Here's a quick rundown on these four cases:

• T-38A. The student got dizzy after about 40 minutes of flight, so the IP took over. The student went to 100 per cent and noticed that the oxygen pressure gage fluctuated between 65 and 85 psi. Descent and landing were made without incident and the aircraft was found to have a defective regulator.

• T-38A. After 40 minutes at FL300, the IP noticed symptoms of hypoxia: hands tingling, shortness of breath, hot flashes, mild disorientation. The student also began to feel tingling. They descended to 10,000 feet and the symptoms disappeared. Both regulators were faulty and both were due for a change.

• T-38A. At FL230, 25 minutes after takeoff, the student began to feel warm. He noticed that the blinker moved only when he took a very deep breath. He developed a dull headache, light headedness and his thinking slowed even on 100 per cent oxygen. The IP took over and landed. The problem: poor fitting mask

(too wide for the man's face) which caused the student to over-breathe and hyperventilate.

• T-37. Student felt symptoms during aerobatic demonstration by instructor. When the IP asked how he felt he replied, "Fine," and began to giggle. The IP instructed him to go to 100 per cent and slow his rate of breathing. The symptoms cleared except for a headache. Apparently the student's mask didn't fit well and slid down every time G was applied. This resulted in hypoxia.

These incidents indicate the need for good mask fit, thorough preflight oxygen system check, the necessity for knowing one's symptoms of hypoxia and the importance of acting quickly when these symptoms are recognized.

SOME INCIDENTS seem to be accidents that just couldn't find a place to happen. The following is a brief account of one of these.

After landing, the bird was being taxied on the runway. Since there were no lights (only pipes with reflective paint) the pilot did not see the taxiway and rolled into the overrun. Radio troubles precluded immediate contact with the tower, but the pilot saw an aircraft on final and taxied off the overrun onto a concrete ramp. When the tower cleared the aircraft to the taxiway, the pilot reentered the overrun and ran over the MA-1A barrier chain. The nose gear collapsed and hydraulic pressure was lost which prevented the crew from opening the canopy. Rescue people opened it from the outside and the crew got out unharmed, although probably highly agitated.

HOW PROUD CAN YOU GET? Without killing yourself, that is! Here's one about a jock who exited an expensive piece of hardware because:

He experienced a severe case of spatial disorientation and—

1. Allowed himself to become separated from his flight;

2. Failed to advise the flight leader of his spatial disorientation;

3. Aggravated his disorientation by using abrupt control movements, excessive bank angles and awkward body and head movements in selecting IFF-SIF;

4. Did not believe his instruments based on failure:

a. To note an apparent 180 degree discrepancy between the magnetic compass, and the heading indicator.

b. To use either standard or partial panel unusual attitude recovery procedures.

The accident board recommended T-33 training before again flying a fighter. This training included:

1. Minimum of one night flight on the wing, preferably with actual weather present.

2. Three (more, if required) instrument sorties with special emphasis on unusual attitude recoveries and partial panel instrument flight.

3. Included in this training are demonstrations of maneuvers and personal head and body movements which commonly induce vertigo.

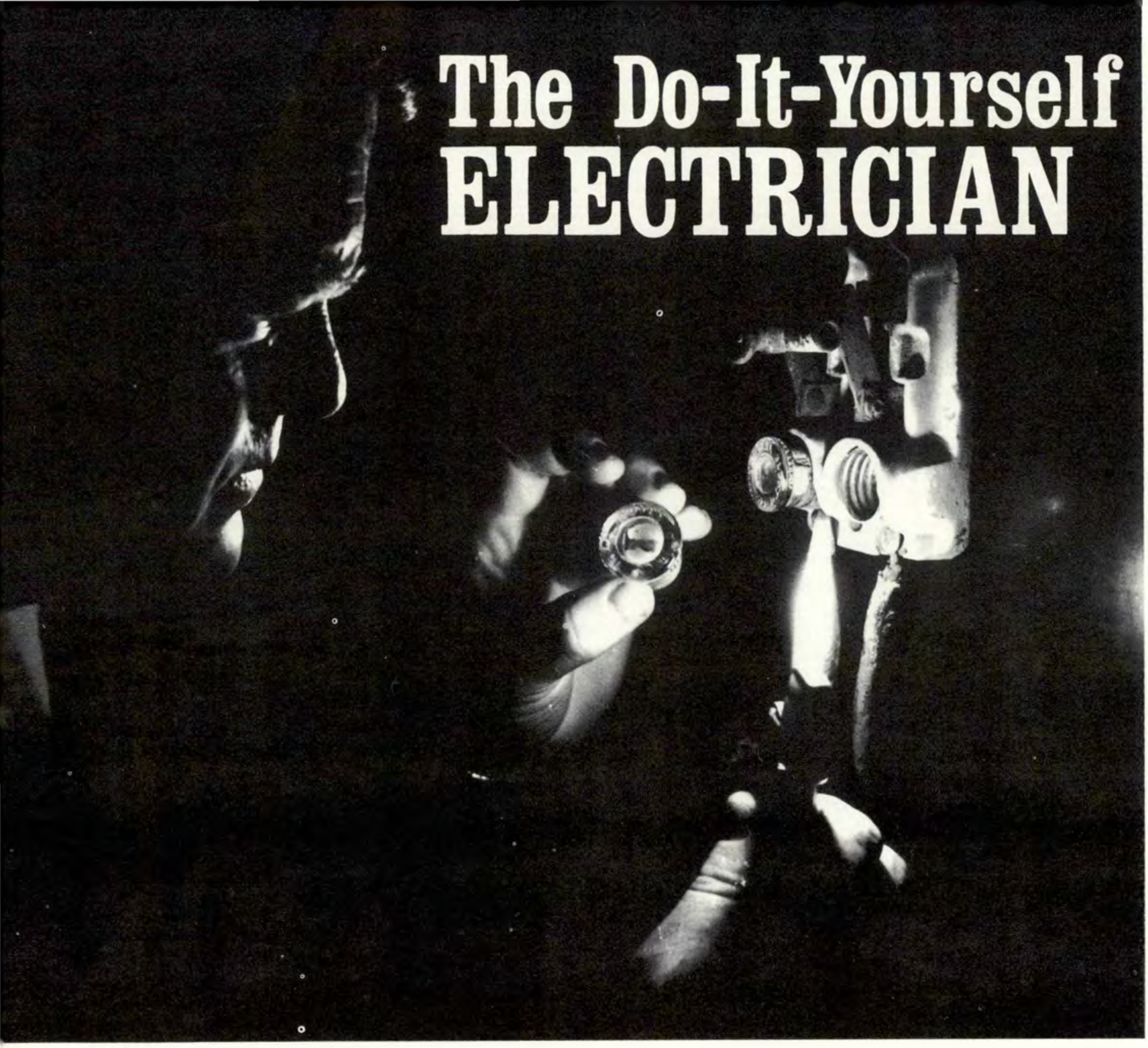
The board further recommended that members of units with single-seated aircraft, and having no instrument simulator available, fly one T-33 flight in preparation for the annual instrument flight check. Unusual attitudes should be emphasized during this flight.

Spatial disorientation incidents and accidents are not diminishing in frequency. Every Air Force pilot and flight supervisor must be constantly aware of the continuing need for instrument training and experience.

NO AMOUNT OF BOOKLEARNIN' CAN REPLACE JUDGMENT! Learning and remembering what's in the book certainly builds a foundation which enables a crewmember to use better judgment. However, I must repeat, no amount of booklearnin' can replace judgment! Here's a very recent example of a young aviator who again proved this frequently ignored truism.

An F-100 pilot, over a target area in SEA, noted a serious loss in oil pressure. His only hope of saving the bird was to land at an emergency recovery base, even though the main runway was closed for construction. Under ideal conditions, landing an F-100 on a 6600-foot runway is extremely risky. The problem was further complicated by a heavy haze layer which restricted visibility to one to three miles and a left drop tank which could not be jettisoned. He flew his precautionary pattern at 220 knots without moving the throttle until he was three miles out on final. At this point he had less than 5 psi of oil pressure and decided that the engine couldn't hack a go-around. He had two choices: eject or reduce thrust and land as near the end of the runway as possible. He chose the latter, stopcocked the engine, and touched down 500 feet past the approach end. Superior judgment and skill enabled him to stop on the available runway without benefit of any arresting gear or even blowing a tire. Stopcocking a running engine in a single-engined aircraft is not a recommended procedure. However, in this case the thrust of the running engine was more a hazard than a help, and it is very doubtful that the pilot could have saved the airplane if he had done otherwise. ★

The Do-It-Yourself ELECTRICIAN



Oliver Henderson, Foreign Wire Relations Engineer, Ohio Bell Telephone Co.

The incentive for "doing it yourself" receives fresh impetus with each hike in the cost of living. More and more often the handy man around the house yields to the temptation to try his hand at things electrical. But too often he is not at all aware of the fact that in the realm of the subtle electron the use of the head should outrank the skill of the hand.

Too frequently the only criterion the man of the house applies to his achievement is "Hurrah! It lights!" or "It runs! It runs!" His admiring family stands around and exclaims, "Daddy did it again." How right they often are. Yet, he may truly have done it again by setting the stage for a future accident or fire. If the novice electrician personally escapes the hazards of his initial installation activities, the odds are that any subsequent injury that may occur will befall someone else. Furthermore, with our transient population he may never know who his ultimate victim was.

Let us examine some of the things that our well-meaning neophyte may not know or may be prone to ignore.

Does he know that the threaded shell of a light socket must always be connected to the grounded wire of the two that feed the lamp? If the socket threads are on the hot side of the circuit someone may get a terrific shock when his fingers touch the threads of a light bulb being changed in the basement or in the bathroom. This deadly error has a very good chance of occurring, and furthermore, the error in no way affects the operation of the light bulb or its switch.

As an aside, just how does our handy man determine which is the safely grounded wire? Of course, if everything is in proper order, the white wire (for innocence?) is safely grounded whereas the black wire (for deadly?) is electrically hot. If these wire color indicators are lacking or not clearly discerned, then there is a problem in Russian roulette, with a real chance of harm to the user of the appliance. We cannot tarry here longer to tell our leading actor what to do about his grounding problem because this article is dedicated to warning him of the problem, not to provide an education in electrical engineering — which takes a long time, and many books, at best.

We surely hope also that our do-it-yourself electrician (we'll call him Jack) will always put the on-and-off switch in the "hot" wire, to avoid violation of the National Electrical Code.

While exploring Jack's knowledge (assuming his skill), does he know that any outlet boxes he puts in the bathroom should be grounded to a water pipe as a special precaution? And let us hope he remembers not to install *anything* electrical within reach of a person in the bathtub or shower.

Are we sure that Jack realizes that he can't just keep adding electrical items to a single circuit just because each additional light or switch he installs seems by itself to light up or work satisfactorily? Jack is prone to be tempted to connect most of his projects to a single circuit in the basement because those particular wires happen to be conveniently accessible. So he loads up a single circuit and later his good wife complains that she lost a day's ironing because the fuse kept blowing. Jack reasons (illegally) that if a 15-ampere fuse won't hold, then a bigger one will. However, he finds he does not happen to have any bigger ones so he sinks deeper into electrical crime by inserting a penny back of the burned out fuse. This "temporary" expedient may not be corrected as soon as he intended. In fact it may be forgotten until the local fire department investigator

Typical "do it yourself" installation by a home handyman. The possibilities for fire are frightening.

Lifting tool by the cord and other abuse will eventually break the lead-in fitting. Replace the cord before it shorts and ignites sanding dust! Dust can explode with considerable force.

The "penny behind the fuze" syndrome. Known to be the cause of many catastrophic fires. Deteriorated wire insulation will help bring on disaster.

locates it just after the fire. A close call for the baby sleeping on the floor above.

Now we leave the area of hazards arising out of ignorance and determine what the untutored home Mr. Fixit too often does, thoughtlessly or deliberately, by short cutting the proper procedures.

Does he install service outlets without boxes? That is, does he just fasten a wall outlet in a hole he cut in the wood lath?

Does he run loose wires up the wall spaces or in other concealed places without suitable protective covering all the way? If he does, no one can see the defect after the job has been completed.

Does he festoon wires over other wires, water pipes, furnace ducts, and bent-back nails? Does he compound the misdemeanor later by hanging the rags he washed his car with over the draped wires to dry?

Does he use extension cords for permanent wiring? If he lives in a rented house, does he save the cost of a needed outlet by dropping a piece of extension cord through a small hole in the parlor floor so as to be able to splice it to wires in the basement?

Does he make sloppy splices of uncleaned wires, loosely twisted, without solder, perhaps not even covered with approved electrical tape? Or maybe he makes an attempt to hide the mess with a few turns of adhesive tape purloined from the medicine cabinet?

In order to improve the lighting in the bedroom where Junior studies his algebra, Jack screwed two 100-watt bulbs in the enclosed ceiling fixture that was approved only for 40-watt bulbs. It took several weeks, but eventually the excessive heat softened the plastic on the fixture wiring to the point where the wires sank down and came into metallic contact with the spun brass canopy. It was then that little whiffs of smoke appeared, followed by big belches of smoke, followed by a fire extinguisher, followed by the burly men from the city fire department.

Jack is not as bad as all the above would indicate. No one person could be. The instances are a recital of the actual observed sins of many sinners. Actually Jack once did a conscientious job, up to a point, of running a line from the basement to a bedroom wall outlet for a new electrical blanket. He very properly used armored cable (or non-metallic sheated cable, depending on local ordinances) but when he came to splicing it to the existing knob-and-tube wires he encountered a dilemma. He just did not have any suitable fittings for this end of the job. He surmounted the difficulty simply by exposing six inches of the BX wire and splicing the ends directly to the existing wires between the floor joists in the basement. No box, no cover, no clamps, no loom, no nothing. Nevertheless he sleeps well, right over the hazard he created because the extra comfort from the warm electric blanket allays any doubts he might have as to the adequacy of his job, and the possibility of fire from makeshift connections.

Let's have a look at the home appliances. With some types of professional servicing almost bordering on incompetence, you can't blame Jack for trying his hand at appliance repairs. More power to him, but does he know, for example, that the 15,000 volt capacitor in his TV set has a memory? After the set is turned off and the high voltage circuit momentarily discharged, the capacitor can regenerate a charge of about 8000 nerve shaking volts, because of its memory of the charge it received from its power supply some time before.

The TV antenna also offers money saving and likewise death-defying possibilities. Granted that Jack is careful with ladders, does he erect an antenna away from all power wires? Far enough away so that if it falls in a high wind it will not tangle with the hot stuff on the power poles? If the antenna needs a lightning arrester and a ground, does it have them? A great many men and boys have been killed while erecting or working on antennas or antenna masts for TV and FM receivers.

When Jack replaces the flexible cord on the electric iron, toaster, coffee maker, or on other heat-making devices, does he always use the specially approved heater cord, or does he perhaps sneak in a piece of ordinary flexible lamp cord? This may occur on evening jobs when the local hardware store is closed, or he may just not know that heating appliances require a type of cord entirely different from that used for bridge lamps and table lamps.

Even a simple thing like putting a plug on a cord can be done wrong and hence often is. Painful hand burns can occur when people manipulate defective plugs in or out of receptacles. Strands of the wire should be so carefully secured that they will not work loose from the screw connectors even when the plug is removed by the bad practice of pulling on the cord.

It might surprise Jack to hear that Consumer's Research, Inc., has pointed out that cheap electrical appliances are potential hazards at times even when they are brand new. Our hero would do well to look over each contemplated purchase of such appliances with a critical eye regardless of the UL listing label which may apply to cords; it is common practice to use approved cords on non-approved poorly engineered appliances.

A neighbor of Jack's helped a son fly a box kite. Ordinary string was not thought to be strong enough so they used some 30-gauge copper wire which they unwound from an old electromagnet. The wind was over the power line. Death was the result of this error of judgment and understanding.

If our friend Jack is a suburbanite, he may have a deep-well pump with a flexible rubber hose connected between the pump and the house water piping system to deaden the noise. The well acts as an excellent ground except that the electrical jumper wire across the hose connection has a way of becoming and remaining disconnected, especially after the householder or a serviceman has come to clean the mud and slime out of the suction pipe. There is a case on record where 4600 volts energized such an "electrically floating" plumbing system in an occupied house for eight danger-fraught hours.

While back on the subject of grounding, Jack would do his helpmate a good service by securely, adequately, and permanently grounding the exposed metal parts of the washer, drier, and other basement and laundry appliances regardless of the voltage employed. But Jack should realize that the outlet boxes in the shop where he works are conduit wired and are, therefore, acceptable means for grounding. But the chances are great that similar outlet boxes in older residences are *not* effective as reliable grounding devices.

Incidentally, if you think the home-owning do-it-yourself electrician is prone to be irresponsible, you should see the work of the non-licensed neighborhood handyman. He finds his way into places such as drug store basements where he is much in demand because of the everchanging need for power for animated window displays, fans, coolers, refrigerators, and the like. He is hired because he is known

Water and electricity don't mix. These children are in serious danger. Electrical outlets, equipment and fixtures should not be located near showers, bathtubs, swimming pools.

Adapter should be used to update old style electrical outlets. When shifted from outlet to outlet ground wire soon breaks.

Ground wire should be attached to outlet box if house is wired with conduit. If conduit is not used, best have circuit rewired.

Never, but never, use masking tape on electrical connections but that's not all . . . although the next guy solders connection (use only rosin core solder) and electrical tape—he's still dangerous. This fixture is designed to mount on a properly wired box, not attach to a cord!

to be handy with tools and his charges are low. Usually he has no license, obtains no permits, has no inspection, and exercises no inhibitions.

But this brief article cannot presume to set forth all the possible errors that the hand and mind of the unqualified electrical amateur can devise. Perhaps enough items have been enumerated to illustrate that the violations are many and sundry.

Let us now concede the point that the majority of men about the house are somewhat familiar with the rudiments of electrical circuits and can, therefore, be counted on to try their hand, more or less, on things electrical. Legislation and local ordinances covering licensing of electricians, permits, inspections, and insurance requirements seldom cross their minds and are not likely to be deterrents anyway.

Now, if Jack is bound to engage in such activities, what can we do to help keep him out of trouble and from unintentionally planting booby traps for others? Since ignorance of electrical engineering and thoughtlessness are two prime causes of his trouble, it should be most profitable to do something in these two areas.

Ignorance is an ugly word but so are its consequences. Frankly, ignorance of the fine points of things electrical is more prevalent than one might suspect; even licensed electricians at this time show a marked weakness in this subject. This is in spite of the fact that many good avenues of learning are open to the interested seeker after electrical knowledge.

Newspapers and homemaker's magazines frequently print short articles and little gems of wisdom along these lines for those who are willing to absorb them. The libraries have plenty of books on the subject.

It might be a good idea for Jack to own a copy of the 1968 National Electrical Code as it costs only $2 and is accepted as the standard in most communities. Since the Code is pretty heavy reading for any laymen, some simplified reference book might be a better choice for most home craftsmen.

Company hobby groups, college engineering and home economics departments, certain libraries, PTA's and the like often do (and in other localities should) conduct classes in repairing home appliances. Interestingly enough, these classes are noticeably patronized by career women who are fed up with being victimized for appliance repairs.

The Boy Scouts have an excellent merit badge pamphlet on "Electricity" and any home mechanic would do well to own a copy of this 35-cent booklet on the subject.

Many high schools offer courses in practical electricity and some even in house wiring that should be invaluable when the young people later set up their own home.

Having divested Jack of any chance to excuse his ignorance, what can we do about his thoughtlessness. Let us assume that he is initially in the category of the thoughtless man who started to enlarge his kitchen by tearing down a partition wall. After sawing through the very first stud, a whomp of flame made him realize that he was then cutting through all of the concealed wiring to the second floor.

So Jack would do well to embark on a program of thoughtfulness and preparation for his life in a world of electrical circuits and appliances. Where to begin? First of all he should check all fuzes and replace with 15-ampere fuzes any in excess of that value, except the service fuzes, stove fuzes, dryer fuzes, and those which might properly be larger, if the wiring they control is of size 12 or larger.

He should check all circuits for overloads and have the loads rearranged if necessary. The family could get in on the game by lighting every light in the house, then unscrewing all but one fuze and writing down the locations of all the lights still burning on that one circuit. Jack's son's Boy Scout merit badge pamphlet on "Electricity" would be a big help here.

Jack should inspect all exposed wiring for improper workmanship which his predecessor may have bequeathed to him, or which Jack himself may have created in his less responsible days. Any faulty items should be corrected immediately.

Each member of the family should be conditioned to recognize and report all loose connections, faulty switches, defective cord plugs, frayed insulation, sloppy outlets, warm spots on plugs and sockets that should be cool and unexplainable shocks or tingles. Jack should take care of each item right away or de-activate the cord or circuit with the defect until new parts are installed.

Jack and his family should adopt the policy of never buying shabbily built or questionable electrical gear or used appliances that have seen long service no matter how attractive the price may be.

Old, dried out and worn fabric or brittle rubber- and plastic-covered cords on lamps, clocks, and the like should be replaced with new modern material wherever they are found. Besides being prime fire hazards, deteriorated cords have been known to cause some pitiful mouth burns to dogs and even very small children who have exercised their instinct to chew on something. Many young children have received dreadful mouth burns from putting live electrical cord terminations into their mouths.

Jack should teach each and every member of his family never to pick up an electric wire lying in the back yard or anywhere else. It is a very natural thing for a curious or tidy person to do, but it can be very dangerous. Even a wire going into the ground from a power-line pole can carry a dangerous voltage at times.

He should also teach his family what to do if they are in a car that becomes entangled with a fallen power wire. This is one situation where the chivalrous bystander should think twice before offering a helping hand.

Common sense, good planning, and acquired skill, if brought into play on the electrical problems of the home will work together to produce a safe and workmanlike job.

Perhaps there is a place for conscience here also. Can a do-it-yourself electrician take an improper shortcut for expedience or economy's sake and yet in good conscience ignore his own children sleeping perhaps right over the hazard he has created? Should he not consider himself "a workman that needeth not be ashamed?"—II Tim 2:15.

To summarize, we may as well admit that many good solid householders will go on repairing electrical appliances or working on the light circuits at home, and this is probably good, on the whole. But what is undertaken by them should be executed with adequate knowledge, skill, and integrity so as to insure a permanently safe and workmanlike job. They should consider the safety not only of their own families, but of those who will live in the house after they have left it for other homes. ★

THE AERO CLUB PILOT touched down and lowered the nose gently to the runway. He touched the brakes to start decelerating on the slightly downhill runway but nothing happened. Approximately 4000 feet later he ran off the other end of the runway and dinged a valuable club asset. Questioning revealed that the pilot's only defense was the fact that he had been warned many times against making touch and go landings. Of course this wasn't an adequate defense, especially in view of the 10,000 foot runway that was available a few miles away.

The pilot knew that the runway he was landing on was slightly downhill; this magnified the improbability of stopping with no brakes. This fellow happened to be a professional heavy aircraft pilot who was used to having reliable emergency systems to back up normal equipment. The only logical back-up in this case was to advance the throttle while there was still enough runway left for a safe go-around. Our Aero Club instructors must stress this all important emergency procedure.

F-104 INADVERTENT JETTISON OF STORES. "During the landing roll, the pilot deployed the drag chute. At about the same time the aircraft tip tanks jettisoned . . ."

"The aircraft made a normal touchdown. Between touchdown and drag chute deployment, both tip tanks jettisoned . . ."

Other incidents reading about the same have occurred. The location of the external store jettison button in relation to the drag chute handle makes it easy to hit if the jock is not paying close attention to where he is reaching. Although stores have been jettisoned inadvertently due to the location of the panic button, relocation to another position might lose us more than we gain. The most simplified corrective action is to insure that jocks are aware of this situation and to make certain that the pinkies do not grasp, fondle, pet, or touch controls other than the one that is needed.

Lt Col Robert A. Preciado
Directorate of Aerospace Safety

AEROBITS

F-104 ABORT. A high-speed abort occurred on takeoff. The pilot on the wing broke ground, got a violent right roll and yaw action and elected to put it back on. He didn't punch a tip—he didn't have the time. He got a good catch, did a fine job.

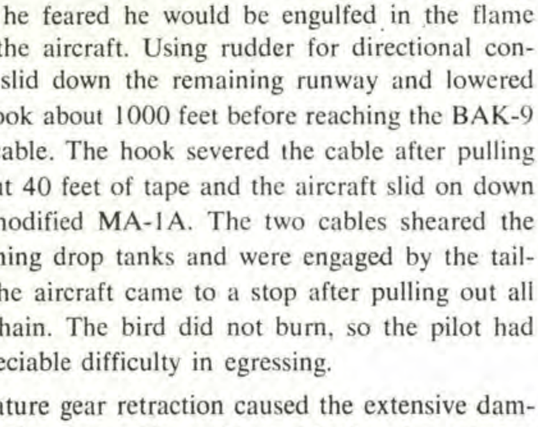
What happened? Why the abort? The answer, wild as it might seem, is a little thing called wingtip vortex (wake) turbulence caused by the element which preceded this one on the takeoff roll at normal 12-second intervals. The wind was calm and the student element leader of this element broke ground right on speed and distance.

Under calm wind conditions, wake turbulence lies heaviest right at the break-ground point. In this case the wingman was thrown off the wing while the pilot in the lead aircraft never felt a thing.

4510 Cmbt Cr Tng Wg (OS)
Luke AFB, AZ

THE LEFT WINGMAN ROTATED with the leader as the formation approached lift-off. Thinking that he was airborne and that he saw Lead's nose gear start to retract, he raised his gear handle. The RF-101G settled on the drop tanks which then exploded shortly after contacting the runway. Upon seeing fire in the rear view mirrors the pilot aborted the mission. He didn't open his speed brakes or deploy the drag chute because he feared he would be engulfed in the flame trailing the aircraft. Using rudder for directional control, he slid down the remaining runway and lowered his tailhook about 1000 feet before reaching the BAK-9 barrier cable. The hook severed the cable after pulling out about 40 feet of tape and the aircraft slid on down to the modified MA-1A. The two cables sheared the still burning drop tanks and were engaged by the tailhook. The aircraft came to a stop after pulling out all of the chain. The bird did not burn, so the pilot had no appreciable difficulty in egressing.

Premature gear retraction caused the extensive damage resulting from this accident. Movies showed that none of the three aircraft was airborne.



YOU SHOULD "SWITCH" TO SAVE YOUR LIFE. Usually it is the "little" things that kill you. "Little" things which distract your attention from the more important job of maintaining the aircraft in a safe attitude. A recent A-26 accident that cost the lives of both crewmembers is a good example.

The tragedy began as the aircraft was preparing to land after completion of a night mission. The right main gear would not indicate down and locked. The pilot spent thirty minutes in the local pattern attempting to get visual confirmation of the gear position and awaiting clearance into a jettison area to get rid of unexpended ordnance. On what was to be his final pass over the field, enroute to the jettison area, the right engine quit. Witnesses stated the aircraft appeared to enter a stall. It then rolled to the left and crashed in a near vertical attitude. It is probable that the combination of low airspeed, low altitude and dirty configuration did not permit recovery from the yaw caused by the engine failure.

Investigation revealed that a faulty downlock switch was the cause of the unsafe gear indication. It also revealed that there were at least 130 gallons of fuel on board at the time of the crash, 110 of which were in the left main tank.

It was probable that fuel mismanagement, causing starvation, was the reason for the engine failure. With both a pilot and a navigator on board, you would think that at least one of them would lend some attention to gage monitoring.

Many of the more modern aircraft have fuel feed systems which are either ON or OFF. After years of experience in this type, pilots are apt to remain too complacent when operating the most austere aircraft. A conscientious program emphasizing inflight procedures is needed in organizations with such aircraft.

Maj Edward W. Johnson
Directorate of Aerospace Safety

WHILE TRANSITING ONE OF OUR BUSY overseas airbases an Air Force pilot found nothing but outdated publications in the planning room. He complained but found the same conditions upon returning a few days later. The repeat discrepancy clearly indicated a continuing operational hazard so the frustrated pilot filed an OHR. The local BASOPS honchos, while trying several solutions without success, discovered that certain aircrews were trading their old pubs for the new ones in the planning room. The problem was not confined to FLIP Enroute Publications; even the Flight Planning Document and Foreign Clearance Guide were found missing.

A sign is now posted advising aircrews that crew copies of FLIP publications are available for issue from Base Operations Dispatch. "Pub snatchers" are like bulb snatchers;" they make it damn hard on the next person who needs to use the facilities. ★

MAIL CALL

ERROR IN TECH ORDER

In the feature titled "The Technical Order System" in the April issue of Aerospace Safety, I noted one discrepancy. The third sentence of the last paragraph on page 23 stated "Additional information may be obtained by reviewing AFR 66-7, TO 00-5-1, and TO 00-5-2." AFR 66-7 has been superseded by AFR 8-2 dated 20 March 1968.

The feature in itself was of great help to me and I'm sure to everyone in the Air Force.

Sgt Courtenay L. Worthington, Jr
NCOIC, Technical Order Section
3960th Strat Wing
Andersen AFB Guam

Thanks, Sarge—and to all of you who called this to our attention.

"TAKING THE OPTION"

Reference the article by Lt Col Karl K. Dittmer in your Feb 69 issue, "Taking the Option." This long over-due article is a most welcome respite from what has become the "normal" way of thinking throughout most of the Air Force.

There must be some way to allow and to encourage our managers to use good judgment as they attempt to fill squares and pick up their "brownie points." Inflexible enforcement of management systems and of methods of operations has, in many cases, caused needless waste of time, money and resources. I'm sure each of us can conjure up a memory of someone's "head rolling" because his judgment did not agree with an inflexible rule—even though he accomplished the goal that was otherwise unattainable.

I maintain that such an approach forces people to think excessively about protecting their necks and too little about a safe, sane way to do the job. Perhaps Col Dittmer's article will start us on a more sensible road.

Lt Col Alvin L. Reeser
6595 Aerospace Test Wing
Vandenberg AFB CA

A SHOCKER

The article "A Shocker" by LtCol William Robinson, Jr., in your April 1969 *Aerospace Safety* Magazine, is the best, short, lucid article on electrical shock that I have read.

May I have your permission to reprint pertinent parts for dissemination to personnel and families of my command?

Capt A. Barker, USN
Commanding Officer
U.S. Naval Air Facility
Washington, D.C. 20390

Be our guest!

"HAVE YOURSELF A PLAN"

I want to compliment you on the very fine article, "Have Yourself a Plan," by Lt Col Raymond Krasovich in your March 1969 issue of *Aerospace Safety*. Our wing commander has made the article required reading for all our RF-4 aircrews.

I'd like to share my own "Have yourself a plan," in line with what Colonel Krasovich wrote. All of us select emergency airfields for possible use during our flight. I go one step further and mentally select points enroute where my choice of emergency airfield changes to the next one. When I'm faced with an emergency which requires an immediate landing, I will already have decided which emergency field to head for. I'll probably have my hands full maintaining aircraft control and taking corrective action; however, having a plan may give me a bit more chance to make a successful recovery.

Lt Col Martin Weissgarber, Jr
Chief, Safety Division
10th Tac Recon Wg
APO New York 09238

FOD

The attached photograph shows cockpit FOD discovered in one aircraft during an acceptance check at Bergstrom Air Force Base, Texas. This aircraft was received at the base from an overseas command.

We have reproduced this picture locally in an 18 x 22 print and have it displayed in our Base Operations, Aero Club and our two tactical reconnaissance squadrons.

Maj Ralph T. Lashbrook
75 Tac Recon Wg
Bergstrom AFB, Tex ★

UNITED STATES AIR FORCE

Well Done Award

Presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Accident Prevention Program.

☆ U. S. GOVERNMENT PRINTING OFFICE 1969 341-219/11

Lt Col Robert E. Dobyns
Aircraft Commander

2d Lt Stanley R. Marks, II
Pilot

Maj John J. Polites
Navigator

SSgt David J. Lott
Flight Engineer

SSgt Louis R. Stennes
Radio Operator

SSgt Kenneth J. Corbin
Radio Operator

460th Tactical Reconnaissance Wing, APO San Francisco 96307

Lt Col Dobyns and crew were flying a classified combat mission in an EC-47 from an RVN base. Fifty minutes after takeoff the crew heard a loud metallic crack. The aircraft lurched and immediately filled with dense blue smoke. A quick damage assessment revealed shrapnel holes in the left engine nacelle and wing, loss of all hydraulic systems and a rough running right engine. The terrain was rough and mountainous, covered with forests, and there were no "friendlies" in the area.

Lt Col Dobyns immediately set course for Pleiku, approximately 100 miles away. The gear had fallen free and both engines were losing power. After a few minutes the right engine propeller began to overspeed. For a while it was controlled by the feathering button, but the feathering system soon failed so the engine was shut down. The propeller windmilled to a stop and the engine froze. The aircraft began losing 200 to 500 feet of altitude per minute.

In the meantime, rescue had been alerted and the flight was advised that two Jolly Greens and fighters were on the way and that four Army helicopters were already in the area. About fifteen minutes after the hit, a Forward Air Controller (FAC) in an O-2 joined the crippled Gooney Bird to escort it to a safe area.

To lessen the load the crew began to jettison everything loose. The oil temperature on the left engine read zero and oil pressure was down to 30 PSI. Maximum rpm obtainable was 2300. It was already apparent the aircraft could never make Pleiku. The FAC then advised that clearing one range of hills would put the crew in friendly territory. The FAC then said there was an emergency strip eight miles ahead but he recommended bailout because of two intervening ridges. After checking with his navigator, who had been giving him fixes during the entire route, Lt Col Dobyns elected to circumnavigate the ridge crests. This was successful and a landing was made with no flaps, no brakes, a left tire blown by shrapnel, and no differential power. The aircraft touched down 300 feet down the runway, veered to the left and left the runway at the two-thirds point and finally stopped even with the end of the runway. There were no injuries.

This flight demonstrated superior airmanship by Lt Col Dobyns and his crew. WELL DONE. ★


MISS LIFE SUPPORT SEZ....
SMART BIRD WATCHERS
KEEP THE BLOODY VISOR DOWN!
Our thanks to pretty Miss Lynn Harwell for being our Miss Life Support this month.
Give Yourself A Break...
It's difficult at best to dodge birds... even when you can see them.