april
1964

AEROSPACE

SAFETY

UNITED STATES AIR FORCE

Something Missing ..... *page four*

MISSILE SAFETY REPORT

In all commands, 1963 was a year of solid progress toward professional missile safety programs. A survey of 1963 mishap data, although it shows a numerical increase over the preceding year, indicates impressive total results, especially in ballistic missile systems. This increase of 36 mishaps over 1962, while moderate, would appear to be a backward step until the following factors are considered.

Although the number of tactical missiles remained relatively stable in 1963, there was a 70 per cent increase in the ballistic missile inventory. In addition, increased expenditures of airborne AGM-12B (Bullpup) missiles in "Operation Full Scope" and TAC Project 63-71 were responsible for an increase in Bullpup mishaps over 1962. Despite the major growth in the ballistic missile inventory, there was an over-all decline of 5 per cent in ballistic missile mishaps.

In 1962 there were 24 missile accidents. In 1963, there were 10. These gains reflect command support and substantial progress by field missile safety officers in implementing effective missile safety programs.

Current studies in progress as a result of the Fourth Annual USAF Safety Congress highlight certain significant factors not commonly known. Excluding the abnormal surge of Bullpup air-launched mishaps, materiel failure accounted for approximately 39 per cent and design deficiencies for slightly more than 7 per cent of the 1963 mishaps. Personnel error ran a close second with 38 per cent, miscellaneous and unknown causes accounted for slightly more than 6 per cent, weather causes ran a little above 3 per cent, and an old contributor, technical data deficiencies, is on the wane and accounted for less than 1 per cent of the 1963 mishap picture.

As reported from the field, supervisory error was a primary cause factor in less than 5 per cent of all mishaps. It is the considered opinion of many unbiased safety experts that, wherever personnel error has been a factor in a mishap, supervisory error may be partially or, in some cases, wholly responsible. This low reporting rate of supervisory error may be attributed to a natural reluctance toward self-evaluation, or to incomplete mishap investigations. A more realistic commander's appraisal of causes may be the key to a significant reduction of personnel error mishaps by means of more thorough supervision.

In the area of personnel error, the 1964 Missile Safety Program, presented at the Fourth Congress, advocated shredout of personnel error into the following categories for special study: (1) operator error, (2) maintenance error, (3) ground-handling error. Supervisory error was recommended as a separate category.

It is now believed that this shredout may not be complete enough for thorough evaluation, especially in the maintenance area. It is also thought that supervisory error can be more precisely identified through shredout of a broad, over-all human error category. The results of a current study, with recommendations for category changes, will be presented at the Fifth Congress.

Although materiel failure is a major contributor in all systems, this factor varies widely by weapon system. A departure from the norm appears in the AGM-12B airborne missile system. This is the result of major exercises, only, and is not a cause for alarm. Reliability data for the Bullpup indicated performance in excess of specification. Since each launch results in destruction of the missile, it is difficult to identify other causes that may be present in addition to materiel failures.

All in all, the progress made in 1963 is substantial and gratifying. It is indicative of continued missile safety progress. ☆

Colonel George T. Buck
Chief, Missile Safety Division

FALLOUT

OUR STORY

I wish to take this opportunity to commend you on your excellent article titled "Our Story" (September 1963). One cannot help but admire the resolution of the Transient Alert Personnel who so often bear the brunt of undue criticism, yet manage to "keep smiling."

As one of the fortunate few RCAF pilots who frequents USAF bases throughout the USA, I can personally testify to the courteous efficiency (even under the severest of conditions) that is prevalent amongst "T/A" personnel.

H. F. Kelly, Flt Lieut, RCAF
RCAF Sta. North Bay, Ont.

JUNK IN JP-4

The December 1963 issue of AEROSPACE SAFETY contains an excellent article, "Junk in the JP-4," which is of great interest to us in the Joint Area Petroleum Office. The problems presented are those we all face continuously in handling the large quantities of fuel used in this area. We would like to get about 20 extra copies of this article to insure that all our customers throughout the Med Area are acquainted with it. The more information they have on this subject, the more apt we are to have completely satisfactory fuel-handling procedures. This applies to NATO users as well as our own people. Thank you for your assistance.

Lt Col Keith Sherman, USA
USNFE, Joint Area Petroleum
Office, FPO New York, N.Y.

Copies forwarded, glad we can help.

SNAKE PIT

The article titled "The Snake Pit" in the December issue moves me to ponder what the pilot was doing about the snake's friends . . . the pink elephant who was trying to stomp on his toes and the little green men who were attempting to unscrew his nose!

All of the above purely in jest, sir—but I still wonder just how much convincing it took to get that pilot back into "The Snake Pit."

May I take this opportunity of extending the congratulations of 414 "Black Knight" Squadron to you and your staff on an excellent magazine.

Douglas G. Bremner, F/O, RCAF
414 All Weather Fighter Sq
North Bay, Ontario, Canada

AEROSPACE
SAFETY

CONTENTS

Lieutenant General John D. Ryan	The Inspector General, USAF
Major General Bertram C. Harrison	Deputy The Inspector General, USAF
Brigadier General Jay T. Robbins	Director of Aerospace Safety
Colonel Charles L. Wimberly	Chief, Flight Safety Division
Colonel James F. Risher, Jr.	Chief, Ground Safety Division
Colonel George T. Buck	Chief, Missile Safety Division
Colonel Jerome I. Steeves	Chief, Safety Education Group

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VOLUME TWENTY NUMBER FOUR — USAF Recurring Publication 62-1

BOOMER TWO, ARE YOU THERE?

"Boomer two, did you copy the clearance?"

"Rog."

"Let's go channel three for taxi."

I acknowledged the channel change by calling my position in formation. "Two." It was quick, a reflection of confidence; another enjoyable flight about to get under way.

We were a flight of two T-38s departing on an IFR formation leg of a student cross-country. Heat was giving way to a cool, on-shore breeze. Weather was 800 feet scattered, 1500 feet overcast, seven miles. In our normal formation briefing we had covered weather procedures in detail, anticipating at least a portion of the climb through clouds.

My student had been having some trouble with radio procedures so I controlled radios in the back seat for departure. Our IFR clearance had come through as requested; direct to our first navigation fix, via flight plan route, maintain flight level 330. Approaching the active runway, ground control instructed us to change to tower frequency for takeoff. After we checked in on the new frequency, tower gave us the winds and cleared us for takeoff. At Lead's request tower confirmed clearance for a left turn out of traffic, climb on course. This was the first mention of any departure procedure although it was what we had requested on the Form 175.

Shortly after the flaps came up on takeoff, tower called again and cleared us to contact departure control on frequency 285.6. Lead acknowledged but didn't call the frequency change until we had passed our critical altitude of 1000 feet. As he called the change, we were in our left turn and approaching the overcast layer. My student had been doing a good job but when he began to take excessive spacing in the turn I took control of the aircraft. Now to make that frequency change. I quickly spun in 286.5 and checked in.

Silence.

I realized I was on the wrong frequency. Did the student hear and remember the frequency? No. Well, no sweat, I remember the departure booklet on my knee pad reflected the proper frequency. Fooled again.

Capt A. R. Langford, 3500 PTW, Reese AFB, Texas

I had knocked it off of my knee pad and it was out of reach behind the rudder pedal. Enough of this spasing around while trying to hold a wing position. I switched to our pre-briefed formation frequency (a pre-set channel), relaxed a little and maintained position.

I had confidence in the instructor in the lead aircraft and could see him bend to make several frequency changes in the climbout. I knew that when he finally got a frequency we would be on for a while, he would call me on our formation channel and give me the frequency. Shortly after level off, I heard his call.

"Boomer two, are you there?"

"Rog."

"Let's go 291.4."

"Two."

Men, this problem of radio frequency changes needs improvement! And particularly on IFR departures. Here's today's sequence on a typical IFR departure to high altitude. A flight clearance on one frequency, change for taxiing, obtain takeoff clearance on another frequency and still another change for departure control. Then the change to the intermediate altitude ARTC center controller and another change to the sector controller above flight level 240. By that time you're probably departing his sector and have to make one more frequency change before you can sit back and relax a little. This means six or seven frequency changes in a period of ten minutes or less for high performance aircraft.

You multi-engine jocks may say, "No sweat, my copilot or radio operator can handle it all and still have time to pour coffee." But it is a real difficult problem for a guy by himself, or worse yet, a guy by himself flying wing position. I even suspect that you guys who drive the heavies are occasionally a little irked by it all.

What can we do about it?

Be aware of the problem and use as much pre-planning as possible. This will help ward off confusion and distractions that may occur once we get the bird moving. It is not much of a problem in the local area where we know most of the procedures and frequencies by heart. But flying out of strange fields the problem may catch you off guard!

• At Base Ops get a good briefing on the sequence of radio contacts you will have to make during the departure and the probable frequencies. If this information is not available as a handout, write it down where it will be available for quick reference once you're in the aircraft.

• Do not try to make radio frequency changes immediately after takeoff! Wait until you have everything under control and sufficient terrain clearance (usually a minimum of 1000 feet.)

• If you are flying in formation, have a definite procedure to follow in case a wingman gets on a wrong frequency. One good idea is to have the wingman simply switch to a discrete pre-set channel. He can then wait until the leader gets a chance to contact him on that channel and give him the proper frequency. All pilots in the formation should leave their Guard receivers on in order to monitor emergency transmissions from either the controller or the flight leader.

Commanders, Operations Officers and Flying Safety Officers can monitor their operations to insure that everything possible is done to make departures easier for aircrews. They can:

• Have the AO or operations dispatcher brief all outgoing pilots on the sequence of radio contacts expected during the departure and the expected frequencies for each controller. Many bases print this information on the reverse side of the Form 175 and it should always be available in the SID booklet.

• Coordinate with controlling agencies (tower, departure control, center) to see if any existing frequency changes can be eliminated or simplified. At bases where traffic is generally light, clearances, taxi and takeoff instructions might all be given on one frequency.

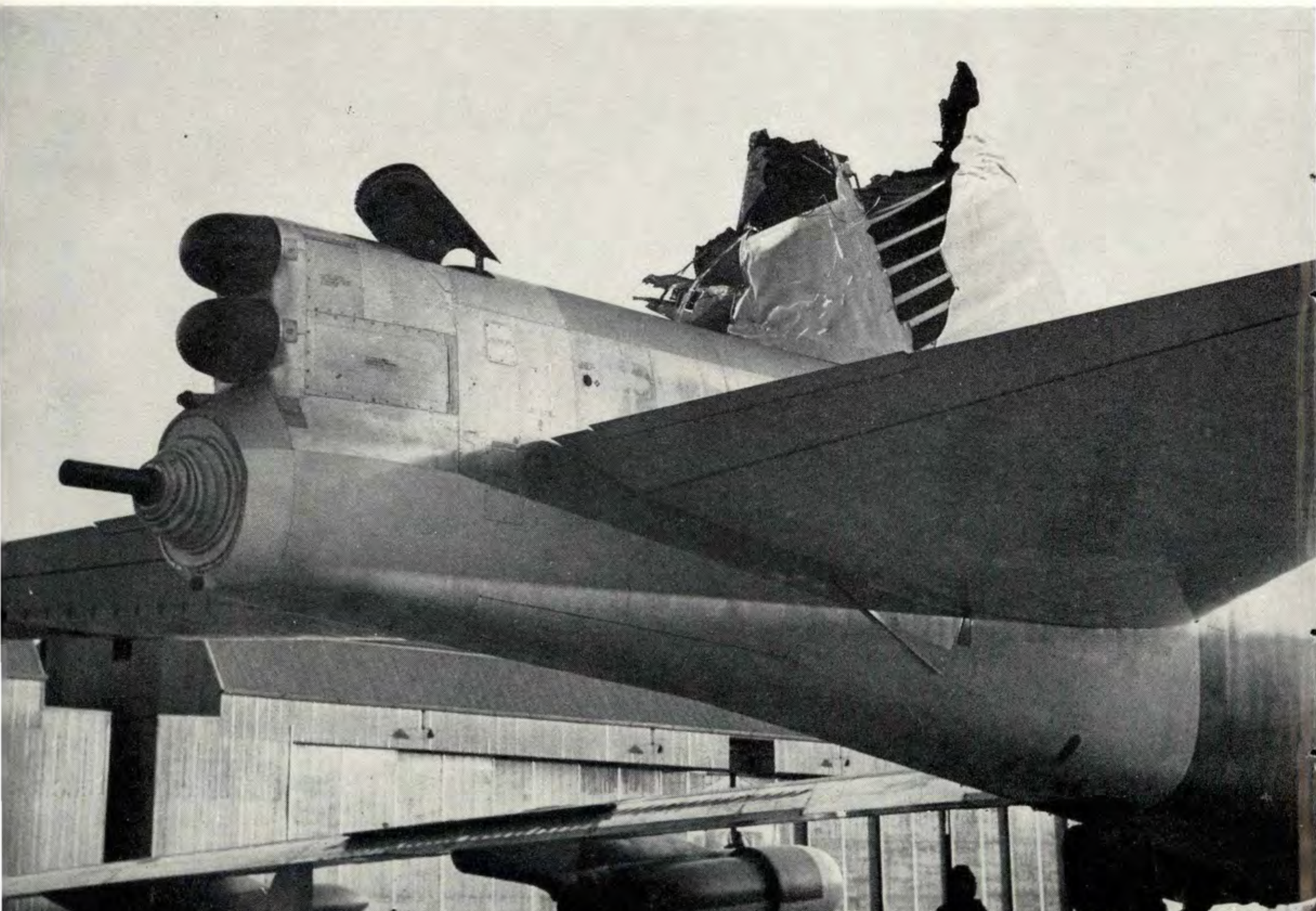
• If it is necessary for departing aircraft to contact departure control immediately after takeoff, have the pilots switch to departure control frequency before they start takeoff roll. They can monitor Guard for emergency instructions from the tower. This will eliminate one frequency change in a critical phase of flight.

• In some cases UHF frequencies can be made compatible to the point that a pilot has to change only one digit instead of four digits when changing frequencies (i.e., 285.6 to 285.7 or 286.6).

These are just some of the ways that IFR departures may be made easier. Some Air Force bases use all of them and most bases incorporate at least some of them in their departure procedures. But there are still some bases where a pilot is unduly taxed and edged toward an accident while making an IFR departure.

With the help of everyone concerned maybe we can keep the aluminum out of the tree tops during departures. ☆

something missing



Those who fly in Air Force aircraft owe much to the men behind the scenes—the designers and builders of those aircraft and to the men who push these machines to the limits of their design in the test programs. Testing is not confined to acceptance testing but continues on through the life span of the aircraft to determine ways of making it safer and to improve its mission performance.

On January 10 a Boeing test crew flying a B-52 was carrying out such tests when the aircraft was subjected to overstress induced by severe turbulence. The crew's reaction, the tremendous support from men on the ground and in the air, not only makes a fascinating story but demonstrates the ability of this aircraft to fly even with serious structural damage.

The narrative consists mainly of the account of the senior test pilot aboard, with added comments by the navigator and with a minimum of editorial assistance to provide continuity.

The story begins with the crew flying a highly instrumented B-52H to obtain dynamic structural load data on a low level mission in the mountains of Colorado.

Prior to the incident all aspects of the flight were normal in accordance with the mission profile, until turbulence caused the crew to curtail low level flight. The aircraft was then climbed to a higher altitude where the air was smooth. Then, in the words of instructor pilot Chuck Fisher,

"This is a real rough portion of the route in that it's a north track on the east slope of the Sangre de Cristo Mountains. Our experience has shown the prevailing westerly winds make it more susceptible than other routes to low altitude turbulence from high surface winds or mountain wave effects. When we abandoned the low level contour portion of the flight we pulled up to an altitude of about 14,000. Dick Curry *(test pilot, Richard Curry, in the left seat)* was flying the airplane and I was calling the signals when we ran into some real smooth air. In fact, it was so smooth as to be of no use from the loads survey standpoint. We elected, since we were going to overfly the low level course at this intermediate altitude, to run through the 350 knot condition at 14,000 feet altitude.

"From this relatively smooth air we hit what I would term near catastrophic turbulence.

"The encounter was very sudden and lasted only about five seconds. *(The data showed 9.6 seconds.)* I earlier estimated three seconds, but after talking it over with the crew we decided it was longer. During the first part of the encounter, the airplane appeared to be stable in that it wasn't moving in roll nor particularly in yaw and there wasn't anything on the instruments that would indicate anything more than normal excursions. As the encounter progressed we received a very sharp edged blow which was followed by many more. As the first sharp edged encounter started bleeding off we developed an almost instantaneous rate of roll at fairly high rate. The roll was to the far left and the nose was swinging up and to the right at a rapid rate. Immediately I reduced power to idle and the airplane started rotating nose-down at the same time.

"During the second portion of the encounter the airplane motions actually seemed to be negating my control inputs. I had the rudder to the firewall, the column in my lap, and full wheel and I wasn't having any luck righting the airplane. I applied airbrakes. In the short period between the first and second encounters, I gave the order to prepare to abandon the airplane because I didn't think we were going to keep it together. By the time we got through the second portion of the encounter I was sure that we had lost the rest of the airplane and we were in the 41 Station by ourselves, because nothing seemed to be working. Well, that's not true, either. The airplane didn't want to climb and power seemed to aggravate the lat-

Boeing crew who successfully landed disabled aircraft, top to bottom, Instructor Pilot Chuck Fisher, Pilot Dick Curry, Navigator Jim Pittman, Copilot Lee Coers.

eral directional oscillations. The roll authority available was exceeded actually by certain combinations of power and motion. We had a certain cyclical motion going also, so I was hesitant about aggravating this motion with thrust. It required about 80 per cent left wheel throw to control the aircraft by this time. We got down to about 250 knots quite rapidly and then continued on down to 225 knots. I shoved Curry the checklist and he looked up the minimum recommended flaps-up, and we figured to stay at least 30 knots over this. This was 310 KIAS so we further reduced our speed. I couldn't get the airplane to climb or turn to the right. We were heading north and wanted to go east. We worked around there eventually. We were getting some kind of blanking effect on the controls making a right turn difficult. This right turn actually turned out to be the poorest way to go. We would have been better off with a 270 to the left. I lowered the airbrakes to position one because of the limited amount of power I was using. This seemed to relieve the situation and was better than what I had used for recovery as far as controlling the aircraft. It still required 40 to 50 per cent of wheel throw to hold the wings level.

"At this time we had everybody in the seats. Our absolute over the ground was down to about 5000 or 6000 feet, and we needed a little altitude. So we climbed up—slowly up to 16. In the meantime we went to Guard and talked to Trinidad Radio. They vectored a B-52 in our direction. It was Firm 13. They were on an RBS run with 150 seconds to go and they broke off and came over. *(Firm 13, a SAC aircraft, assessed turbulence at different altitudes and advised that there was no turbulence at 10,000 feet. The aircraft then descended to that altitude.)* We never did rendezvous with them but we really appreciated their help: the information they furnished on the absence of turbulence at the lower altitudes since we were encountering light to moderate at our altitude. We felt we couldn't tolerate any with our control problems. Finally the pitch response of the airplane seemed to improve except for minor excursions. We would be in good shape and be holding 210 knots and the airplane would pitch or it would tuck in response to control. When this occurred control was very marginal. We still didn't know exactly what was wrong. We kept trying to figure out some reason for our control problem; we had all eight engines and all leading edge structure. We had everything we could see. We came to the conclusion that we had really ripped up the tail; and because of the continuous change of feel and vibration on the airplane we didn't hold out for much hope of getting it in a landable condition. But we headed for Wichita.

(Help appeared in the form of radar following by Denver Center and an F-100 flown by Boeing Chief Experimental Test Pilot Dale Felix who assessed the damage and reported it to the crew.)

"As soon as we got into a range where we could rendezvous with a Boeing-Wichita airplane, Dale Felix came up in a fighter and reported our damage. Dale informed us that most of the vertical fin was gone but the horizontal stabilizer was intact. We were relieved to know that we still had an operable stabilizer and to know that we also had at least one elevator that was in good working condition. There was no other observable damage to the empennage and all we really had to contend with was the asymmetrical yaw contribution of the remaining stub of the vertical stabilizer.

"During the three-hour burndown period, while orbiting the local area, we performed stability and control checks. Control of the aircraft even in optimum configuration was extremely difficult; but we felt that adequate margin would be available to land the aircraft under ideal conditions. Due to unfavorable surface winds, turbulence, and populated approaches at Wichita, it was decided to land at Blytheville. All of these conditions were considered favorable there. A final flaps-up landing configuration was determined to be most suitable because of

With most of vertical stabilizer gone, B-52 was landed at Blytheville, Ark. Outstanding support by men on the ground and in the air contributed to safe landing.

the higher approach and touchdown speeds. Of primary importance was the lateral directional instability present in the aircraft. We did go to 40 degrees on the outboards and the airplane then was power trimmable in that we could set up zero sideslip and fly the airplane. However, this wasn't too comfortable because, as Jack *(Chief of Flight Test, Jack Funk)* pointed out on one radio transmission, there would be very little damping for the near zero sideslip angles. We discovered that the lateral directional stability margin was aided if the aircraft was flown in a slight sideslip and that oscillations could be minimized by some small sideslip angle. We accomplished this by decreasing very slightly the power on engines 7 and 8. Flying with outboard airbrakes set at the number four position increased the directional stability.

"An aft C.G. was severely destabilizing the aircraft, and we found that a forward shift of C G. was advantageous in assuming a better lateral directional control condition. This was confirmed by Boeing Engineering, and we moved the C.G. forward to about 21 per cent MAC. The shift was accomplished by transferring and burning out fuel from the aft body tanks and 1 and 4 mains. Outboard airbrakes aided the control problem since these airbrakes are aft of the center of gravity. All these steps made the aircraft more stable, and airspeed was maintained at 210 KIAS. It was further decided by all technical advisors and ourselves that it would be best to lower the aft gear to improve lateral directional stability.

"We proceeded to Blytheville with the T-33 and KC-135 escorting us. *(Captain Samuel Kishline of the Boeing-Wichita AFPRO flew the T-Bird. The KC-135, with engineers was flown by James Adams of Boeing.)* Prior to our flight down there a B-52, flown by Major Fred Saunders and Captain Mert Baker, made a trial run at the altitude block we had been using to check the turbulence levels. Turbulence appeared non-existent.

"Arriving at Blytheville we lowered the rest of the gear. The front main gear made flying kind of tricky when it came down and we got several yaw excursions, but only during the transition up to down. Once it was down we were in real good shape. We still had to hold left wheel throw for wings level and if we tried to turn to the right the airplane would yaw quite severely to the left. I had the feeling that if you got the right wing down, the tail would just fall down the bank angle, so to speak. When turning to the left the airplane would also yaw to the left, however the excursion and sideslip was not as great as it was in the right bank. This phenomenon made the right turns real hairy because you would have to actually go to a pretty steep bank angle to get an appreciable right turn. We ran several checks before landing. Ray McPherson and Ted Slack were aboard the KC-135 and helped with the gross weight and C.G. Steve Starch calculated our 40-degree outboard contribution for body angles so that we wouldn't over-rotate on touchdown. We had good support all the way to touchdown.

"After we ran the checks I notified the people and they were satisfied, so we set up a wide pattern to Runway 17 at the base. We checked the steering and had a normal indication. The landing was not my best one, but the airplane was drifting left off the runway and the only way to stop it was to get it on the ground. Curry actuated number six on touchdown and we popped the chute at 130. Our weight at touchdown was 250,000 pounds. We touched down at 158 knots on my indicator. The calculated stopping distance was 5000 feet, that's with no chute, and we didn't have any problem whatsoever being ready to turn off at the first intersection."

(Navigator James Pittman now gives an account of the severity of the turbulence encountered.)

"I had been out of my seat prior to the occurrence and I sat back down while we were climbing. When this event occurred I was preparing to make an AUTO FIX with the BNS system and it was so violent that I was literally picked up and thrown against the left side of the airplane and forward up over the nav table. The winds just prior to the strike, although we were smooth, were building up and to the best of my ability to recollect, were in the vicinity of 65 knots out of the west and about 27 knots out of the south. The impression I got was that somebody reached down and took ahold of the airplane and was shaking it."

The aircraft, which was highly instrumented, was struck by severe clear air turbulence of mountain wave origin. Data are being analyzed to determine the true magnitude of the gust strike.

This incident, hazardous as it was, will pay off many times in the knowledge gained. It also points to the fact that we still do not really know the magnitude of the forces with which nature so often confronts us —a reason for scientific testing, as was being done on this flight. ☆

PROPELLERS

When the Wright Brothers made their first powered flight at Kitty Hawk they obtained thrust from propeller blades. Sixty years later the Air Force still operates over 5000 propeller-driven aircraft. Despite all this experience, propeller malfunctions continue to occur. In some cases these malfunctions are of such magnitude they can literally tear prop assemblies apart, ripping away nose sections of engines and slicing into wings and fuselages.

Not in all cases, but usually, there is an emergency procedure that permits the aircrew to control the prop in such a way that a safe landing can be made. It is because of the seriousness of some propeller malfunctions, more than the frequency, that this article has been prepared. It is an attempt to trace propeller development and problems and present the best information available on dealing with propeller problems.

To recap, briefly, the first propellers were made from one piece of wood. The blades were carved in such a way that each presented the same airfoil as the prop turned about the hub. The prop was fastened to the engine drive shaft, either directly or through a gear and shaft arrangement. When power was applied the propeller literally screwed (propellers are still called *airscrews* by the British) its way through the air, dragging or pushing the aircraft along.

These early wooden props were made in different shapes; some were laminated and some sported metal caps along the leading edge. Actually, they were also quite trouble-free, as long as they were in balance, made of good sound wood and the tips didn't strike obstructions on the rough landing fields.

Durability was increased further when metal props were developed. This period, from a reliability standpoint, was probably the safest period insofar as propellers are concerned.

These fixed pitch propellers were a compromise. The blade angle had to be flat enough to allow the engine to be revved up to full speed for takeoff, yet there also had to be enough bite left to produce a reasonable cruising speed at reduced power during level flight. (Fig. 1)

A tremendous increase in efficiency would result if a variable pitch prop could be devised—low pitch for takeoff and climb, a higher pitch for cruise. Such a propeller was devised. (Fig. 2) It worked fine, but added to the complexity in the cockpit. There had to be a prop control. And now some new prop malfunctions were encountered. Sometimes the prop would overspeed, causing engine RPM to exceed limits. Slight overspeeding became common, especially during stalls or other low-airload maneuvers, particularly if power were applied at the time. (Fig. 3)

One of the next developments was feathering capability. When malfunctions occur, either to prop or engine, if the engine can be shut down and the prop blades angled into the airstream until ram air forces on both sides of the blade are equal, rotation of prop and engine will cease and drag will be at a minimum. Full feathering propellers were devised. (Fig. 4)

For discussion of engine failure we should consider that there are two types of reciprocating engine propellers used by the Air Force. These are identified as (a) those which use the engine oil for propeller control (C-118, C-54, etc.) and (b) those which use their own independent oil system (K/C-97, C-119, SA-16). If an engine failure should occur with the (a) configuration, two possibilities exist:

(1) If the engine oil supply to the propeller governor remains available and uncontaminated the propeller will continue to govern at whatever RPM the pilot has selected.

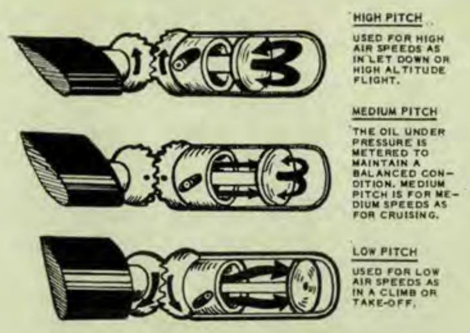
(2) If the engine oil supply to the governor is blocked or contaminated the propeller governor will probably lose control resulting in the blades moving to the low pitch stop. If the propeller incorporates a pitch lock the blades will lock pitch at the blade angle which produces the overspeed setting of the pitch lock system. The ability to feather for possibility (1) is very probable. For possibility (2) it is possible depending on degree of contamination and oil available to the feathering pump. In both of the above possibilities for propeller configuration (a) there will be drag, however, a potential runaway exists only for possibility (2).

If an engine failure should occur with the (b) propeller configuration the propeller will continue to govern normally at whatever RPM is selected by the pilot. The propeller can be feathered. There will, of course, be drag because the propeller is absorbing energy from the airstream.

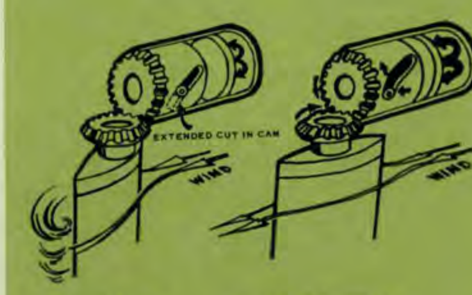
Should the prop stop, as could occur if the engine

An early vintage fighter sports a fixed pitch wood propeller; simple, but most inefficient by today's standards.

Fixed Pitch Prop



Variable Pitch Prop



Prop Feathering

bearings freeze, drag would be further increased. Each molecule of air is deflected less in getting by a moving blade than a frozen blade. Drag of both turning and frozen propellers is less at higher blade angles, but, of course, a prop must be at a low blade angle to overspeed. There is a cross-over point for drag of a rotating propeller versus a frozen propeller, however, this cannot be generalized by calling out specific blade angles as there is too great a difference in the method of specifying blade angles among different propeller blade designs.

With increases in aircraft speeds, cruising altitudes and use of variable pitch propellers, overspeeding when the aircraft was being operated at high altitudes and speeds posed an increasingly greater threat to safety.

As aircraft became faster and heavier it was reasoned that, if the prop blades could be turned through flat pitch and to a reverse angle and power applied, this procedure would aid in stopping the aircraft after landing or in case of a takeoff abort.

Reversible props were next. (Fig. 5) Now the blade angle range had been extended from full feather to reverse. Excellent, performancewise, but more malfunction headaches. When propeller control was lost the blade angle would usually go to normal low pitch, but sometimes below. If the blade angle flatted to low pitch and no prop control could be regained it might not be possible to keep the crippled airplane from turning into this prop or keep the prop within maximum RPM limits.

In all Hamilton Standard propellers the low pitch stop is the only mechanical stop other than the full feather and the full reverse stops. In the turbine engine propellers there is also the mechanical pitch lock which engages as a function of RPM somewhere above the low pitch stop and feather blade angle. The low pitch stop is not necessarily above frozen/windmilling drag crossover point for all installations.

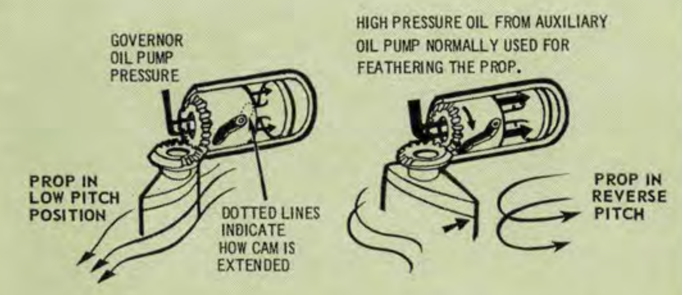
In addition, and as a measure to prevent inflight reversals, various throttle pedestal safeguards were installed. A common design practice is to require the operator to manually move a reverse lock device to energize the reversing mechanism. Most installations are also inoperative until the weight of the aircraft closes a microswitch on a main gear.

In later model recip aircraft and in turboprop aircraft power plants became more powerful and prop size had to be increased to handle the torque output of the engine. Now, due to prop size, higher altitudes and higher airspeeds it became necessary to add another safeguard. Something had to be done to prevent the uncontrolled, high speed runaway. If not, the prop would tear itself free, possibly ripping a wing loose, before the aircrew could take effective action to bring the emergency under control.

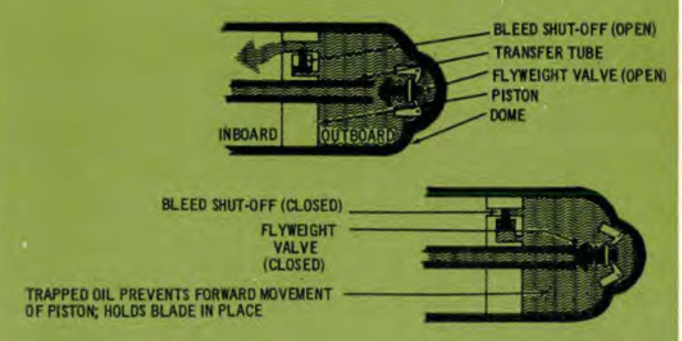
This led to the mechanical pitch lock. With this system, when normal prop governing fails and the prop tends to go toward flat pitch and overspeed, there is a device that senses the overspeed and automatically locks the prop in whatever position it has reached (just a few degrees blow its normal setting). When this happens RPM is controlled with the throttle—forward more power and higher RPM; back, less power and lower RPM. In this condition the pilot is back in the fixed pitch configuration reminiscent of the Wright Brothers days. He has a livable situation that will permit him to reach a lower true airspeed (lower altitude and indicated airspeed) and a suitable landing field. Normally the procedure is then to feather the prop and land. Should prop control be completely lost during the process, true airspeed will be low enough (unless the aircraft is extremely heavy) to permit the propeller to rotate at less-than-destruct speed.

Before attempting to detail common prop problems and what to do about them, a differentiation should be made between overspeeds and runaways.

Overspeeds are momentary surges in RPM, as can occur with rapid forward throttle movement during periods of relatively light airload, and possibly from momentary prop control adjustments. If the overspeeds are not pilot induced, or if they are and subsequent surges occur, they should always be written up in the 781-2 so



Prop Reversing



Pitch Lock

the system can be carefully and completely checked out by a propeller specialist.

A runaway is a condition in which RPM exceeds normal range limits and is not controllable by governor action. When a runaway is experienced there is always a high drag situation.

Following are some common principles—true of all propellers during a runaway condition:

• Windmilling speeds are directly proportional to true airspeeds and drag increases on the order of the square of the velocity. The lower and slower the aircraft can be flown, the lower the true airspeed and the drag.

• Once true airspeed is reduced to a minimum safe control margin above stall, runaway RPM will likely be within maximum RPM limits, especially if the propeller has pitch locked.

• If power is not required from the affected engine in order to maintain flight the prop should be feathered and the engine shut down.

• Very possibly, in the case of a true runaway, all control, *including feathering,* will be lost.

In critical flight situations (on takeoff) it is probable that some positive thrust can be realized by flying the aircraft at minimum safe control speed and adjusting the throttle to stablize RPM at max allowable limits. If some degree of positive thrust can be attained in this manner there is less danger of engine damage than when the propeller is driving the engine, as in a power off runaway condition.

A high-pitched, piercing whine will be very noticeable when a prop runs away. This sound alone is conducive to some degree of panic and thorough knowledge of all propeller malfunctions and what to do about them is the best insurance against hasty, but incorrect, actions at this time.

Unless structural concerns require (extreme vibration, loss of oil, fire or nose case discoloration from heat) or unless controlled flight cannot be maintained at low true airspeeds, *do not freeze the propeller.* If an uncontrollable propeller decouples it will be essentially unloaded and its RPM is limited only by its blade angle (pitch locked at a higher blade angle or on the low pitch stop) and aircraft true airspeed. Such resulting RPM could be high enough for the propeller to destroy itself. If freezing occurs abruptly the prop may leave the aircraft, striking the adjacent prop, the wing and the fuselage. (Should RPM gradually or sporadically reduce during this process, attempt to feather—turning moment forces may have been reduced enough for feathering pressures to be effective.)

If freezing is imminent, either intentional or otherwise, and flight conditions permit, consider feathering the propeller on the adjacent engine until freezing has occurred. If the adjacent engine and prop escape damage the engine can be restarted.

Summarizing, for reciprocating engine aircraft, here are procedures designated to counteract a runaway:

1. Slow down to minimum true airspeed.

2. If safe flight can be maintained, feather. If the propeller will not feather, then:

3. Check RPM. If the RPM is within maximum allowable limits, the propeller has either pitch locked or is against the low pitch stops.

4. Advance the throttle for the affected engine to not exceed maximum continuous allowable RPM (take off RPM for a short time if needed to climb over obstructions). A positive thrust condition (determinable from the torquemeter) will probably result.

5. Land at the nearest available field.

6. If level flight cannot be maintained under the above conditions and a crash landing is imminent, level the wings and comply with Dash One crash landing procedures. Reduction of power on the opposite side may be necessary to level the aircraft wings.

An article in a forthcoming issue will deal with turboprops. Because they must harness more power than the props on reciprocating engines, and are therefore more critical when prop control difficulties are experienced, they must receive special consideration. ☆

THE

It was when C. Z. Chumley bit down on the dry, hard piece of toast and recognized that horrible burned taste that he really went into a neighbor-waking tantrum. There is a limit. He had overcome the urge to throw a shoe at the rasping, insistent electric alarm clock that had tortuously pulled him from a sound sleep in the grey half-light of morning. He had managed to smother a kid-waking epithet when he had jammed his right index toe on the corner of the bed en route to the alarm clock. He had even managed to blind stagger his way to the linen closet in the hall when, after emerging from the shower, he had made the soapy-eyed discovery that there were no towels in the bathroom. Yup, he was getting in great shape for an early morning flight with a bunch of VIPs in the back and a new copilot at his side.

He turned to his curler-topped, shapeless-gowned ever-lovin' and stormed, "When'd 'ja put this toast in—last night!"

Mrs. Chum, not overjoyed at having to get breakfast at this hour anyway, simply slipped a fresh piece of bread in the toaster. Her version was not "ever-lovin'," it was "ever-sufferin'."

"Don't'cha remember that safety meeting for the wives when they told you how important it is for a pilot to have a good healthy breakfast and start out on a flight all relaxed and happy?" her husband asked through a mouthful of soft scrambled.

Not that again, Mrs. Chumley thought, but she resisted the temptation to make an acid comment on how she had spent a night next to the snoring champion of the Air Force. "Yes, Dear," she said. She had long since made the evaluation that, next to "Yes, sir," there was nothing that sounded better to her Air Force officer than, "Yes, Dear!"

Fed, coffee'd and dutifully lip pecked, Chum's ever-sufferin' got him out of the house on time. Some-

EVER-SUFFERIN'

day though, she promised herself, she was gonna tell him. She'd trade him for that cushy job where he even has a guy to pull up the wheels, do all the navigating and radio calling while he sits there and steers. Let him whip up breakfast at 0400 sometime, especially for an unappreciative mate who goes through the meal with triple threat monotony—grunts, grumbles and morning paper reading. She'd have him get up three times in the night to let the dog out, and three more times to let the miserable mutt back in. She'd let him worry with a youngster with a bellyache. Then, when he was in bed, she'd keep him from going to sleep by having him be committee chairman and do some desperate thinking on how to decorate the club for the next wives' luncheon. But for now—and when she heard the familiar snarl of the Jag's exhaust as The Great One upshifted his way out of the Capehart area—she slid into an ungainly sprawl in a kitchen chair and took the first leisurely sip of a half-cup of coffee.

And when she went back to bed she couldn't rest. She had let herself become worked up over the subject of Air Force wives' inequities, and suffered a terrible nightmare:

She had on some sort of strange, filmy robe, and she stood behind a pulpit sort of arrangement. She was making a pitch; the surroundings were unfamiliar, but the speech seemed perfectly natural. Her audience, too, was as it should be—aircrew members.

"One thing," she was saying, "most of the rules you go by were made up by a bunch of military pilots who wanted their cake and wanted to eat it too. For instance," and there was considerable fervor in her voice, "you think you can drink and mistreat yourselves all week, then the night before you go on a flight you lay off the booze and go to bed early. Does that few hours completely refurbish the old body? Not on your life." She pounded the lectern with each word. "If you'd reverse the procedure—live like boy scouts six days of the week, then have that martini or two before dinner on Saturday night, you'd be much better off. You might then be as robust as you like to think you are.

" 'Nother point." It seemed like she glanced at a note, but that would be ridiculous. She didn't need any notes for this. "You have a lot of pride as to your physical prowess; and that's about all it is—pride. For five days you are so weary you have to ride the elevator to go a single flight of stairs, you wouldn't think of walking two blocks to work, you're so tired that at night it's all you can do to drag yourselves from the TV couch to the bed, then;" she paused, sweeping her audience with scorn, "comes Saturday. All at once you are berserk dynamos. All week your wives have had to coddle, plead, beg, threaten and shake to get you out of bed at seven. Now, at five o'clock you are bounding around, singing off key in the shower and hunting in all your drawers for things you dropped all over the house last Saturday. You can't understand why the little woman isn't overjoyed to be bustling around in the kitchen fixing you a mammoth breakfast that will last you through eighteen strenuous holes of golf."

She was in full cry now—the urgings of years finally coming to the fore. "You racket around, waking the kids, getting the dogs excited, torturing your poor wives; then, when you've accomplished all this, you happily tear off to the links. There you flail away at defenseless little balls, drag unoiled carts up and down hills, sweating miserably and puffing mightily because of the years' old cigarette habit and the oversized midriff."

Mrs. Chumley shook her head as in disbelief, then continued. "You suffer in pleasure, telling yourselves how good all this exercise is for you and, in your mind's eye, picturing yourselves as budding Palmers. You become more and more mentally maladjusted as the morning wears on, due to unjustified ill fortune that deals you bad shots frequently." She paused and took a drink of water to settle herself before proceeding.

"Saturday afternoon then, after a morning of exertion, you cry like wounded bears if your ever-sufferin' asks you to do some monumental task—raise your feet while she sweeps, f'rinstance.

"One thing all wives agree on—I've attended enough wives' luncheons to be certain of this—the only sure way to keep you even semi-civil is to have plenty of beer in the refrigerator and a football game on TV."

Mrs. C. paused, sweeping her audience with frigid eyes. Many, she noted, were squirming.

"Let's go on. Our fervent hope is that you will do what comes naturally—fall asleep in your oversized, overstuffed, tilt back ottoman. 'Guardians of the peace' doesn't apply to you alone—it applies to the wives who keep the offspring out of doors and out of earshot on Saturday afternoons."

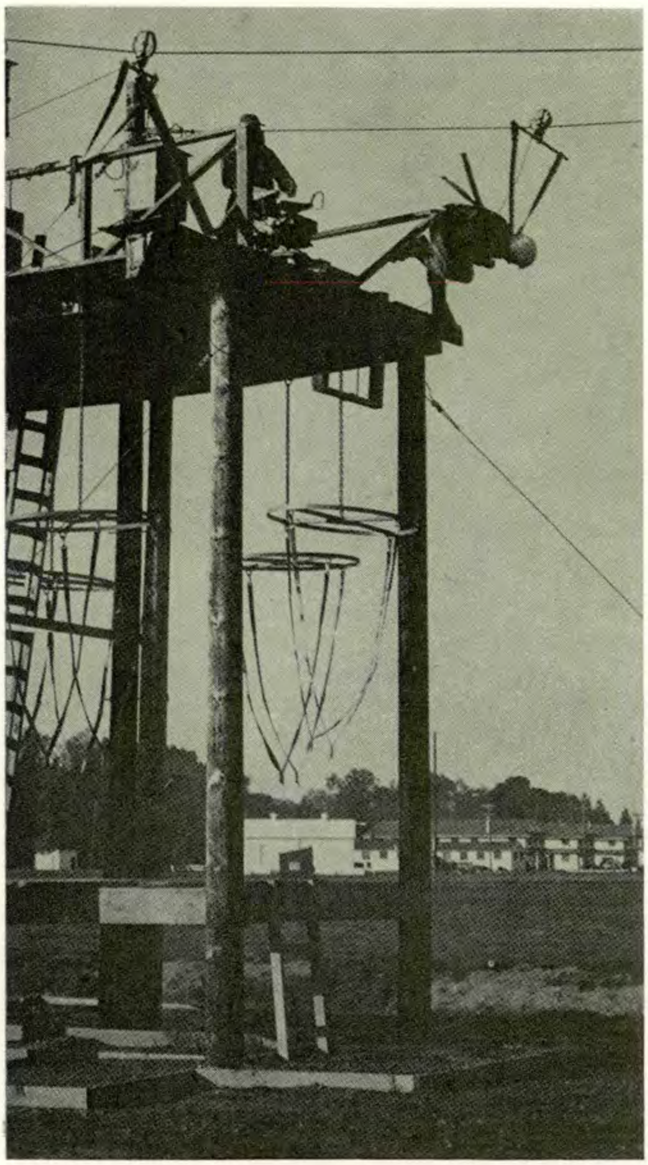
She thought she caught a question, and tilted her head to hear better before replying. "What's all this got to do with accident prevention? More than you think. Wives might just be the best safety officers in the Air Force. The housewife is the only specialist in the world who has the patience, the fortitude and the raw courage to, weekend after weekend, ride herd on the prides of the Air Force and turn them back again Monday morning, blue-suited and flyable."

She paused and looked at her audience. "Questions . . . any questions?"

The last words were clearly audible and they jarred Mrs. C. back toward the reality of the kitchen and the smell of burning toast. A small, half-awake voice completed the transition for her.

"Mommy, Mommy—I got a question. When's breakfast? I'm hungry." ☆

"Be afraid, gentlemen, it's a natural reaction," is advice of MSgt Anthony Martino, NCOIC, Hamilton survival school. Below, student "ejects" from 20-foot jump tower during training. Course includes practice sessions in helicopter pick-up and correct landing procedures. Students, all veteran pilots and radar observers, are from 25th and 28th Air Divisions. (USAF Photos by TSgt Dave Mayhew.)



TRAINED

Pilots reporting to the 28th Air Division Survival School at Hamilton AFB take a look at some of the equipment that is used in their training and begin to wish they were somewhere else. But after it's all over they are glad they stuck around for the whole course.

The school is operated by a trio of sergeants who have a total of more than 40 years of parachuting experience. The boss is MSgt Anthony Martino who has spent 10 of his 12 years in the Air Force in rescue and survival work. Assisting him are TSgt Tommy Cox and SSgt Noel Crowson.

SSgt Lerc

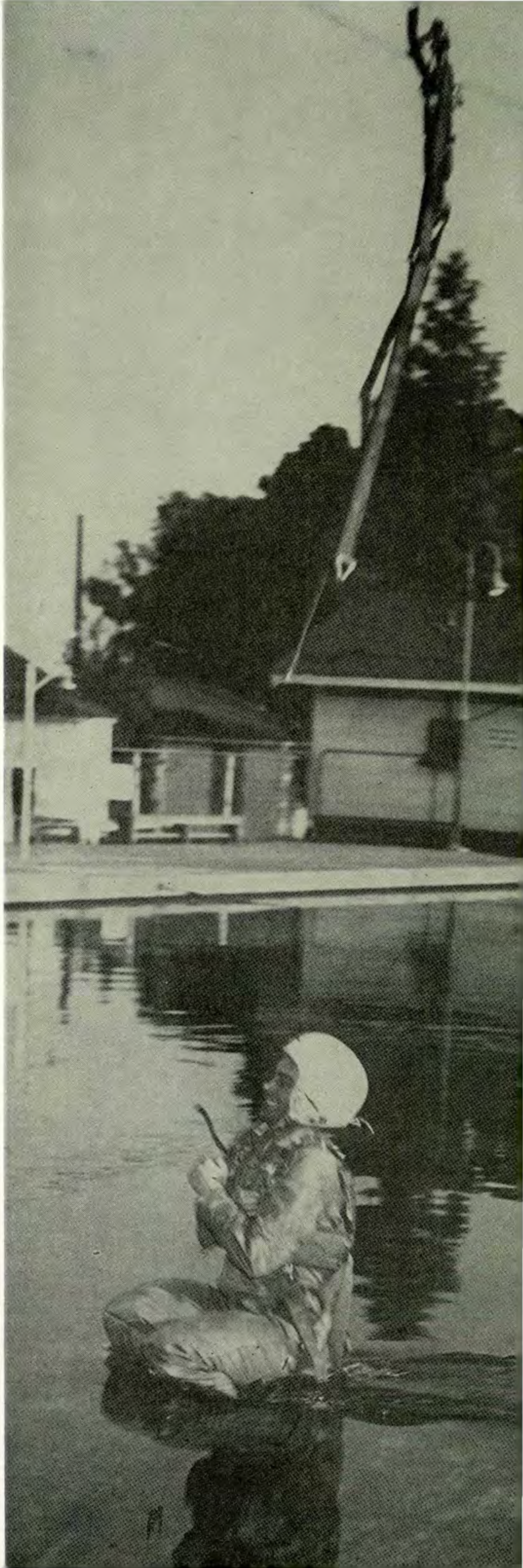
Above, left, HIT THE DIRT! Student learns how to land and roll, following emergency bailout. Training is conducted off 4-foot platform into sawdust pit. Above right, BLAST MACHINE—a converted Swamp Glider—is used primarily to give students effect of being dragged when landing after emergency ejection.

TO LIVE

Packed into the one-day school is training on ejection procedures (descent and landing techniques) as well as water survival. The school is fast, thorough and rough. Its effectiveness is testified to by aircrews that have had to eject from their aircraft. One pilot put it this way: "Because of this training, I was extremely well prepared for all phases of the ejection sequence and subsequent descent and landing. All flying organizations would benefit greatly from a similar program."

The pictures on these two pages illustrate equipment and methods used at the school.

y S. Ray, Survival School, Hamilton AFB, Calif



Above, water survival instructions are pointed out by TSgt Tommy Cox. Life rafts are boarded after students are dropped into water from a 16-foot tower, inflating life preservers upon impact. Right, GERONIMO! Pilot grimaces just before getting full impact of a 16-foot drop into 10 feet of chilly water.

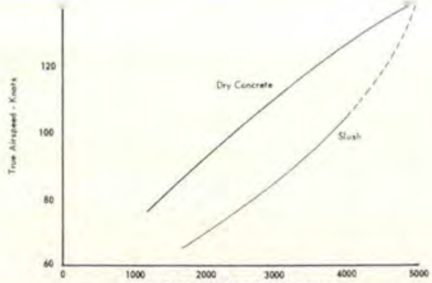


Figure 1 - Comparison of Stopping Distances for Slush and Dry Concrete

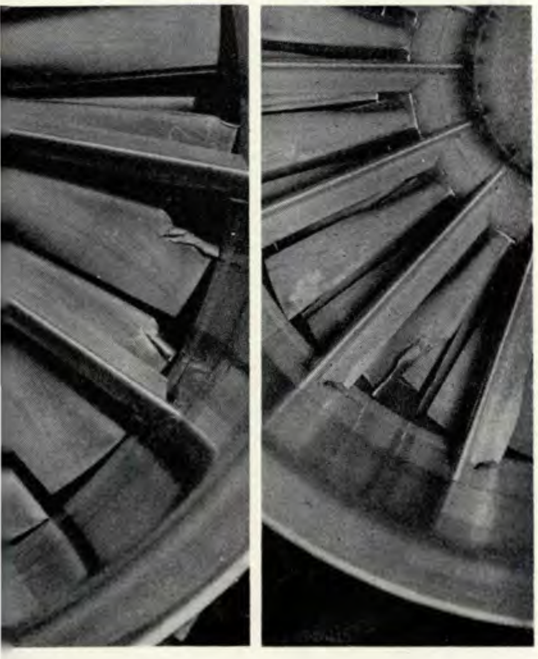
Tire damage caused by locking wheel during braking run on slush.

Testing the Talon

Larry A. Roberts, Directorate of Flight Test Operations, ASD

Above photo shows dents in the bottom of left flap caused by slush thrown from main gear.

Below, ice ingestion damage to left and right engines.

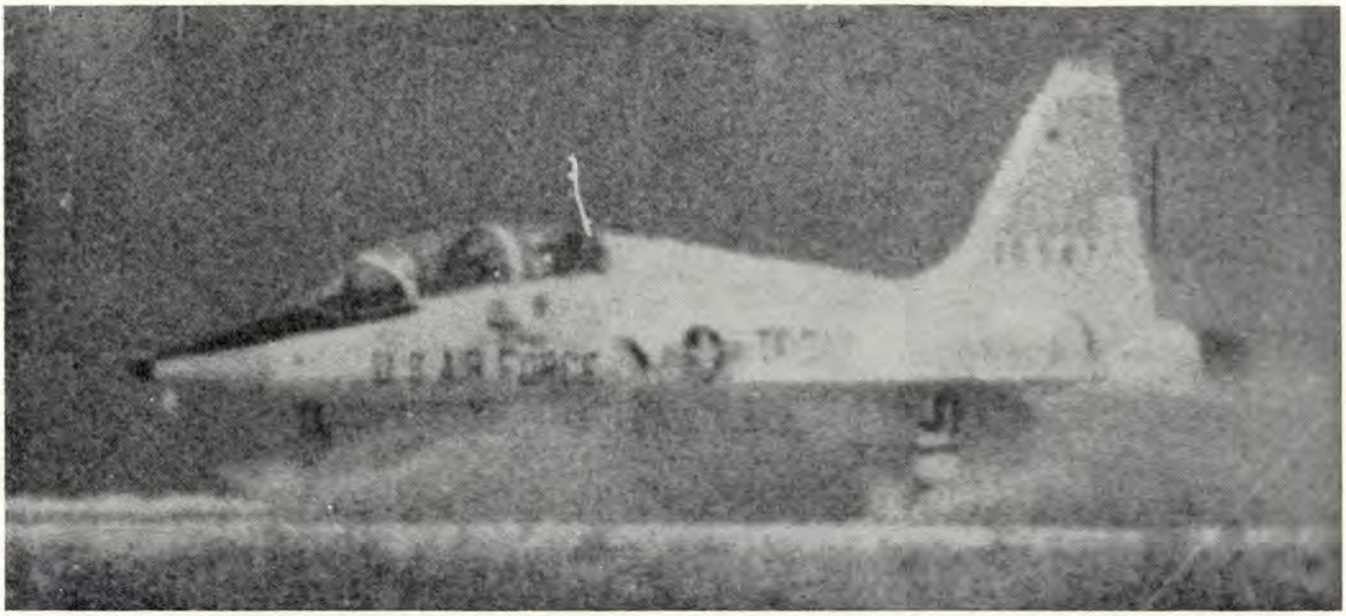


In order to determine stopping and handling characteristics of the T-38 trainer on various types of slick runway surfaces, the Aeronautical Systems Division's Deputy for Flight Test ran a series of tests with a Talon at Wright-Patterson AFB, Ohio, and in the surrounding area.

Taxi runs at speeds up to 120 KIAS, made at one of the test sites, yielded operational data of particular interest to a pilot faced with the necessity of landing on a slush covered runway. The runway was covered with a layer of slush approximately one and one-half inches deep, on the average, and characteristically varying in density and composition from place to place.

The directional control of the Talon, on slush, is marginal. Differential drag, caused by one wheel rolling through a deeper puddle than the other, etc., creates a considerable workload for a pilot as he fights to counteract the resulting yaw. This situation is further aggravated by slush, sprayed from the wheels, impinging on the flaps and airframe. The inboard half of the spray pattern from each main wheel strikes the outboard end of the flap and the subsequent Newtonian reaction generates the maximum possible yawing moment. Above 70 KIAS the rudder is the best means of maintaining directional control.

A comparison of the Talon's stopping capabilities on slush and on dry concrete is contained in Fig. 1. The curve for stopping distance on dry concrete is conventional in shape and conforms to theory. The curve for stopping distance on slush, however, exhibits some interesting differences, the greatest of which is the concavity upward rather than downward. The reason for this is that slush drag, like aerodynamic drag, is proportional to the square of the velocity. Therefore, the retarding force exerted on the wheels by the slush increases exponentially with increasing speed. In other words, slush drag at 100 knots is four times greater than it is at 50 knots because doubling the velocity increases the drag by a factor of four. Consequently, rollout distance does not increase in proportion to increasing speed. If the possibility of hydrodynamic planing is neglected and the slush curve is extended to 140 knots according to its established trend (see dotted portion of curve in Fig. 1), it would intersect the dry concrete curve. Thus, from touchdown speeds, rollout distances on slush might com-



Slush sprays from wheels during a taxi run. Spray from nosewheel is reaching engine ducts.

pare very favorably with those for a dry runway.

The maximum speed reached during the test was 120 knots and no noticeable planing occurred. Apparently, the small footprint of the tires enables them to cut through almost any surface covering but ice. It is not known at what speed the T-38 will begin to plane, or if it will plane at velocities below takeoff speed. However, the landing speed envelope extends from 120 to 140 KIAS and if the planing speed of the aircraft is above the touchdown speed for a particular landing condition, certain adverse circumstances might result on landing. For instance, a large downward pitching moment might develop as the main wheels settle into the slush, or the gear might be damaged by the sudden application of high retarding forces on touchdown. These things would depend on the depth of the slush and the gross weight of the aircraft. At present there is insufficient data to make a judgment regarding operation in this region, but hazards may exist.

Tire damage, such as that shown in Fig. 2, can result from locking the wheel brakes during landing rolls on slush. The pilot has very little "feel" of the brakes on a slick surface and the wheels can be locked very easily. Even momentary skids can result in serious "ice burns" and possibly even blowouts.

Flap damage can also result from operation on slush (Fig. 3). The flaps are honeycomb structures and slush, sprayed from the main wheels, can dent them very easily. No other airframe damage was observed during the test.

The most serious problem encountered was that of engine ice ingestion. At speeds of 40 knots and above, slush, sprayed from the nose wheel, was slinging high enough to enter the engine ducts (Fig. 4). Some of this slush was impinging on the inside walls of the ducts and freezing. Finally, after several runs, the accumulation of ice was sufficiently large and, when broken loose by vibration, aerodynamic forces, etc., entered the engines. As the ice entered the first compressor stages the blades, because of their pitch, deflected forward and struck the trailing edges of the inlet guide vanes. The resulting damage is shown in Figs. 5 and 6. A piece of metal tore out of one of the blades of the left engine (Fig. 6) and ingested also, causing extensive damage to other blades throughout the compressor section.

A similar situation occurred during a test in 1959. A T-38 was taxiing in slush six to eight inches deep. It reached a speed of about 50 knots. The engines were ingesting slush in such large quantities that they flamed out before the run could be completed. Both compressors were badly damaged.

The results of this test gave a definite indication of problems which would be attendant to T-38 operation on slush covered surfaces. These problems might be more or less acute as the slush depth increases or decreases. To summarize, from touchdown speeds, tests on a runway covered with slush one and one-half inches deep showed that:

a. Directional control can be maintained but it is marginal.

b. Stopping distances compare favorably with those for dry runways.

c. Tire damage from skidding is a definite hazard if wheel brakes are locked during the rollout.

d. Flap damage from impinging slush will result.

e. Engine ice ingestion is a virtual certainty and compressor damage is highly probable.

Operation of the T-38 on slush seems inadvisable on the basis of items c through e. ☆

The successful demonstration of heavier than air flight at Kittyhawk was a long way from the aviation world of today and many painful lessons had to be learned. The path of the history of flight is marked by broken machinery and aviator's heads. The possibilities of space flight have already been demonstrated and there is little doubt that the future will see a growth in the use of space flight to rival that of the aircraft. The challenge facing those currently involved in manned space programs is to advance space technology without reliving those painful lessons.

It is something of a surprise to many that we in the Air Force are directly involved in the Gemini program. Although NASA has the overall management of Gemini, the Air Force is responsible for the engineering and procurement of the launch vehicle, activation of the launch complex and for providing the launch services at Cape Kennedy.

The basic launch vehicle is a Titan II, an operational weapon system in the Air Force arsenal. But while the Titan II has the performance potential to lift the two man spacecraft, the design criteria for a weapon system are quite different from that for a manned booster.

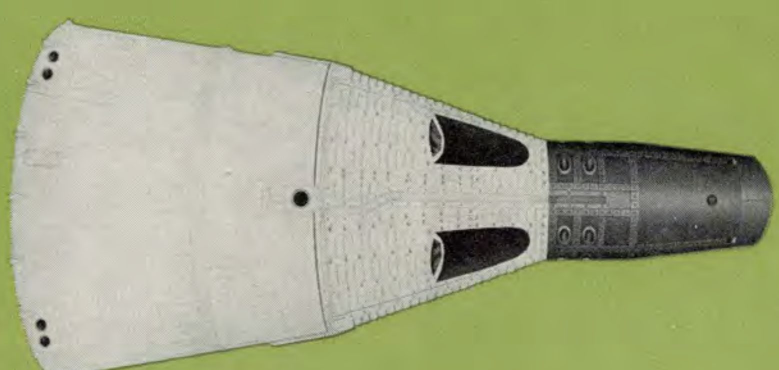
A common misconception is that all that is required to convert a basic Titan II to a Gemini launch vehicle is to make up a cockpit of sorts, complete with oxygen mask and seat belt and bolt it on. Unfortunately, it just isn't so.

There is little question that the mission requires 100 per cent reliability. But over 50 years of flying experience has taught us that such a goal will not be achieved in the foreseeable future. What we are trying to do is to raise the reliability through every practical means to a maximum and then bridge the remaining gap with a system that will detect a malfunction and allow safe escape by the astronauts.

The "man rating" of the booster is not a new technique. It follows the basic pattern used for the Mercury Project with additional elements which evolved from Mercury experience.

MAN-RATING THE GEMINI

Lt Col Robert J. Goebel, Space Systems Division



Lt Col Robert J. Goebel, of Air Force Space Systems Division's Gemini Launch Vehicle Directorate, examines model of Gemini and booster.

The first step is a total review of the system within the framework of the Gemini mission requirements. Not only performance capability but the entire system of drawings and specifications, tolerances, environmental levels, component subsystem and system tests are reviewed and altered when necessary. A ground rule was established very early that hardware changes were to be kept to a minimum. The Gemini program includes only two unmanned flights and depends upon the Titan II flight test program for validation of the basic design. Therefore every change from the Titan II configuration makes less valid the direct use of Titan flight test history for Gemini. Every change is carefully weighed by a contractor board and again by an SSD/Aerospace board to be certain that changes introduced to improve reliability and pilot safety don't in fact produce the opposite effect.

The studies resulted in the design and installation of a Malfunction Detection System capable of sensing and displaying to the astronauts in the shortest possible time those parameters which could indicate serious trouble. It monitors various launch vehicle subsystems, keeping the crew posted on operations and, in case of malfunction, provides a warning before the actual failure occurs. One type failure which could not be sensed in time to permit astronaut escape was taken care of by a redesign to provide automatic switchover to a backup flight control system.

Design improvements of the system would be worthless if the actual fabrication and checkout were not conducted in a manner to reduce or preclude human errors. Every pilot has been exposed to this in the form of loose fuel caps, empty fuel tanks, tools left in the engine compartment, etc. Gemini pilots will not be able to return to the launching pad for repairs and a few well chosen words to the fellow "who wasn't the regular crew chief." The aim is to have nothing but "regular crew chiefs" work on the program both in the factory and at the launch site.

Gemini production and inspection personnel are given special training including technical training, special training in Gemini procedures and disciplines and orientation on the total Gemini program. Successful completion of all requisite training results in the issue of individual stamps which identify the worker who performed the particular job. An important part of the program is to cultivate the desire of the workers connected with the program to do a superior job. This is done through a continuous motivation program on the importance of Gemini and the necessity for doing the job right the first time.

Man rating the manufacturing process is in some respects more difficult than man rating a system design. Besides the technical considerations of what can be done, there is the program office problem of what ought to be done. Each technique, procedure, control, etc. must be weighed in terms of its contribution to increased reliability and its impact on the program in terms of dollars and schedules.

Typical of the areas which receive additional emphasis for Gemini are contamination control, configuration control, tool control and discipline, time-sensitive component control, critical components control, special handling, and failure analyses. All of these have been applied in varying degrees to most programs. The significant point is the extent to which they are carried on in the Gemini program. As an example, all failures are reviewed in order to understand the physics of failure and to be assured that similar parts which may perform satisfactorily during test do not in fact contain latent defects which may cause a catastrophic failure. In all cases some corrective action is required before a failure report is closed out. The goal is to have all failure reports closed before the bird flies.

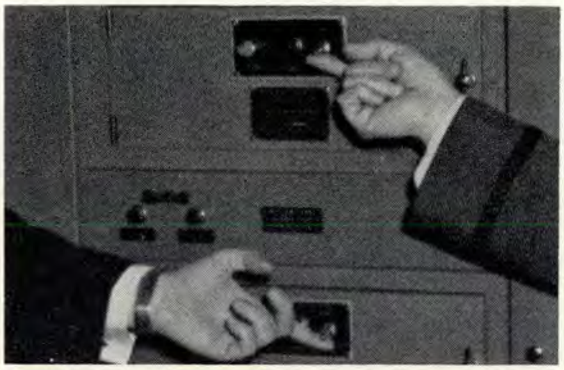
The acceptance testing of the vehicle consists of several mock countdowns and flights in the vertical position. Everything is done in actual flight except firing the engines. Data tapes from this vertical testing are reviewed in detail for unusual behavior in any black box. Any suspicious indication must be explained or the black box changed and test rerun. At the same time the entire history of the vehicle is reviewed down to the component level for any "skeletons in the family closet." Operating time logs are reviewed to assure that components were not run past their useful lives during testing. Inputs from the entire Titan program are evaluated in terms of the effect on the Gemini mission.

The same tender loving care provided the vehicle in the factory is carried over to Cape activities. Air Force personnel head teams of specialists who monitor all operations and tests performed on the bird from arrival at the Cape to launch.

Following the successful pattern set by the Mercury Project a Pilot Safety Review Board, chaired by Maj Gen Ben I. Funk, Commander, Space Systems Division, will make a final evaluation of the launch vehicle. This review will include a detailed analysis of the complete history of the bird from assembly to prelaunch. All difficulties will be reassessed, any open items weighed for impact on pilot safety and the final determination made whether to certify the vehicle as "man rated" and release it to NASA for launch.

While "man rating" is an important part of the Gemini program, it is also a key block in the larger picture of military space activity. The mutual exchange of knowledge resulting from our association with NASA will far go toward advancing our next manned space programs, leading to the day when space flights will be routine. ☆

ADC. FAA JOIN HANDS



Col Glen W. Clark, Air Defense Command, Ent AFB, Colo

Air Defense Command and the Federal Aviation Agency have begun combined operations in the Great Falls Semi-Automatic Ground Environment (SAGE) Direction Center at Malmstrom AFB, Montana.

FAA's new Great Falls Air Route Traffic Control Center will make joint use of ADC's operational facilities, computers, long-range radars and related equipment to provide air traffic control services to civil and military aircraft operating in approximately 135,000 square miles of air space over Montana and the western half of North Dakota.

The integrated air defense/air traffic control facility at Great Falls is part of the program designated Northern Tier Integration Project (NOTIP).

The overall control area extends approximately 610 miles West to East and 220 miles North to South. Joint use by FAA and ADC of long range radars for air defense, air traffic control high altitude civil jet advisory service and other related purposes has been under way for a number of years. This joint use program has proved to be efficient and economical, saving the government millions of dollars by avoiding duplication of facilities and equipment as well as overlapping functions. Location of the FAA facility within the SAGE center provides additional advantages not available until now in air traffic control. FAA use of the SAGE system will not affect current military manning nor interfer with air defense operations of the Great Falls Section.

Under the new concept, FAA controllers, for the first time in air traffic control, will have available processed digitalized data from a number of radar sites which will provide a composite picture of the air situation for the entire area covered by detection and identification systems. This data reaches the center via telephone circuitry. High speed computers combine the radar inputs from the various sources in micro seconds and display the composite picture on the controller's scope. The display is in the form of alpha-numerics, including aircraft identity, altitudes (both assigned and reported) and other information that the controller can call for electronically. The system also provides automatic tracking of targets on either primary or secondary radar, or a combination of the two; computer-generated radar hand-off displays and special alerting features.

Other important display features include such information as Air Defense Identification Zones, climb corridors and flight test areas, high and low altitude airways, aircraft trails, identity as to SAGE or FAA tracks, geographical boundaries and landmarks, and a common tracking system for the entire area. ☆

FAA operators receive an explanation on the new air traffic control system from Charles Irwin (pointing into the radar scope), chief, FAA, Great Falls Northern Tier Integration Project (NOTIP). New scopes using data from radar sites and processed by the SAGE computer in thousandths of a second will give FAA controllers information on the civilian and military air traffic situation.

Charles Irwin (third from left) receives first hand explanation on the operation of a SAGE Center from Col Jean H. Daugherty (second from right), commander, Great Falls Air Defense Sector (SAGE). Irwin or another FAA representative will be included on the battle staff during the simulated exercises.

MISSILANEA

SNAP, CRACKLE AND POP! While performing the CIM-10A roll bulkhead flush and bleed operation, hydraulic pressure was applied to the missle. The aileron movement snapped off the control surface lock, cracking and bending the left wing stub stringer rib. Although the appropriate technical order was being used as a checklist to perform the operation, the procedure to remove the control surface lock prior to hydraulic pressure being applied was obviously overlooked. As a result of this error, the following actions were taken:

• Standardization of minimum training required prior to an individual's operating the hydraulic station.

• Individual involved was re-trained under competent supervision.

• Acetate over T.O. pages is now used so that each item may be checked off with grease pencil as accomplished.

Major James C. Morrison,
Directorate of Aerospace Safety

CHECK AND SIGN OFF— During a recent forcible entry at an LGM-30 Minuteman Launch Facility, an old human failing, forgetfulness, was very much in evidence. Part of the prescribed gear to accomplish the task included a nitrogen gas bottle and connector kit. You have already guessed the fun part. When the kit was finally opened and the flex lines and hardware readied for use, it was discovered that an essential flex line and a required Allen-head wrench were missing. (The support base was only 50 miles distant.)

When are we going to use checklist and sign-off sheets as they are intended?

Lt Col Valdean Watson,
Directorate of Aerospace Safety

FROM SEA TO SHINING SEA. Across this great land of ours, the introduction of missiles into our operational inventory has created topographical changes. The first generation ICBMs caused unusual looking buildings to be erected, new access roads to be built, communication facilities to be expanded, and many blue vehicles to pass through little towns on a daily basis. The second generation ICBM complexes are not so easy to see, but the new roads were built in places which, to call them isolated, would be an understatement. Again, more communications equipment was installed and the same color vehicles go through out-of-the-way towns.

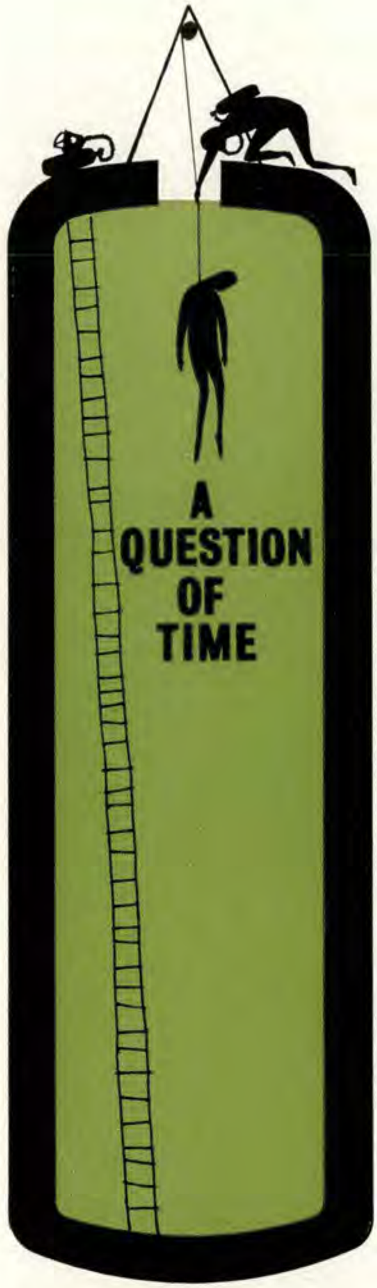
We have necessarily spent millions of dollars to build this missile system and, in doing so, have brought the Air Force to American people who in the past have never been in contact with us. In spending this money we have obligated ourselves, you and I, to spend it wisely, get the most for the dollars, and then to maintain safely what we bought.

In the past, incidents occurring on an airfield generally passed unnoticed by most of the local people. Now that a part of the Air Force is in Mr. Smith's field, our actions are subject to closer scrutiny. Mr. Smith may wonder if we are the professionals we advertise to be. The screaming sirens of onrushing fire trucks, ambulances, and combat defense vehicles cannot help but alarm folks like Mr. Smith. The billowing black smoke they see or the explosion they hear could make them wonder about us and our capabilities.

We don't want Mr. Smith to think that we get tired of wiping up oil around the LOX lines; nor do we want him to think that we wait for a leak to get real bad before we fix it or change the impregnated gasket. He thinks we maintain what he bought for us in a professional manner and do not use short-cuts or unauthorized procedures. He expects to see the same white clad crews drive by and on the same schedule. It would be hard to explain to him that one of the crews that used to drive out to his field to go to work had an accident in the silo. We couldn't tell him that because we were nonprofessional in our safety approach, one of the crew members was critically injured and we had to replace the crew. He just wouldn't understand.

When you get right down to it would we? ☆

Major Curtis N. Mozley,
Directorate of Aerospace Safety



A QUESTION OF TIME

Lt Col John A. Anderson
Directorate of Aerospace Safety

Is time the only factor to be considered in the question of whether or not you can hold your breath in an atmosphere of inert gas, such as nitrogen?

While you ponder the answer to this question, let's assume a theoretical situation, just to impose a little urgency and complexity. This situation is not really so farfetched. It could happen to you. So, here we go.

You and your buddy (for the sake of a better name, we'll call him George) have been given the task of cleaning and decontaminating a welded seam inside a LOX storage tank. The tank has been nitrogen purged. Both of you have done similar jobs before and know exactly what to do. George will enter the manhole at the top of the tank, descend a 45-foot ladder to the bottom, and accomplish the cleaning task. You will assist him and handle the life line.

George observes that the manhole is a little too small for him to squeeze through with his bulky air pack, so he evolves a simple plan and briefs you on it. He'll remove his air pack, take a deep breath and hold it, then descend the ladder through the manhole. You'll hand him his breathing apparatus and he'll put his mask on. No sweat, the whole operation shouldn't take more than a minute or so and anyone can hold his breath that long.

Once inside the tank, however, something goes wrong! While you're handing George his air pack, he either slips or falls from the ladder. Unconscious, he dangles some 10 or 15 feet below the manhole opening. You excitedly recall that lack of oxygen for five or six minutes can result in death. If George is to be saved, you must promptly retrieve him.

You call out an alarm to nearby workers and hurriedly begin to hoist the lifeline. Help finally arrives and together you pull George to the top of the tank. But, as you try to pull him through the manhole, you encounter trouble trying to align his limp form with the narrow opening. After two more futile attempts, you begin to feel a little panic as you realize that at least three precious minutes have elapsed. Something must be done to get him through that manhole and quickly! Out of desperation, a possible solution presents itself. If you fill your lungs with air, hold your breath, and descend the ladder, you can perhaps manipulate his body through that narrow opening.

Now, let's go back to our original question: "Can you hold your breath for a minute or so in a gaseous-nitrogen atmosphere?" Even though you could hold your breath underwater for three minutes when you were a kid, come from a long line of indestructible heroes, and carry a lucky rabbit's foot, please don't be too hasty in your answer to this question. Because if you can and don't, then George's life is forfeited. Whereas, if you can't hold your breath and you attempt to do so, you will be needlessly committing suicide. So, before we undertake to answer this question, let's look at some of the variables which will influence the outcome:

First, how long can YOU hold your breath? Do you know precisely to the second under all possible conditions of stress? The average person, under ideal conditions, could possibly hold his breath for a minute. But, when the elements of excitement and physical exertion are imposed, the length of time is decreased. So, if you are contemplating a rescue attempt, you'd better be absolutely certain of your capability.

Second, how long will it take to perform this particular task? If you have time to "dry run" the problem, you can probably come up with a pretty close estimate. But you won't have time to "dry run," so a quick on-the-spot "guesstimate" will have to suffice. And, it had better be accurate, as we'll see in a minute.

Now, what happens if your estimate was slightly wrong and the task requires even a single second longer than your breath-holding capacity? Or if you involuntarily cough, choke, or gasp? You will inhale some nitrogen and as a result, the blood leaving the lungs will be loaded with nitrogen. Within 10 seconds, this oxygen-deficient, nitrogen-laden blood will be passing through the brain. While the brain tissue represents only two per cent of the body mass, it requires approximately 28 per cent of the total oxygen intake. Since it is sensitive to even the slightest lack of oxygen, the nitrogen-laden blood will cause swift and certain unconsciousness. Should you gasp in a breath of nitrogen, your life will be strictly in the hands of your rescuers. And, if rescue is not effected within five or six minutes, you might as well forget it, because it really won't make much difference!

An example of how quickly an involuntary intake of nitrogen can affect a man is apparent in an incident which occurred some time ago. Both men involved were fully knowledgeable and well-equipped. Prearranged signals had been agreed upon since the worker inside the tank would not always be in full view of the safety observer. Everything progressed normally until the safety observer's attention was distracted and he failed to observe and respond to a signal from the worker in the tank. Repeating the prearranged signal and again failing to get a response, the worker in the tank decided to take a deep breath, remove his air mask and shout to get his buddy's attention. He did so, but in the process involuntarily inhaled some of the nitrogen. Fortunately the safety observer's attention was no longer distracted. He noted the tank worker to be in trouble and withdrew him. Even so, in seconds he was unconscious. Fortunately, the prompt administration of oxygen revived the victim.

Because of the many variables involved, you just might be lucky enough to get by with a risky operation of this type. Maybe you even know someone who has taken such a chance and lived to tell of it. But the law of probabilities is vastly opposed to your doing so, and the incidents in our official files should be sufficient to deter even the most foolhardy. To date, three people have lost their lives and several others owe theirs only to the prompt action of rescuers.

An effective accident prevention program for entering tanks and enclosed spaces requires a recognition that responsibility for safety, both at the time of entry and during the entire operation, rests with the SUPERVISOR. He must make sure that adequate steps have been taken to identify and eliminate or control the many hazards associated with the operation. Additionally, he must assure that all personnel understand the nature of hazards and the precautions to be taken. The hazards inherent in tank entry can be avoided or overcome if the following principles are applied *each* and *every* time a tank is entered:

• Establish a definite system of preplanning for tank entry and a worker instruction program.

• Prepare the tank for entry by physically isolating it, cleaning it to remove harmful contaminants, and testing it to insure absence of such contaminants.

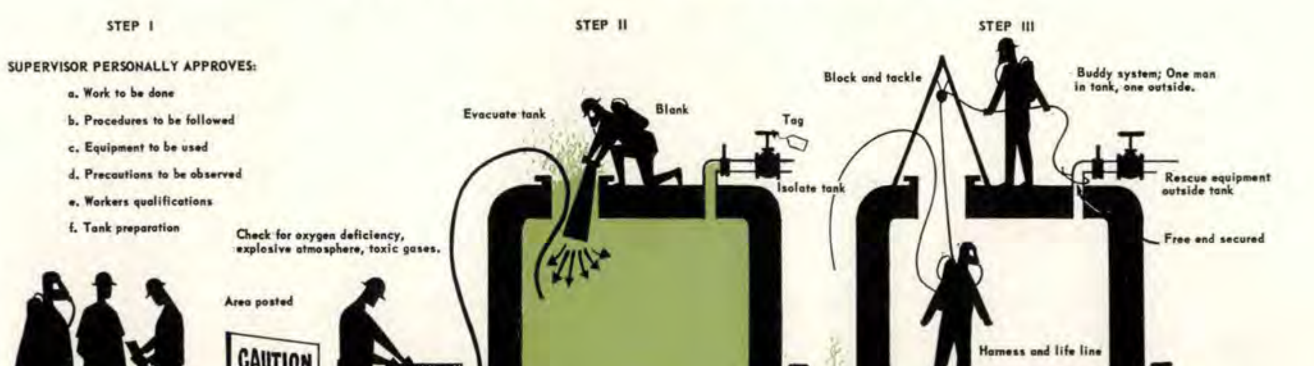
• Protective clothing and respiratory equipment should not be used *as a substitute* for cleanliness and ventilation.

• Use a formal permit system requiring written authorization for entry only after the supervisor in charge is satisfied personally with tank preparation, precautions to be taken, personal protective equipment to be used, and specific procedures to be followed.

You've heard the expression, "the best laid plans of mice and men. . . ." Yep, it applies here, too. Just in case something goes wrong, you must be prepared to promptly rescue the worker. He should be equipped with respiratory equipment, body harness, and a lifeline. The size, shape, and location of the entryway must be considered in selecting the proper equipment. In some cases, it may be desirable to have a block and tackle positioned on a tripod or otherwise fastened above the manhole. For obvious reasons, the manhole should be large enough to accommodate the man and his equipment. But when the manhole is too small to accommodate the fully clothed and protected man, specific procedures must be developed in the preplanning phase and *made a part of the tank entry permit*. The outside safety observer must always keep the man in the tank in sight, or must have prearranged signals. The safety observer must never be distracted from his "life guard" duties. He must never enter the tank until he is relieved of his post, and then only if he is properly equipped for tank entry and assured that outside assistance is adequate.

Proper supervision, careful preplanning and preparation to cope with a mishap, should it occur, will go a long way in guaranteeing that you are never faced with the dilemma described at the beginning of this article. ☆

ENTERING TANKS OR ENCLOSED SPACES



moment of truth

USAF Tactical Missile School, Orlando AFB, Fla

It's Christmas Eve and dismally grey instead of white. Dusk is beginning to settle, accompanied by a drizzling rain that has persisted throughout most of the day. Inside of the cab of the pick-up truck, it was comforting to hear the commanding drone of the engine and the snappy clicking of the windshield wipers. The brakes were grabbing though, as they always did when it was soaking wet outside. I thought I was playing it safe by keeping the speed at 45 instead of going the maximum on this slippery country road.

I saw the bent arrow of the left turn warning sign just before I saw the turn itself and thought that it was another lazy turn I could maneuver without interrupting my moderate cruising speed. Then immediately I was in the turn. It was a sharp, flat one and I had to slow down. When I hit the brakes, the right front brake locked and the pick-up spun around violently.

The centrifugal force of the swerving skid hurled me from behind the steering wheel and slammed me up against the right door. I grabbed for the steering wheel and held on. This caused the front wheels to turn farther away from the skid. The truck hit the shoulder of the road broadside and the rollover began.

I held my grip on the steering wheel throughout the first rollover and just as the wheels hit upright the first time, the right door flew open and my hold was snapped loose. As the second sickening turnover began, I went out the open door underneath two tons of crushing, pitching metal. The truck continued its roll, leaving me behind mashed on the ground.

During all of this violent action I never lost consciousness for an instant. A searing pain in my back and a growing numbness in my legs brought on the realization that mine was a very serious injury.

If I had been wearing a seat belt, I wouldn't have been forced from behind the steering wheel and probably could have controlled the pickup in the skid. Even if I could not have done this, a seat belt would have kept me from being thrown out during the rollover and I wouldn't be lying here now paralyzed from the waist down. ☆

This Cluttered Scope

CWO-3 Jae P. Rogers
AFSC, Scott AFB, Ill

"Don't tell me, Dad! I know what I'm doing. This is my home base and that GCA crew is hot. Just last week GCA landed me with only 100 feet and a quarter mile. Snow or no snow, I'm putting this bird in the nest."

The fact is, 100 feet and a quarter mile with no precipitation is duck soup compared to as much as 500 and one, in heavy rain or snow.

You probably wouldn't have a mile in heavy rain or snow, but the radar doesn't know that.

Are the chips down? Must you land at a particular base at a particular time? Especially when there is heavy precipitation?

At a time and place (Berlin, 1949) it was necessary to land aircraft through heavy precipitation. These were big C-54 aircraft, but heavy rain blended with their big radar targets. They were timed through part of the landing pattern and successfully completed the flights.

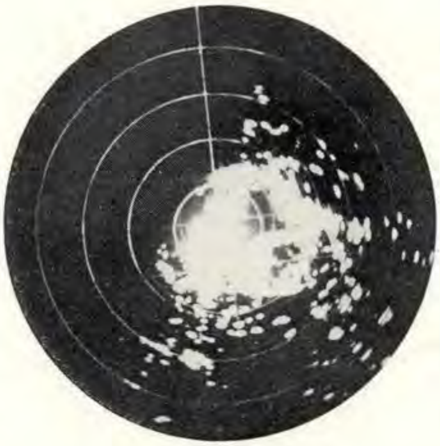
The files are full of successful landings under adverse conditions. Many crews have stated GCA saved them. But let's be fair to the radar gear.

Thunderstorms affect radar scopes by partially obscuring and, in some instances, completely obliterating all aircraft targets thereby nullifying any possibility of radar assistance. This occlusion (snow on the scope) problem is further aggravated by weak, intermittent definition of small jet fighter targets on all surveillance radar scopes.

When viewed head-on, a typical jet fighter or trainer offers two to three square feet of reflectable surface to the ground radar antenna. As a result, this type of bird just doesn't paint as well on the radar scope as larger conventional aircraft with their "fans" turning.

When small jet aircraft penetrate in severe weather situations, the most proficient GCA controller in the world would be rendered helpless attempting to control the aircraft because he cannot pick up the aircraft, make proper identification and maintain positive radar contact throughout the entire approach.

In an effort to successfully combat these problems, electronic engineers have incorporated many inno-



vations designed to eliminate undesirable ground clutter, reduce precipitation interference and at the same time improve discernibleness of aircraft targets. The following improvements are integral parts of all mobile GCA and RAPCON radar equipment systems:

Moving Target Indicator (MTI)

Fast Time Constant (FTC)

Sensitivity Time Control (STC)

Off-Centering

Circular Polarization (CP)

MTI cancels out undesirable terrain clutter which enables the GCA controller to give more accurate ASR (surveillance) approaches. In addition, MTI removes light to moderate precipitation echoes from radar scopes.

FTC is effective in breaking up large concentrations of ground returns. This aids the controller in picking up aircraft targets moving through heavy ground clutter areas. This feature is primarily used when the MTI is inoperative or not appropriate. FTC is also effective in "breaking up" the return from rain to a greater degree than it does the return from the aircraft.

STC permits maximum return from distant targets simultaneously with minimum return necessary to "see" close-in targets. Without STC multiple approaches would be virtually impossible.

Off-centering allows the traffic director to move the radar presentation to any desired position on the scope, which immeasurably aids him in concentrating on heavy traffic areas and observing movement of weather phenomena to a maximum of range in the selected quadrant.

Circular polarization considerably reduces the "Snow on the Scope" effect during periods of moderate to fairly heavy thunderstorm activity. It permits only unsymmetrical objects, such as aircraft, to be displayed on the radar scope and rejects comparatively smooth, teardrop returns such as rain. However, very heavy, extreme thunderstorm conditions containing rain or wet snow will persist in making the radar scope uninterpretable.

It remains a cold, hard fact that even with all of these "gimmicks" and "gizmos" to combat the ever present threat of weather elements —radar, as radio—is highly susceptible to interference caused by extreme thunderstorm activity. For this reason pilots should exercise caution when planning flights into areas experiencing heavy precipitation and/or wet snow and should give every consideration to the problem the GCA controller has under these adverse conditions.

In this jet age, each and every pilot should know something about the ground environment which aids him in the performance of his flight mission.

Every pilot can well afford to spend time to possibly save his neck, by visiting the RAPCONs and GCAs.

Look for yourself and look out for yourself!! ☆

Aerobits

NEAR-MISS OHRs. While the following applies specifically to SAC crews, others who may occasionally operate in the lower airspace regions should be interested.

A B-52 was on an IFR clearance, 8000 feet on an Oil Burner low level route when the pilots spotted an air carrier aircraft at the same estimated altitude and less than three miles away at the 0130 position. A climbing right turn was made immediately at military thrust. Less than 30 seconds later the other aircraft emerged from beneath the bomber's nose at the 1130 position. Vertical distance was estimated to be less than 500 feet. It was later determined that the other aircraft was operated by an air carrier on a VFR flight plan and letting down for a landing at a nearby municipal airport.

Another B-52 crew had a similar experience with a light single engine private plane. Distance this time was approximately 300 feet vertically and 500 feet horizontally. A check with FAA revealed that the light plane had not filed a flight plan and was apparently on a local VFR flight. Both aircraft turned as they approached each other and their pilots' vigilance may have prevented a collision.

Vigilance is the key word in both of the above cases. Without it there might have been disaster.

T-29 DOUBLE GENERATOR FAILURE. Approximatly 200 miles from destination the alternator generator system failed. The system was turned off, electrical load reduced and flight continued in VFR conditions. During GCA downwind the navigator noticed sparks coming from the accessory vent on the left engine, and the pilot noted that the left generator had failed. The pilot turned off the left generator but sparks continued from the vent. The left engine was shut down and four unsuccessful attempts made to feather the propeller with battery DC power. The tower was advised of the emergency and a straight-in landing accomplished without further incident.

The right generator had failed due to a crack in the aluminum pressure tube assembly, and the left due to internal materiel failure.

During subsequent tests investigators were able to feather both props on battery power during ground and air tests. No malfunctions were found in the feathering system. Suspected cause of failure of the left propeller to feather was given as excessive air load and depletion of battery power due to use of all lighting and radio equipment during the feathering attempts.

IF YOU DECIDE TO EJECT. If you are an aircrew member, there is a possibility that sometime you will have to decide whether to eject. The circumstances will govern your choice. Your decision may determine whether you live or die. If you decide to eject, give yourself the best break possible and do it correctly.

The explosive components of your ejection system are engineered to give you the "edge" in getting out and down in one piece. After you initiate them, they will take over and do the job for you, but

you must initiate them at sufficient altitude and suitable airspeed and attitude. The December-January Flying Safety Officer's Study Kit contained a copy of the USAFE publication AIRSCOOP, titled "Vector for Survival," which is the most complete work we've seen on this subject. We strongly recommend that everyone who flies in an ejection seat equipped aircraft study this pamphlet.

Another factor you should be concerned with is the mechanics of the ejection sequence. The best system cannot help you if it isn't used correctly. Each aircrew member should be trained and tested in escape procedures to the extent that, regardless of the circumstances, he instinctively follows the proper procedures for the aircraft he is flying.

To digress a bit, I know a man who frequently travels by bus, and each time he goes aboard he immediately locates all the emergency escape routes. I asked him why he was so concerned, and he replied, "If we have an accident I don't want to have to *hunt* for a way out. I'll be busy enough just getting out." Makes sense, doesn't it?

To go back to our major theme, crewmembers, practice your ejection sequence by the numbers. The simple systems will require only three actions: 1, assume the ejection position; 2, raise the grips and fire the canopy; and 3, release the grips, grasp the triggers, and fire the seat. Simple, isn't it? Yet we experienced an accident recently where the pilot never fired the seat. He lives, but it was because he was thrown out by centrifugal force at a high enough altitude to allow him to survive. He thought he had fired the seat, but it was found in the wreckage of the cockpit!

We believe that a crewmember should concentrate on flying the aircraft and performing his mission until he has decided he should eject. Then, by all means, he should concentrate on getting out alive.

If you decide to eject, and conditions permit, pick the best altitude, speed, and aircraft attitude, then concentrate on the mechanical actions required to safely get you out.

George W. Williford, OOAMA, Hill AFB, Utah

(AEROSPACE SAFETY endorses this advice and suggests that, as a backup, crewmembers concentrate on the "follow through" of the ejection sequence. That is, mechanically going through the procedure of manually releasing the lap belt, pushing clear of the seat and pulling the parachute "T" handle. This insures early detection of possible equipment malfunction, and precludes holding onto seat actuating controls. Many aircraft ejection seats still do not have seat-man separators.)

BARBED WIRE—AIRCREW ENEMY. A little over a year ago, during a safety survey of a major air command, the facilities member of the survey team recommended that barbed wire fences adjacent to the end of runway overruns be replaced with frangible fencing.

In the reply to this portion of the survey report, it was stated that the deficiencies noted were not programmed; however, these deficiencies would be considered by the Facility Programs Panel for the next fiscal year.

But about 12 months later, before action was taken, two pilots were practicing touch and go landings in a T-33 at the auxiliary field belonging to the base named in the foregoing report. After becoming airborne on the third touch and go, airspeed 120-125 knots and prior to raising the gear, with approximately 1500 feet of runway remaining, an apparent loss of thrust occurred and the pilots attempted to engage the barrier. The aircraft flew over the barrier, broke a support pole and knocked the webbing to the ground without disturbing the cable. After rolling, ballooning, and shearing the gear and speed brakes, the aircraft slid on its belly 265 feet through a six foot barbed wire fence. One strand of barbed wire was pulled across the top of the nose section, windscreen, canopy, and rear fuselage, eventually wrapping itself around the vertical stabilizer. Fortunately, there were no injuries or damage other than to the aircraft, barrier and barbed wire fence. The report stated: "When the aircraft ripped through the barbed wire fence, the top strand of wire

slid up over the windscreen and gouged nearly the entire length of canopy. If the canopy had been jettisoned prior to this time, the pilot most certainly would have received serious, or possibly, fatal injuries."

In this case the Air Force lucked out. As a result, there was no "blood on the paper" to help eradicate barbed wire from the end of runways. Let's keep it that way. If you see this killer at the end of a runway—see your Flight Safety Officer or take some other positive action to get rid of it.

Lt Col Clifford P. Patton
Directorate of Aerospace Safety

LET THERE BE LIGHT. As aircraft have become more and more complex, designers have included more and more lights in the cockpit to indicate systems operation or non-operation and various warning and emergency conditions. In modern fighters such as the century series, in addition to the usual array of lights on the instrument panel, there is a warning or "Peek and Panic" panel which monitors most of the systems in the aircraft. This panel consists of over 20 lights, each labeled so that when the light is illuminated the condition it indicates can be read directly from the face of the cover.

A moot question in any accident investigation is always which systems were operating at impact and/or which lights were illuminated when the pilot ejected if such were the case. In the past we've had to rely on the pilot's memory, always a tenuous procedure because of the stress of the moment, or physical evidence of component function at impact. In many instances such evidence is not always available, as in the case of electronic systems having no moving parts, or the evidence may be disguised by other indications.

In an article published in the December 1962 issue of the Canadian Aeronautics and Space Journal, Mr. F. H. Smith of Royal Aircraft Establishment, Farnborough, describes a procedure for analyzing the filaments of small type lightbulbs in order to ascertain which lights were burning. In general, the light bulbs used on aircraft warning systems utilize tightly wound tungsten filaments. When these filaments are shock loaded, such as at ground impact in an aircraft accident, the pattern of deformation of a heated filament is quite different from that of a cold filament (see pictures). In the case of the heated filament, the tungsten wire stretches and the windings separate. In the case of the cold filament, the break is clean and the windings do not separate. These indications have been used as an aid in accident investigations by the Royal Aircraft Establishment for a considerable length of time. In addition, laboratory tests conducted by Republic Aviation have proved the reliability and validity of the procedure, providing post impact heat damage is not a factor.

Once the validity of this approach is accepted, the determination of systems operation and/or emergency conditions can, in many instances, be made at the scene with great accuracy. Using light bulb analysis as a pointer, the accident investigator will then be in a position to make more detailed and accurate assessments of other physical evidence which might otherwise be overlooked. ☆

Lt Col Donald G. Page
Directorate of Aerospace Safety

Left, typical case of a small filament shocked in the heated state. Right, small filament shocked in cold state.

WELL DONE

1st LT WAYNE L. GOSNELL

354 TACTICAL FIGHTER WING, MYRTLE BEACH AFB, S. C.

First Lieutenant Wayne L. Gosnell demonstrated exceptional skill during an inflight emergency while participating in Swift Strike III. During a formation takeoff on an air-to-ground mission, Lieutenant Gosnell, flying in Nr 2 position, fell slightly behind lead. As he retracted his flaps at 150 feet and 200 knots, he felt his aircraft decelerate rapidly and start sinking. He quickly placed the throttle inboard, checked the pressure ratio and found it low. Noting the RPM drop rapidly through 75 per cent, he immediately hit the airstart switch, selected the emergency fuel system and jettisoned his two external tanks. He felt a surge in power and the RPM climbed to full military. Lieutenant Gosnell then pulled up onto a high downwind, declared an emergency and landed without further incident.

The power loss was caused by a break in the PB-4 line between the P&D valve and the main fuel control. Such a break will cause engine RPM to drop to 32-40 per cent regardless of throttle position. In flight, however, this could cause a flameout by rapidly leaning the fuel-air ratio in the combustion chambers. Although caught in a situation most conducive to panic, Lieutenant Gosnell's immediate, deliberate and precise reaction to an emergency in a most critical phase of flight saved the Air Force a valuable combat aircraft and certainly merits the USAF Well Done Award. ☆

A TALE OF TWO ALTIMETERS

'Twas early in the letdown, the descent check complete
A call came from the scanner, made me shudder head to feet.
"Saw a mountain thru the clouds, sir, at our 3 o'clock position!
If we'd descended more to right, there'd sure been a collision."
We checked the entire panel, feeling something was amiss
For the dope we'd got from RAPCON shouldn't cause a fright like this.
What was that setting, Harry, the controller passed to us?
Could a wrong set up altimeter be causing all this fuss?
No, the setting that we used, Tom, is the one we just received.
We missed the mountain, partner, for that I'm much relieved.
But wait a minute, Harry, the dial took quite a spin
One thousand feet or better marked the change that we cranked in.
Look at the forecast altimeter on our 175
By golly, see that entry, it's a wonder we're alive.
The setting that we got, Tom, was far from being right.
There's something wrong in RAPCON or the troops have lost their sight.
Although they erred in giving us this setting, for sure
Just a little check by us would have been the safest cure.
So that's the little story of a miss good as a mile
Don't let up for a moment, we've got no cause to smile.
Use all the brains you've got, lads
Double check when you're in doubt
And you'll live to be a hundred
No problems worse than gout. ☆

Maj George H. Tully, AFCS Scott AFB, Illinois

☆ U.S. GOVERNMENT PRINTING OFFICE: 1964 - 701/215/8