flying

SAFETY NOVEMBER 1986

THERE I WAS

■ This incident happened on my third air refueling track in my pilot upgrade training program. It was a daytime, VMC, air refueling with one B-52 on one KC-135.

After 30 minutes of successful air refueling training, the boom operator and I coordinated a practice emergency separation. I approached the contact position from precontact. The boom operator told me to return to precontact. As I returned to that position, the boom operator said, "Move back 200 feet." At this point, I suspected something was wrong.

I told the tanker I planned to descend to the bottom of the block. I pulled the throttles to idle, slowed to 240 CAS, and began a shallow descent. The tanker called out the Center frequency and our squawk. At this point, I was falling back to 100 feet plus, and well below the tanker.

I checked my squawk and then rechecked the tanker position. He was 70-80 feet and closing both vertically and horizontally. My airspeed was 220 CAS approaching the bottom of the block. I attempted to level off, but the IP in the right seat pushed the yoke forward. He was not sure what the tanker was doing and did not want to lose sight. The IP suggested going to the left of the tanker. I made a turn to the left while continuing my descent. As the tanker approached my altitude, I lost sight of him. I transferred control to the IP who had a clear view of the tanker.

We were still closing rapidly and we called for a breakaway. The tanker raised his airbrakes. Our closure increased. The safety observer called for gear. The copilot (IP) lowered the gear handle. We moved 3 feet closer and dropped like a rock. I got the squawk to emergency in our descent. We passed well underneath the tanker, slightly offset to the left.

After we landed, we talked in detail with our tanker people. The reason they started the emergency descent was because the outer pane of the pilot's window shattered. He did transmit his intentions over the radio after he thought we were well clear. However, his radio was inoperative because some of the buses were off the line.

We all learned a great deal from this incident. Most important is call the breakaway earlier. If I had monitored my own aircraft's airspeeds and altitudes better, I could have called it earlier. Guard would have been a good frequency to call on since AR primary gave no response. Also, next time I have a choice, I will go to the right side of the tanker so I can keep him in sight. Finally, I learned lowering our gear really provides quick and positive separation. Next time, I will be a lot quicker in my actions. Fly safe! ■

UNITED STATES AIR FORCE

flying

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SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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LT COL JIMMIE D. MARTIN
Editor

"There's a time for some things, and a time for all things, a time for great things, and a time for small things."

Cervantes, ***Don Quixote***

■ Our lives are ruled by the clock. This seems especially true for those in the flying business. We have briefing times, times to be at the aircraft, start engine times, taxi times, block times, chock times, and on and on. More times than I have time to write about and you have time to read about.

As if these times weren't enough, we occasionally run into delays that further reduce the amount of time available to meet a schedule. We may be able to get the schedule revised and have no trouble making it. On some occasions, we may try to compress things to make our original schedule. This may be because the schedule can't be changed for some reason or simply because our pride won't let us admit we can't hack it.

Another complication to meeting our schedules occurs when increased activity is scheduled such as during an exercise, sortie surge, or ORI. We all want the wing or squadron to succeed, so we put everything into it. Our crew duty day goes to the maximum, and we pay close attention to every detail. The problems come when we get behind schedule for some reason and try to make up the time. The problems are especially severe when the increased activity is in its second or third day. As we hurry to catch up, we're more likely to make mistakes because of the accumulated strain over the past day or two added to the stress of trying to catch up. This is exactly the situation in the following mishap.

■ An F-4G was being flown the fourth day of a local exercise and sortie surge. Immediately after takeoff, as the pilot raised the gear, he heard a loud bang, felt a loss of thrust, and the aircraft yawed 15 degrees left.

The electronic warfare officer (EWO) confirmed decreasing RPM on the left engine while the pilot checked both throttles in maximum afterburner, reduced climb angle, and prepared to jettison the external stores. The aircraft continued to slowly climb and accelerate, so the pilot decided not to jettison the load. At a safe altitude, the pilot shut down the left engine which had stabilized at 15 to 17 percent RPM. He was then able to restart the engine normally. After burning down fuel, the pilot made an uneventful straight-in approach and landing.

The cause of the engine failure was easy to find. Witnesses saw paper fly up around the aircraft as it rotated for takeoff. The aircraft's AFTO Form 781 binder was later found beside the runway, and the left engine had pieces of 781 pages in the intake.

Finding out what happened was

An F-4 showed what happens when you ASSUME. The pilot, electronic warfare officer, crew chief, and end-of-runway inspection crew all made assumptions. They were *all* wrong!

much easier than finding out how it happened. No one knows where the forms were placed or why. The EWO reviewed the forms while the pilot was preflighting the aircraft. Neither the EWO, pilot, or crew chief remembered stowing the forms in or on the aircraft. The end-of-runway (EOR) inspection crew didn't see the forms, but they were obviously not secured in the cockpit.

The forms were most likely wedged in the nose gear scissors linkage or placed on top of the left intake where they may have fallen between the fuselage and splitter vane. In either case, the launch crew should have seen the unsecured forms, but since they didn't, the EOR crew should have. Finally, the pilot should have reviewed the forms and made sure they were secured.

This is a case of inattention to detail by everyone involved. This was probably a result of complacency as well as rushing to meet the sortie surge. The wing didn't have a standardized place to secure the forms, so the placement varied from aircraft to aircraft. The aircrew was apparently expecting the crew chief to keep the forms, and he was expecting the crew to take them in the aircraft. The EOR crew didn't expect to see the forms at all, so they didn't.

Anyone could have stopped the mishap chain of events by taking care of one small detail — securing the forms. But, everyone was looking for bigger problems and let this small one develop into a big one. The sortie was lost, an aircraft and crew were endangered, and extra work was created for maintenance. All because everyone thought someone would take care of what anyone could have done, but no one did. The following quotation seems appropriate.

"A little neglect may breed mischief: For want of a nail the shoe was lost; for want of a shoe the horse was lost; and for want of a horse the rider was lost."

Benjamin Franklin
Poor Richard's Almanac ***(1757)***

This next mishap introduces a slightly different aspect of time pressures. In this case, an emergency created a sense of urgency that demanded immediate action.

■ A C-130E was taking off on the third leg of a three-leg logistical support mission. Just after liftoff, at about 50 feet AGL, the No. 4 engine flamed out. The engineer noted torque, RPM, and turbine inlet temperature (TIT) decreasing and said, "No. 4 engine just flamed out." As the pilot advanced the operating engines to maximum power, he directed the copilot to shutdown the No. 4 engine.

The copilot immediately grasped the No. 1 engine condition lever, and without waiting for confirmation from the engineer, moved the condition lever towards feather. Before he reached the feather detent, the copilot realized his mistake and moved the condition lever back to the run position.

The engineer saw the RPM on the No. 1 engine decreasing through 65 percent, advised the pilot, and with his concurrence, moved the No. 1 condition lever to airstart. At the

continued

Proper crew coordination takes a little time. But, that time is well spent as an over-eager C-130 copilot discovered.

same time, the copilot, with confirmation from the engineer, feathered the No. 4 engine. The No. 1 engine recovered and was on speed within approximately 5 seconds.

The pilot left the gear and flaps down while he climbed the aircraft to a safe altitude, leveled off, and accelerated to a safe flying speed. The crew completed the applicable checklists and made an uneventful three-engine landing.

In the premission briefing, the copilot had been told to get a verbal and visual confirmation from the engineer before pulling an engine condition lever to feather if an inflight emergency engine shutdown became necessary. So why did he not follow the briefed procedure? He was concerned with feathering the engine as soon as possible because he believed a flameout just after takeoff was one of the few times an immediate shutdown was necessary.

The copilot was correct in thinking an engine failure during a heavy weight takeoff at high pressure altitude required quick action. But, his feathering the wrong engine emphasized the importance of proper crew coordination to prevent making a bad situation worse by taking a hasty, incorrect action. This is why the Dash 1 says the steps necessary in any emergency are:

- Maintain aircraft control.
- Analyze the situation.
- Take coordinated corrective action.

The copilot's hasty actions unnecessarily placed the aircraft and crew in an even more dangerous situation with two engines out instead of one. They were fortunate the engineer was able to get the No. 1 engine back up to speed in a very short time. This was definitely a case of:

"Haste makes waste."

***John Heywood**, Proverbs*

Let's look at another example of how trying to make up time can be the first step in a chain of events leading to a mishap.

- An F-4E was scheduled as No. 3 in a 4-ship range mission. Everything was normal until time for the crew to go to the aircraft. The Phantom had already flown one mission and was still being refueled, so the crew had to wait. When the refueling was complete, they went to the aircraft.

The refueling delay caused the crew to be late starting their preflight inspection. To catch up with their flight and make their range time, the crew divided the preflight duties. The pilot reviewed the aircraft forms and performed the aircraft preflight while the weapon systems officer (WSO) preflighted the weapons.

Approximately 10 minutes after takeoff, the WSO noticed smoke coming from the rear cockpit radar. The aircrew went on 100 percent oxygen, the WSO turned off the radar, and the smoke began to dissipate. Immediately after the smoke started, the pilot remembered reading a writeup in the aircraft forms concerning the radar. The last line in the writeup had been added by a maintenance technician in red pencil stating, "Do not turn on radar."

Because of their hurrying to catch up with their flight, the WSO didn't review the forms with the pilot. The pilot forgot to tell the WSO about the radar writeup. The WSO didn't ask the pilot if there were any writeups and turned on the radar as he would on any sortie. But, the pilot and WSO weren't the only ones hurrying in this case.

The aircrew on the first sortie of the day had experienced a problem with blanking of the rear cockpit scope. After the aircraft landed, a radar technician was dispatched to troubleshoot the problem before the second sortie. The technician found the radar was overheating, but

A KC-10 and its flight crew were placed in jeopardy by someone else's misuse of time. Then they all had to waste time while the error was corrected.

didn't think the problem could be fixed before the next sortie. To prevent damage to the scope, he wrote "Do not turn on radar" in the forms. He didn't take the time to disable the equipment by disconnecting the power cables or pulling the circuit breakers. He thought the writeup in the forms would do the job.

Rushing to make the scheduled mission time resulted in losing the mission. It also caused failure of several electronic components and an in-flight emergency that endangered the aircraft and crew. The people involved in this mishap would have done well to remember the Greek proverb:

"Make haste slowly"

The following mishap illustrates a different aspect of time as it affects our crewmembers.

■ A KC-135 was scheduled for a dry thrust takeoff with a 100,000-pound fuel load for a training mission air refueling with a KC-10. Prior to the exterior preflight, the aircraft commander (AC) asked the crew chief if water was loaded on the aircraft, and the crew chief said it was dry. During the exterior preflight, the AC didn't check the water level in the water injection tank as required by the Dash 1. The tank actually contained nearly 6,000 pounds of water. During the preflight and after takeoff, the water boost pump low pressure warning lights were illuminated. This indicated the tank contained water. But, the crew still believed the tank was empty and did not activate the dump switch.

At 10,000 feet on the departure, the crew drained the water injection tank as directed by the after takeoff-climb checklist. Since the freezing level was at 8,000 feet, ice formed along the underside of the tanker between the water drain mast and the boom sighting window as the water drained out of the tank.

As the receiver approached the refueling position, three large pieces of ice fell off the bottom of the tanker and hit the KC-10. The KC-10 was not damaged, but the refueling was terminated, and the KC-135 climbed to FL 310 so the ice could sublimate.

In this case, the crew was not pressured by an exercise, late takeoff, or any unusual situation. They just didn't take the time to do what they should have. The AC believed the water injection tank was empty, so he didn't take the time to check it during the exterior preflight. The crew didn't take the time to extinguish the water boost pump low pressure lights because they continued to assume the tank was empty.

This picture of the business end of a KC-135 looks nonthreatening enough. But, a KC-10 found an unexpected hazard.

We were lucky the KC-10 wasn't damaged, but the refueling had to be delayed while the KC-135 crew took the time to climb and let the ice sublimate. Training time was lost, and a valuable aircraft was placed in jeopardy. All because this crew didn't spend their time wisely.

"It was a favorite expression of Theophrastus that time was the most valuable thing a man could spend."

Diogenes Laertius
(Circa AD 200)

I'll not belabor the point that as aircrew members, we are constantly subjected to the pressures of time. Just remember when you're tempted to cut corners to save time, you're setting yourself up for mistakes. Weigh the situation carefully, and don't sacrifice safety to save a few seconds or minutes. The cost may exceed the payoff. ■
One last quotation.

"Hurried and worried until we're buried, and there's no curtain call, Life's a very funny proposition, after all."

George Michael Cohan
Life's a Funny Proposition

FLYING AND ICING DON'T MIX

PEGGY E. HODGE
Assistant Editor

■ Ice and aircraft just don't mix. If you ask our aircrew members what they think about operating an aircraft in icing conditions, I don't think you'll find any fans. Most people don't even like to think about it.

But, we *must* think about it. Aircraft icing can and does cause mishaps. Taking the ostrich approach and trying to ignore the problem won't help, so it's time for a little review of when and where icing can occur, what our icing mishaps tell us, and some protective measures.

When Icing Can Occur

Conditions. Ice forms when two conditions are met. Moisture in liquid form must be present in the air, and the effective temperature must be freezing or lower. All clouds contain moisture in one form or another so icing can be expected if the temperature is at or below freezing. In fact, light ice or frost forms when an aircraft flies from a cold area that has reduced the temperature of the aircraft itself to freezing, into a saturated cloud where the temperature is above freezing.

Supercooled water droplets can exist in the atmosphere as a liquid at temperatures as low as −40° C. These droplets do not freeze because of the surface tension of the drop, its salt content, and most important, the liquid is undisturbed. Once it is disturbed or broken, as when it is struck by the *aircraft*, the drop quickly transforms into ice. Crewmembers should anticipate and plan for some type of icing on every flight conducted in clouds with temperatures colder than freezing.

Seasons. Icing may occur during any season of the year, but in temperate climates, such as found in most of the continental United States, it is most frequent in the winter. The freezing level is nearer the ground in winter than in summer, leaving a smaller low-level layer of airspace free of icing conditions. Frontal activity* is also more frequent in winter, and the resulting cloud systems more extensive.

Geographical regions at higher latitudes, such as Canada and Alaska, generally have the most severe icing conditions in spring and fall. During winter, the air is normally too cold in the polar regions to contain heavy concentrations of moisture necessary for icing, and most cloud systems are stratus and composed of ice crystals.

Where Icing Can Occur

Terrain. Icing is more probable and more severe in mountainous regions than over other terrain. Mountain ranges cause upward air motions on their windward side, and these vertical currents support large water droplets that would fall as rain over level terrain. The movement of a frontal system across a mountain range combines the normal frontal lift with the upslope effect of the mountains to create extremely hazardous icing zones.

Ominous Cloud Structures

▪ **Stratus.** Icing in middle and low-level stratus clouds is confined, on the average, to a layer between 3,000 and 4,000 feet thick. The intensity of the icing generally ranges from trace to light, with the maximum values occurring in the upper portions of the cloud. The main hazard lies in the great horizontal extent of some of these cloud decks. The icing region can extend for many miles horizontally. High-level stratus clouds are composed mostly of ice crystals and give little icing.

▪ **Cumulus.** The zone of probable icing in cumulus clouds is smaller horizontally but greater vertically than in stratus clouds. Icing is more variable in cumulus clouds because many of the factors conducive to icing depend on the stage of development of the particular cloud. Icing intensities may range from trace in a small cumulus to moderate or severe in a large towering cumulus cloud. Although icing occurs at all levels above the freezing level in a building cumulus, it is most intense in the upper half of the cloud. Icing in a cumulus cloud is usually clear or mixed with rime* in the upper levels. Whenever operational conditions permit, the general rule should be to change altitude (climb or descend) when encountering layer cloud (stratus) icing, and vary course as appropriate to avoid cumulus type cloud icing.

▪ **Cirrus.** Aircraft icing rarely occurs in cirrus clouds although some do contain a small portion of water droplets. However, light icing has been reported in the dense, cirrus anvil-tops of cumulus clouds where updrafts may contain considerable water at rather low temperatures.

*See AFM 51-12, Vol 1, Chapter 12, Weather for Aircrews, for frontal zone icing conditions, icing forms, and induction and structural icing definitions.

Major Icing Problem

After a review of our icing mishaps, one of the major icing problems confronting the crewmember today is ice ingestion by an engine. Included on the list was the tragic loss of a CH-53 helicopter with 16 fatalities. In that mishap, induction ice was dislodged and ingested causing catastrophic compressor failure and a total loss of engine power. Fortunately, the other cases did not involve fatalities but the potential was there. The following mishap illustrates.

▪ While flying wing position on a formation ILS approach, the IP noted his aircraft yaw slightly and the No. 1 engine RPM decreasing with indications of flameout. This mission had been uneventful from the time of departure until passing 10,000 feet en route to practice areas when the flight began to experience light rime icing. The pilots, thinking the icing would diminish shortly, continued their climb. While passing 16,000 feet, the icing intensity increased to moderate rime, and the engine-ice light illuminated.

continued

Stratus

Cumulus

Cirrus

FLYING and icing don't mix continued

Our newest aircraft boast many technological advances, but they are not immune to icing problems.

The flight leveled off at 17,000 feet, and lead requested vectors to home station and to remain at 17,000 feet until beyond mountainous terrain so they could be assured of an expeditious descent through the freezing level to limit the exposure to the icing conditions.

On final, all ice had departed the windscreens. Approximately 25 seconds later, the wingman's No. 1 engine flamed out. He assumed lead and flew an uneventful overhead approach.

Investigators felt the engine most likely flamed out due to ice ingestion as a result of rime icing encountered.

As this and other mishaps tell us, ice ingestion can be a problem. So, let's review some critical and possibly life-saving information about our aircraft's engines and ice ingestion.

It is important to recognize that while all USAF jet aircraft have engine anti-ice systems, not all have engine *inlet* anti-ice systems, so you must be very familiar with the system operation on your aircraft.

You should also know the conditions under which ice can form. The conditions most common to engine inlet icing are free air temperature between +5° C and −20° C and visible moisture present or the dew point within 4° C of the free air temperature.

Remember, when visible moisture is present, engine inlet icing can occur over a wide range of temperatures, above or below freezing. The increase in air velocity as it enters the aircraft engine duct, the engine compressor inlet, and the compressor inlet guide vanes causes a drop in temperature of the entering air. Moisture in the air becomes supercooled as it passes through the engine inlet, and it can cause engine inlet icing even though external ice is not being formed on the aircraft. The following incident illustrates.

■ An FB-111 was cruising clear of all clouds at FL 220. As the aircraft approached its target area, the No. 1 engine stalled and rolled back to 60 percent, then completely flamed out. The pilot made a successful airstart and returned to base. After the aircraft landed, maintenance found the fan case and first stage compressor had been damaged by ice. On preflight, the auto-ice detector had been inoperative, so the crew was to use manual anti-ice if required. Since the aircraft was clear of clouds at all times, the pilot didn't use anti-icing.

If you find yourself in an icing environment and have ice buildup on wing leading edges and windshield, etc., before you have initiated anti-ice procedures, you should assume ice has started to build up in the engine inlet and inlet guide vane area as well.

In this situation, and if applicable to your aircraft, it would be a good idea to switch the ignition ON before actuating the engine anti-ice system. Keep the ignition ON until the ice is gone and stable engine operation is resumed. When anti-icing system activation is delayed after ice has already formed, there is a chance of ice breaking off in large pieces and being ingested into the engine.

Once compressor damage due to ice ingestion occurs, you should be aware of the possibility of compressor stall and/or flameout. Engines with compressor damage from ice ingestion are likely to operate stall-free up to about 85 percent RPM. However, this will depend on the amount of damage incurred. A damaged compressor has a greatly reduced stall margin and will stall with very little inlet duct airflow

Simply remaining clear of clouds won't guarantee you'll remain free of icing. Make sure you know when to expect icing so you can avoid it.

distortion. Avoid rapid throttle movement, abrupt altitude changes, and tight turns.

Protective Measures

Ice ingestion is only *one* icing problem we need to be aware of. An important message in all our icing mishaps is to recognize the dangers in time to take protective measures whatever the problem. So, for your help and review, we offer the following checklist for your winter prevention program.

Preflight

- Know de-icing/anti-icing procedures and cold weather procedures for your aircraft.
- Understand the limitation of aircraft anti-icing. The effectiveness of anti-icing is limited by time and the amount of precipitation falling.
- Clear runways, taxiways, and ramps of loose ice. Remember, your aircraft may be clean when it leaves the ramp, but engine blast from another aircraft may blow almost invisible particles of snow onto the surface of your aircraft. The result may be flight control difficulties from ice formed by freezing of snow or water.
- Remove all ice/snow from aircraft before takeoff.
- Be certain static ports, pitot heads, and other inlets are free from ice. (While we are all aware of the loss in performance due to ice, sometimes it is easy to forget how quickly it can form on the ground under certain favorable conditions. Also, remember a snow covering may conceal a layer of ice.)
- Know how to compute stopping distances using runway condition readings and braking action reports.
- Conduct a visual inspection just prior to takeoff in conditions conducive to aircraft icing.

Takeoff and Inflight

- Avoid areas of visible moisture at all times.
- Avoid the use of reverse thrust during ground operations to keep blowing snow and ice from adhering to the aircraft and decreasing aerodynamic efficiency.
- Climb or descend to altitude where temperature is above 0° C.
- Use all necessary anti-ice/de-ice equipment — during taxi, takeoff, and inflight.
- Taxi slowly and use brakes with caution, especially if ramp areas are crowded and have marginal maneuvering room.
- Cross-check engine EPR against other engine indicators to ensure proper thrust for takeoff.

Descent and Landing

- Anticipate the need for engine/nacelle and/or wing anti-ice at all times, especially during descent.
- Arm the autobrake and the autospoiler systems before landing, if available.
- Deploy speed brakes immediately after the main gear contacts the runway (if applicable).
- Do not hold nose gear off runway. Apply brakes smoothly and symmetrically with moderate-to-firm pressure until a safe stop is assured.
- Do not attempt to turn off the runway until speed is reduced to a prudent level.
- Send pilot reports if icing is encountered or if it is forecast and none is encountered.

The material in this article is not all inclusive; its purpose is to get your attention. According to our records, you are more aware of the dangers than ever before. With your continued awareness and prompt action, I hope it will be very difficult to find an icing subject next year. ■

Engine Mishap Investigation

WILLIAM D. BRADFORD
Directorate of Aerospace Safety

■ You are in maintenance with engine experience and have been tasked to go out to a smoking hole in the ground to determine why it happened. What do you do? Just what does the safety investigation board (SIB) need from you at the mishap scene?

What they want is for you to provide them with information as to how the engine or engines may have or have not been involved in the mishap scenario. They need your expertise. They need you to provide them with factual data, findings, and analysis applicable to the engine and how it may relate to this mishap. They need to know what the engine was doing at impact and how the data relate with the mishap scenario. More specifically, they need from your investigation and analysis answers to such questions as:

- What was the condition of the engine at the time of impact? Was it operating normally?
- How much power/thrust was the engine producing, and what was the engine RPM when it failed or when it impacted?
- Was there an engine malfunction or failure? If so, what was the sequence of the engine failure? And, most important, what was the cause of this failure?

Just how does a person go about getting that kind of information from a large smoking hole and scraps of metal? A good question by any measure.

Well, first of all, you need to get to that smoking hole and look it over. Do *not* expect instant success. Much work is required before you will be able to determine the role the engine played in the mishap sequence.

At first, just walk around the crash site and look the whole thing over from a general, overall perspective without paying particular attention to any one specific item. Just walk and look. This way you will gain a greater, overall knowledge of the mishap, on this, your first time around. Note the type of impact, how the aircraft broke up, the terrain characteristics, and the wreckage scatter pattern.

Then, on your next walk around the site, get right into the meat of the investigation. Pay close attention to the finer details, study the engine wreckage, and take photographs, measurements, and notes as you feel necessary. Look at the wreckage; what does it tell you? You should not be too concerned with what happened at the last investigation; instead, concentrate on all the evidence available to you *now* at this wreckage site as it will tell you exactly how this mishap occurred.

When you arrive at the impact site, you will have the opportunity to evaluate the physical features of the crash site — ground hardness and texture, trees, structures, hills, depressions, etc. After observing the crash area, make a sketch of the crash scene including such things as the initial impact point, as well as subsequent impact points and the position of aircraft parts, engine, engine parts, engine accessories, and any other items or topographical features that might be helpful in your analysis.

The engine will undoubtedly sustain some damage due to the impact. That damage can range from minimal to extremely severe. In addition, the damage characteristics and the scatter pattern of the wreckage will vary from one aircraft mishap to another. Factors that will have to be considered and determined that affect the damage severity, the damage characteristics, and the wreckage scatter pattern are the velocity of the aircraft, terrain, impact angle, aircraft attitude, and engine speed.

Additionally, prior to wreckage recovery, you should take as many photographs as possible of the impact area as well as both the inside and outside of the aircraft. These pictures should include, but not be limited to:

- Inlet ducts
- Engine inlets
- Engine exhausts
- Fire damage
- Engine instruments and switch positions
- Engine controls and throttle settings
- Compressor variable vane actuator position
- Exhaust nozzle actuator position
- Any discrepancy that may have been noted or any questionable condition.

Please note it is of the utmost importance to study the wreckage *before* it is moved! The conclusions you arrive at will have a much higher confidence factor associated with them if the investigation was initiated at the wreckage site, prior to recovery operations, and finalized at the hangar, rather than if the investigation was conducted totally in a hangar following wreckage recovery. The overall view of the wreckage site allows you to (1) better relate a particular component to its point of recovery, (2) evaluate the effects of the terrain, (3) appraise single or multiple impacts and the energy associated with each one, and (4) access the wreckage distribution and scatter pattern. All of these can then be factored into your analysis.

As has been stated, you will need to determine engine power at the time of impact. The best way to do this would be to use the thrust equation, $F = M (v_j - v_p)$. However, since there is no direct method of determining the mass of the velocity change after impact, you will need to ascertain engine thrust via other more circuitous methods. These methods use various engine system and parameter values as well as their pistons, levers, actuators, cams, feedback cables, indicators, etc. Since these systems are scheduled and positioned by interacting engine functions, their relative position can be equated to a specific value of a related parameter. When this is used with other known conditions, the value of these parameters can be correlated to a thrust value. It is then you can identify a balanced or unbalanced engine cycle and along with it, pinpoint any malfunctioning system or sub-system.

There are numerous components within the engine that can be analyzed to determine the engine's power at the time of impact due to their capture marks, impact marks, etc. It is here where an intimate knowledge of the engine model you are investigating is an absolute must! The list of components that can provide hard evidence varies from engine model to model, and it includes, but is not limited to:

- Throttle system
- Main fuel control
- 3-D cam
- Fuel control servo
- Compressor discharge pressure servo piston
- Variable compressor geometry
- Variable vanes
- Variable vane actuator
- Variable vane feedback assembly
- Compressor bleed valve
- Variable exhaust/augmentor nozzles and actuators
- Fuel flow transmitter
- Engine instruments
- Warning lights
- Electronic engine controls
- Data recorders.

Information gathered from these components, along with known facts such as impact site elevation and weather conditions, can estab-

continued

Good, clear photographs are important to your investigation. They not only provide clues, but also furnish visual support for the conclusions you reach.

Engine Mishap Investigation continued

lish if the engine was operating and what the thrust output of the engine was.

The SIB president will want you, as the engine investigator, to examine the state of the engine after impact and ascertain what damage happened before impact and what damage was caused by the impact. The goal is to determine whether or not the engine was providing enough thrust to maintain flight.

Do not simply try to wade through the wreckage looking for the part that caused the engine to malfunction. Instead, try to assemble all the facts that can be gathered from the impact site, the engine teardown, and, if required, the laboratory and/or metallurgical analyses, and study those facts.

This approach is a much more logical one, and it will allow you to assess all the facts, determine how each system was performing relative to its intended design, pinpoint the area of any malfunction, and isolate any failure or contributing factor. This will, in most cases, allow you to determine if the engine malfunctioned, and if so, to identify the cause of this malfunction.

When you are investigating a mishap, you must not only gather all the facts, but also apply these facts toward a logical conclusion. The validity of this derived conclusion is directly related to the quality and relevance of the facts used in your analysis to derive that conclusion. Quite obviously, the more consistent the conclusion is with all the facts, the more likely it will be well-founded.

So, if you desire to reach the most valid conclusion as well as one that is accepted by others, you, as an investigator, are professionally compelled to seek out, evaluate, and analyze every fact available and fit the mishap scenario to those facts. You must *always* avoid trying to find facts to fit a scenario because this invariably leads to important evidence being ignored or lost.

This article was written to give you an overview of some investigative philosophies and techniques that have been successfully used by experienced engine mishap investigators. This should help you on your next engine mishap investigation. Though by no means complete, I hope this article gives you some insight into the how and why some investigators do what they do. ■

Additionally, the accompanying list of publications describes in detail how to investigate a specific aircraft/engine mishap and will greatly assist you when investigating a mishap.

INVESTIGATIVE AIDS

J85 Turbojet Engine Accident Investigation Manual. Technical Note ASNJ-TN-68-1, Feb 69.

J79-15/-17 Turbojet Engine Accident Investigation Procedures. Technical Report ASD-TR-75-19, Aug 75.

J85-GE-21 Turbojet Engine Accident Investigation Procedures. Technical Report ASD-TR-77-5, Mar 77.

TF41 Turbofan Engine Accident Investigation Procedures. Technical Report ASD-TR-78-2, Jan 78.

TF34 Turbofan Engine Accident Investigation Procedures. Technical Report ASD-TR-79-5003, Jan 79.

F100 Turbofan Engine Accident Investigation Procedures. Technical Report ASD-TR-79-5002, Aug 79.

J79 Accident Investigation Training Manual. General Electric Company, Evendale, OH, revised Oct 84.

Air Force Pamphlet 127-1, Vol II, Chapter 6, "Engine Investigation," to be published in late CY 86.

Fire and Explosion Manual for Aircraft Accident Investigators. Technical Report AFAPL-TR-73-74, Aug 73.

Jet Engine Accident Investigators Course Material, Jet Engine Branch, Chanute AFB, IL.

FSO's CORNER

CAPTAIN DALE T. PIERCE
919th Special Operations Group
Eglin AFB Aux Field 3, Florida

■ Most FSOs are continually on the lookout for new sources of information to use for their flight safety bulletin boards, flight safety meetings, or just to spark those new ideas that keep the job interesting. Most of us will settle for hearing about something that has been around awhile and somehow eluded us.

A few weeks ago, while talking to another FSO, the subject of information sources came up. I told him about the *Aviation Medical Bulletin* I subscribe to for $7.95 per year. He told me about *Callback*, which is distributed free by NASA. I called some FSOs to find out whether I was the only one who didn't know about *Callback*. Only one had heard of it.

I then called the NASA folks at Moffett Field, California, and talked to Rex Hardy. He told me about *Callback*, added my name to the mailing list, and sent me some back issues and background material. While reviewing the material, I learned that *Callback* is a monthly newsletter, published by NASA, funded by the FAA, and distributed in the public interest. The published material is based on information gathered by the Aviation Safety Reporting System (ASRS).

The ASRS does for the FAA what the Air Force flight safety reporting program does for the Air Force. Most ASRS reports are based on civilian incidents and submitted by the people involved. The ASRS receives an average of 25 reports per day. Most relate to high mishap potential incidents and flight mishaps. Some relate to air traffic control. The common thread for the *Callback* articles generated from the ASRS reports is that all revealed a lesson to be learned. Here's an example from the June 1986 issue.

"Descending through FL180, I asked the First Officer for the correct altimeter setting since he had recently copied the ATIS. He replied '30.20.' Level at 12,000 feet, the controller asked our altitude and said he showed us 400 feet low. He gave the altimeter as 29.84. The First Officer had mistakenly read me the transponder squawk instead of the current altimeter setting, which was written on the same pad." (Sounds like a good way to get leaves in your landing gear.)

Rex Hardy told me anyone may be placed on distribution by writing to the following address and requesting to be placed on the mailing list.

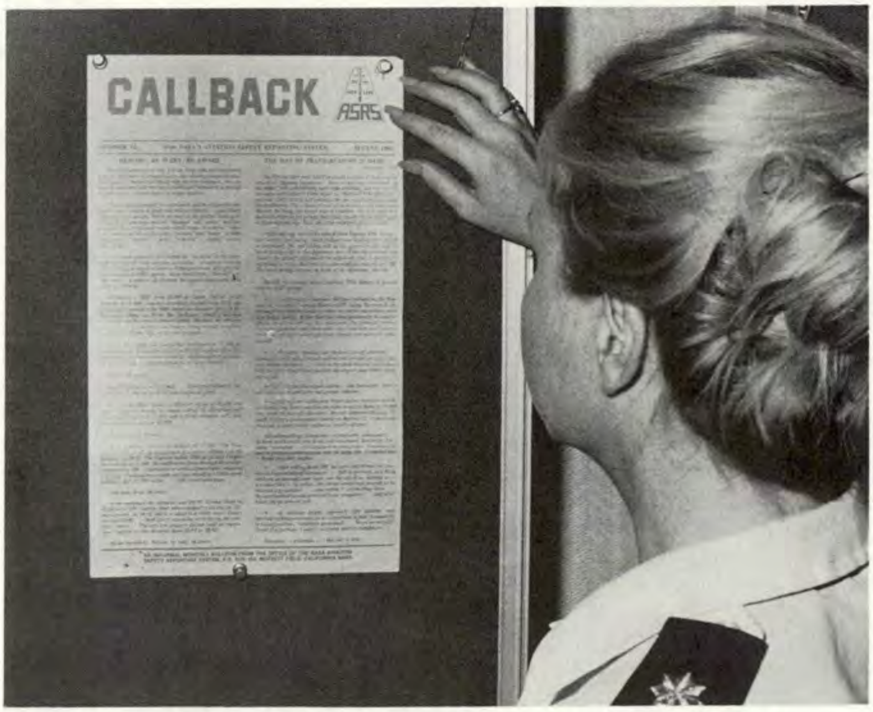
NASA Aviation Safety
Reporting System
P.O. Box 189
Moffett Field, CA 94035

Incidentally, the *Aviation Safety Medical Bulletin* I mentioned above is a good source of health information tailored to flyers. To subscribe to it, send $7.95 to the following address and request a subscription. (No, I don't hold stock in the company.)

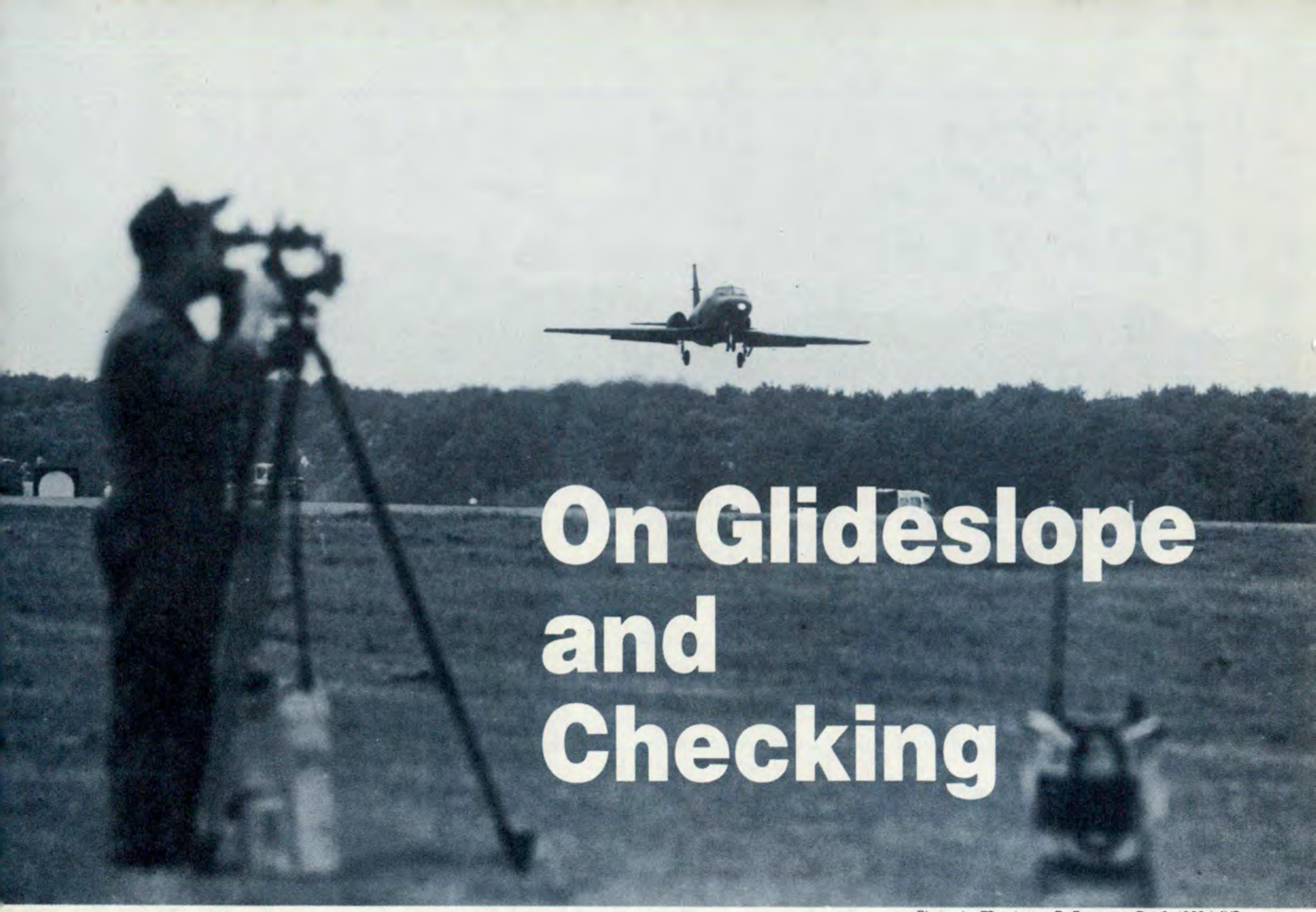
Harvey W. Watt and Company
Atlanta Airport
P.O. Box 20787
Atlanta, GA 30320

Captain John Sanlorenzo provided this month's FSO's Corner idea. He's the FSO for the 22d Air Refueling Wing at March AFB, California.

The FSO's Corner needs your ideas. What are you doing in your program that would help other FSOs if they knew about it? Call me (Dale Pierce) at AUTOVON 872-8537 or 872-3741, or send your name, AUTOVON number, and program idea to 919 SOG/SEF, Eglin AFB Aux Fld 3, Florida 32542-6005. ■



Callback is excellent reading for aircrews. Even though it deals with civilian operations, many lessons are just as applicable to military fliers.



On Glideslope and Checking

Photos by TSgt James R. Ferguson, Det 6, 1363d AVS

PEGGY E. HODGE
Assistant Editor

■ Aircraft operators and maintainers realize the importance of carefully maintained and technically accurate air navigation equipment. The quality of this equipment is an important facet of flying safety. The job of ensuring quality air navigation — to make sure we can keep going no matter what happens and do so safely — is indeed an important one to all the flying community. It is a function of the Air Force Communications Command (AFCC).

AFCC serves the Air Force and other federal agencies in air traffic services and maintenance and evaluation of all related equipment. The command manages and operates the free world's largest military air traffic services system which handles more than 13 million civilian and military air traffic control (ATC) operations annually. This system includes nearly 300 navigational aids and more than 200 radar facilities and control towers.

An integral element of this operation is the maintenance and evaluation of air traffic services and electronics-communications equipment systems. The command's maintenance responsibilities extend to nearly all of its worldwide units where thousands of individual items of electronic equipment are annually repaired, maintained, or tested by AFCC technicians.

A significant portion of the command's evaluation mission is to check ATC facilities and their associated navigational aids (NAVAIDS), as well as radar and tower ATC personnel to ensure pilots receive accurate and reliable flight information. These tests are performed by technicians on the ground and aboard AFCC's T-39 and C-140 aircraft assigned to three facility checking squadrons at Rhein-Main AB, Germany, Yokota AB, Japan, and Scott AFB, Illinois.

To help us fully understand the details and impact of maintaining quality air navigation, I visited with Colonel Richard B. Ensign, Commander, Pacific Information Systems Division, who has direct operational control of the 1867th Facility Checking Squadron located at Yokota AB, Japan.

History

As the Air Force's smallest squadron, the 1867th Facility Checking Flight (as it was called then) was formed at Clark Air Base, Republic of the Philippines, on 1 June 1963, with two C-140A "Jetstars." They initiated flight inspection of certain United States Air Force and Army navigational aids located in South Vietnam.

As the US involvement in Southeast Asia expanded, so did the 1867th. They were upgraded to a squadron and received more aircraft in 1965. They supported emergency operations in Australia, Malaysia, New Guinea, New Zealand, Singapore, and Taiwan, as well as the rapidly expanding mission in Southeast Asia.

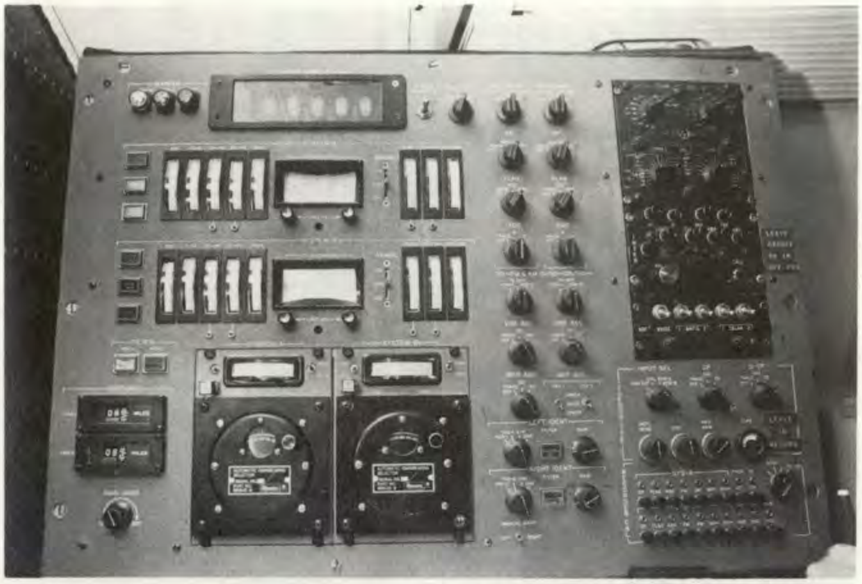
At its maximum size in 1969, the squadron also operated a detachment at Yokota AB, Japan, covering Japan, Korea, and Okinawa. The US's disengagement from Vietnam produced a drastic reduction in the squadron's size. In December 1975, the unit relocated to its present home at Yokota.

Mission

Currently, the 1867th ensures quality NAVAIDS for aircrews flying in the Pacific and Indian Ocean areas in peacetime or during wartime/contingency operations. Colonel Ensign says, "It's AFCC's commitment to *sustainable* operations throughout any level of conflict by providing a reliable, high quality air traffic system and procedures. When a pilot takes off, he expects very high quality from his air traffic controllers. We want to sustain that high quality. The pilot has enough variables in his mission without problems from ATC."

The 1867th provides flight inspections and operational evaluations of US Air Force facilities in the Pacific and Indian Ocean areas. Flight inspections are required for all electronic NAVAIDS to ensure the radiated signals are providing accurate, safe, and reliable guidance for aircraft. The 1867th also has direct responsibility for all mobile facilities deployed in support of military exercises or as a temporary replacement for a permanent facility and all facilities within combat/contingency areas.

Operational evaluations of ATC and communications facilities are conducted by the 1867th at all US Air Force locations in Guam, Japan, Korea, Okinawa, and the Philippines. Each evaluation encompasses the NAVAIDS, communications, and air traffic controller performance from initial contact to final landing.



Accurate flight checks of NAVAIDS and precision landing systems are dependent on the entire crew. The pilots must fly the aircraft precisely while the technician uses special equipment to monitor, record, and analyze the transmitted signal.

The newest mission of the 1867th is TRACALS evaluation. TRACALS is an acronym for Traffic Control and Landing Systems. This program is highly useful in identifying system deficiencies through detailed technical analysis of the NAVAIDS.

The 1867th accomplishes this mission three ways — flight inspections, ATC operational evaluations, and notice-to-airmen (NOTAM) evaluations.

Flight Inspections A flight inspection validates the accuracy of NAVAIDS and precision landing systems through airborne analysis of the electronic signals being radiated by these ground facilities. These signals must meet established tolerance, performance, and reliability standards prior to being considered safe for aviation use.

The flight inspection technician in the back of the aircraft is key to the chain of events during a flight inspection. The signal being radiated by the facility under inspection is electronically monitored and recorded. The technician analyzes the data and advises the flight inspection pilot and ground maintenance people whether the facility is meeting the required tolerances.

The pilot must precisely position

continued

The theodolite operator is a key member of the flight inspection team. The theodolite provides a visual cross-check of aircraft position. This helps ensure the in-flight check is accurate.

the aircraft so proper analysis can be accomplished. A ground theodolite operator* often assists the pilot by sighting the aircraft and providing its exact location in space. This indepth airborne analysis is performed to ensure the NAVAID or precision landing system is providing the pilot an accurate, reliable signal by which he can safely navigate his aircraft.

Official flight inspections are of five basic types: Commissioning, site evaluation, periodic, special, and surveillance.

- Commissioning — a comprehensive flight inspection to obtain complete information as to facility performance and to establish that the facility will support its operational requirements. A commissioning inspection is accomplished prior to certifying any air navigation facility for use.
- Site evaluation — a flight inspection to determine the suitability of a proposed site for the permanent installation of a facility. It may include checks normally made during a commissioning inspection and any additional tests which may be required.
- Periodic — a regularly scheduled flight inspection comprehensive enough to determine the facility will still meet standards for a commissioned facility and support its operational requirements.
- Special — a flight inspection to determine facility performance or characteristics for special purposes or due to special circumstances. Examples of circumstances requiring these inspections are aircraft mishaps, facility equipment modifications, or restoration to service following a scheduled or unscheduled outage.
- Surveillance — an unscheduled flight inspection of commissioned air navigation facilities to determine the ability of the system to continue to meet applicable standards. A surveillance inspection becomes a special flight inspection whenever an out-of-tolerance condition is found.

Operational Evaluations A second way the 1867th ensures quality air navigation is through ATC operational evaluations. These are comprehensive looks at ATC procedures, communications, and control agencies at USAF bases. An operational evaluation starts with the evaluator, himself an air traffic controller, coordinating with local air traffic service managers for any special requests they might have. A preflight review of flight publications and all other available data on the base is also conducted. Inbound communications with base weather, operations dispatcher, command post, and USAF global command and control system agencies along with local NAVAIDS at the base are checked.

The flight phase of the evaluation includes execution of the various instrument approaches at the base, a look at control tower services, and

*The flight inspector advises the theodolite operator (a theodolite is a piece of optical survey equipment) of the exact location in space of the aircraft. After sighting the aircraft, the theodolite operator will preset the theodolite to a certain point ahead of the aircraft and, at the exact moment the preselected reference point on the aircraft (engine, nose, etc.) crosses this prescribed point, the theodolite operator will confirm with the pilot. The theodolite is then preset to the next point, and the procedure is repeated. This provides a check of ATC's instrument readings.

incorporates maneuvers and procedures not normally seen by the air traffic controllers on a daily basis. Colonel Ensign says, "We force the people in the facilities to work under degraded conditions. For example, the pilot of the T-39 says I'm going to fly without a transponder on. Now the aircraft is just a smear on the controller's radar screen without that clear little marker that makes it very easy. The purpose of this is to *exercise* the system without certain conveniences on the aircraft."

The most important element of an operational evaluation is the post-flight debriefing which provides identification and explanation of problem areas and feedback to local managers on their overall service.

NOTAM Evaluations The third aspect of ensuring quality air navigation is through NOTAM evaluations. The NOTAM evaluation is to make sure the Department of Defense NOTAM System is providing military aircrews accurate and timely information needed for safe air operations. These evaluations identify any communication deficiencies, procedural faults, or system management problems to managers at all levels.

The 1867th accomplishes its mission covering the Pacific and Indian Ocean areas with only one aircraft — a specially equipped T-39A. This is the last USAF T-39 still operating in the Pacific.

FAA's Role

The 1867th operates in conjunction with the Federal Aviation Administration (FAA). All unit aircrews are trained and certified by the FAA and use FAA standards during flight inspection missions. The FAA has primary responsibility for flight inspection of all US NAVAIDS in peacetime. The 1867th provides the contingency/wartime flight inspection capability. Colonel Ensign describes our relationship with the FAA as a "handshake that the FAA understands we need to maintain a proficiency in the Pacific to do this kind of work should we have to transition from peacetime to wartime. It's a courtesy the FAA extends to us, and sometimes, of course, we're helping them because their aircraft are occupied so they can't provide a timely flight check on a particular situation — so we fill in. It is a good working relationship."

He further states "We don't expect the FAA to fly in hostile conditions. What we have is the capability honed every day by doing it just exactly like the FAA. We can then transition into any level of conflict because we work with them every day. The pilot never perceives a difference in quality of air traffic services through peacetime right on through to any kind of conflict he might see."

Getting The Job Done

The 1867th operates a single aircraft — a T-39A Saberliner fitted with a NAVAIDS flight inspection system. It is the only USAF T-39 still operating in the Pacific. The twin-engine jet is an excellent aircraft for reliability, flexibility, and rapid response for contingency missions while providing high altitude inspection capability. Colonel Ensign explains, "I've got the minimal amount of equipment out here to maintain proficiency. If that should become insufficient, all I have to do is go to AFCC, and one or more of their C-140s will be on its way to reinforce us. Right now, the FAA and our T-39 are handling everything out here, but that could change in a heart beat. What we try and do is use every resource in our command to make sure we are flying safely."

During peacetime and wartime, quality air navigation is a must. Col Ensign says, "We don't want conflict, but the only way to avoid it is to be prepared for it. If you've got a pilot flying in a hostile environment, his stress level is up, and he probably comes back with an airplane not quite as good as when he left. The *last* thing he needs is some lesser quality of service or to have to worry about whether the equipment is calibrated correctly."

It is this kind of dedication and concern that ensures safer skies as well as combat readiness. Colonel Ensign explains, "Our part is to make sure the air traffic facilities are as honed as they possibly can be. We're trying to be very combat ready — right at the peak of proficiency — but we're also trying to do it without bending airplanes with a good conscious eye towards flying safety." ■

COCKPIT STRESS

MAJOR BILL KORNOVICH
63d Military Airlift Wing
Norton AFB, CA

■ This article is a discussion of stress and the conduct of flight crew duties. More specifically, the point of view will be that of the aircraft commander (pilot) of a multi crew aircraft such as the C-141.

We will consider stress as a result of an unforeseen or unexpected event during the course of a flight. This not only includes aircraft systems failures (emergencies), but

also includes the unexpected; the event that is not routine. This could be not seeing the runway at decision height or finding the runway does not look like you expected.

Any event or situation different from the routine or the unexpected can lead to disruption and fear — stress. This is due to the nature of aviation — events can rapidly become life-threatening.

The cost of inadequate response to an emergency or unexpected situation can be a mishap involving death and the loss of costly equipment. The safe resolution of an aircraft emergency or unexpected event is greatly the result of how well the crew is prepared to work together to deal with the stress of the situation. During a stressful situation, it is my experience that crewmembers are, at times, distracted enough to affect aircraft control. Of course, this is a function of aircrew proficiency, experience, and effective crew coordination.

I hope this article will stimulate discussion of stress in the cockpit and some "hangar flying." Being *prepared* for the unexpected can improve your efficiency and reduce the level of stress in a given situation.

The Stress Factor

In the early stages of aviation, stress was a more normal part of the training. Early aircraft did not enjoy a high reliability rate. Though young aviators of the past did not get the amount of training we enjoy today, they most probably spent a higher proportion of their training in stressful, life-threatening situations. The pilots who survived adapted well to stress, or at least took it for granted.

Air Force aviators today enjoy a very high level of reliability and safety in the equipment we fly. Our modern aircraft are designed and built with safety in mind and have many redundant features. In fact, with each generation of new aircraft, in my opinion, less of the decision process (thus the stress factor) is left to the crew. The chances for human error are, in some cases, being designed away.

The bottom line is that crews fly more hours of incident-free experience and less seasoning experience. The terms, "by the seat of the pants" or "I got her home on a wing and a prayer," are not part of the modern Air Force war story. In fact, most of the war stories seem to concentrate on keeping up with all the new equipment and avionics we are giving the aircrews. Our simulator training programs encompass all the marvels of computer technology. However, nothing in the simulator can equal the stress of a real life-threatening situation. Because of this, when an emergency does occur, many of our pilots are taken totally by surprise.

I believe that during the initial stressful moments of an emergency, many pilots have difficulty focusing on the problem and setting priorities. They are compromised in their ability to diagnose the problem and select a course of action. They may well overlook the proximity of the ground as the most immediate priority.

The response of a crew and their ability to correctly handle more than one task simultaneously is, to a large part, a function of good crew coordination and experience. If experience is low, the successful aircraft commander compensates by delegating tasks to enable better prioritization and so keep ahead of the situation. This requires a crew who understands one another's habits and capabilities. Experience together can help build their working rapport, but not without effort. A competent aircraft commander realizes he or she is a cockpit resource manager and accordingly cultivates the crew's efficiency and trust.

Preparation for Survival

The Air Force Standardization Program prepares our crews very well for business as usual. Pilot flight skill levels are generally very good. Business as usual rarely results in mishaps. Yet, a routine event, which may not be recognized by an inattentive crew, can lead to tragedy.

A few points should be made at this juncture:

- All crewmembers must anticipate the stress of an emergency or unusual situation. It is not a question of "*if* it will happen to me" — but *when* it will happen.
- Being prepared for the stress of the inevitable emergency is difficult, but critical. Likewise, knowing how you and your fellow crewmembers may respond in light of your experience and an honest personal assessment of your capabilities may be the key to survival. This leads to the next point.
- What single/critical action can the pilot take to reduce the possibili-

continued

ty of immediate death — it may not ensure resolution of the original problem, but it will give the crew a chance to live long enough to take action.

■ Finally, the crew must know the environment in which they are currently operating and, more importantly, plan for the environment which they are about to enter (both planned and unplanned).

The best we can do, currently, is teach a management of priorities in crew actions. Our training is generally aimed at a critical action approach — the Bold Face. That is, selected actions are committed to memory. However, only recently have we begun to consider prioritized use of the whole crew to get the job done. Good cockpit resource management will help keep basics from being overlooked (such as keeping the aircraft flying and getting away from the ground).

In a large multisystem, redundant-laden aircraft, such as the C-141, there is a tendency to misplace emphasis on complex and numerous systems. An entire crew can be distracted for too long by multiple-flashing annunciator lights, horns, bells, or whatever stimuli is used to get their attention. A more simplified survival approach should be taken to emergency (stress) training — reducing what I call the "along-for-the-ride"* time.

That is, reducing precious seconds during which the whole crew is trying to analyze what is happening. During these moments (as I have seen numerous times as a flight evaluator), the entire crew is distracted from the immediate need of keeping the aircraft flying and getting away from the ground if on takeoff or landing. The statistics show most multicrew, nontactical aircraft mishaps happen in the takeoff and landing phases of flight. That makes sense — the aircraft is close to the ground.

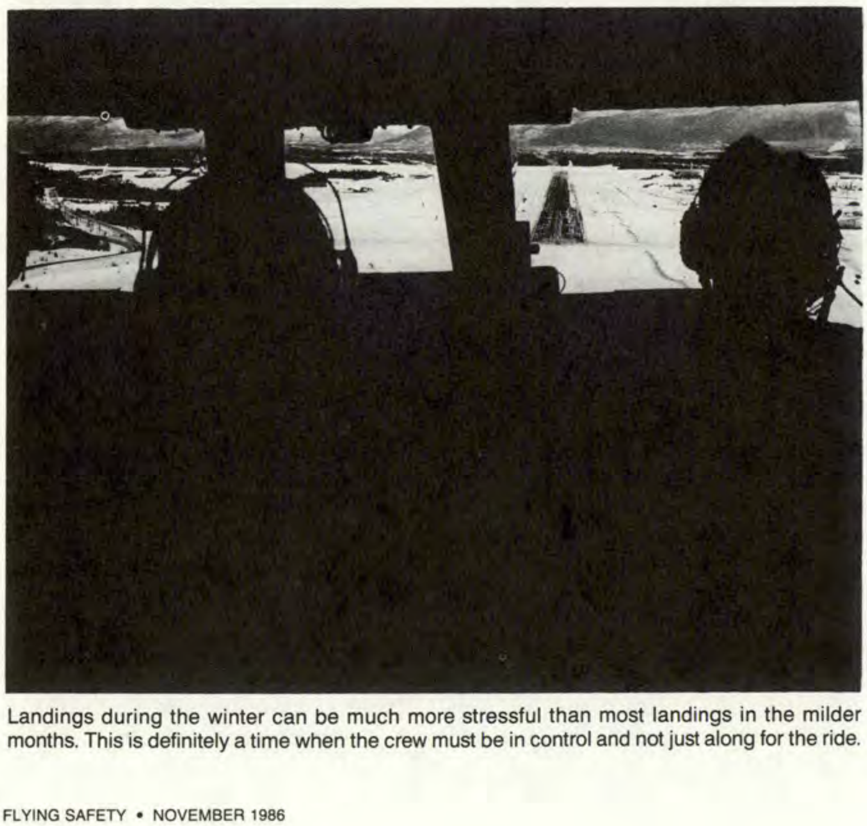
The along-for-the-ride syndrome was mentioned earlier. Every pilot has experienced the situation.

*The author defines "along-for-the-ride" time as a loss of situational awareness. Specifically, a time during an emergency when the crew is not totally aware of where the aircraft is or where they are taking it.

When the crew is under the stress of an emergency or unexpected situation, they may be giving little or none of their attention to the basics of flying the aircraft. This is obviously a function of a lack of basic experience and task delegation. When this happens, it is important to have a preplanned course of action that will increase the buffer zone of recovery as I like to call it. These actions may be simple ones — grabbing a hand full of throttle, full thrust, level wings, flying airspeed, and pull the nose to the best angle of climb. It sounds simple, and we would hope is almost instinctive to our highly trained pilots.

It is not so when attention is misdirected to other tasks. If, however, the tasks are effectively delegated, the crew is again in control and not just along for the ride. The crew may not have fully analyzed the emergency or unusual event, but is most probably reducing the stress factor by increasing that margin of recovery and making additional time available to deal with the unexpected.

One further thought before going into some examples of how to reduce the stress factor by immediately going from along for the ride to in control. If this has not yet happened to you, it will. If you don't think it will happen to you, you're wrong. And, if you believe that you, as an individual, cannot be overloaded to the point where you are along for the ride, you shouldn't be flying.



Landings during the winter can be much more stressful than most landings in the milder months. This is definitely a time when the crew must be in control and not just along for the ride.

The Basics

The intent of this discussion is not to minimize the need for good systems knowledge and understanding. That need is basic. The intent is to emphasize mental preparation for the unexpected and the coordinated use of the crew. The unexpected increases stress, disrupts the thought process, and leads to the along-for-the-ride syndrome. Pilots don't like feeling they are not in control of the aircraft or situation such as, not being sure of where they are, what the aircraft is doing, or if they can safely complete a maneuver.

I experienced that feeling during a descent over mountainous terrain while being vectored by radar. No one in the cockpit was sure if the assigned altitude and heading would provide terrain clearance. The stress factor was high, and the crew was along for the ride. We told the controller we were leveling. The crew was then in control again.

A commercial airline lost an aircraft a few years ago in a similar situation. The crew was uncertain of terrain clearance (as revealed by the voice recorder). The stress factor was high as the captain and flight engineer discussed the terrain. However, the crew did not take the one critical action needed — stop the descent and climb. The aircraft was on autopilot and was continuing the descent. Everyone in the cockpit was along for the ride. They impacted the terrain during the discussion. The copilot was silencing the ground proximity warning (probably to hear the captain and flight engineer discuss the terrain).

The key, in my opinion, is for each crewmember to establish a point you will not proceed beyond. Some "no compromise" rules for the various stages of flight must be established. These are points where allowing a change in your habit patterns can lead to disaster. An example in the C-141 may be the gear will be extended immediately after the flaps during a landing approach. No compromise in any situation — period! The aircraft feels like it is in the landing mode without the gear if the flaps have been extended.

This leads to another point. There are those situations when everything feels right and is very wrong. The term "chair flying" is valuable here. Some time flying an entire profile in the mind can identify some of these areas and point out those no-compromise points beyond which you will not proceed.

As was pointed out earlier, the most critical phases are takeoff and landing. High speed, heavyweight rejected takeoffs in the C-141 are potentially hazardous. Being prepared for the stress of a system failure and the decision whether to stop or continue is the key. If the aircraft is generating forward thrust, no drag devices are deployed, the flight controls are operating, and there is a source of airspeed and altitude monitoring available, the C-141 can be flown. Thinking about these basics, delegating the tasks, and then confirming they are working properly can greatly reduce the stress of an annunciator light coming on at "go" speed.

The same preparation applies to landing. Not every approach has to result in a landing. Many pilots have experienced the stress of not being sure the aircraft will stop in the remaining runway. At that point, they may have been along for the ride. Again, establishing no compromise boundaries beyond which you will not proceed can keep you in control. Knowing the stopping performance of the aircraft at the particular weight, and, at what point you will be on the ground or be executing a go-around, are critical factors for the crew. If the entire crew has good experience and judgement and yet someone is not sure you can enter the landing environment safely, take the one critical action that will return you to an environment where you can remain in control — *go around!*

There are examples for every stage of flight, and the variations are endless. The key is having a coordinated plan — the action the crew knows will put them back in control immediately.

The stress and accompanying complications of an emergency or unexpected event are obvious and should be expected. Every crewmember is vulnerable to the along-for-the-ride syndrome. By remembering to properly prioritize the basics of keeping the aircraft flying and increasing that margin of safety, the crew can rapidly return to in control. Once in control, they can take appropriate corrective action. ■


During the takeoff is another time the stress factor can be very high if an emergency or unexpected event occurs. The first priority must be to keep the aircraft flying.

Lots of errors

The following mishap occurred in 1948. This was a time when maintenance was simpler and our airfields were less congested. The lessons learned from this human factors mishap are still applicable to our modern Air Force. More than two-thirds of our recent mishaps have been the result of human factors. Are we learning from the past or repeating it?

■ The pilot of an F-47 conferred with the crew chief before takeoff and learned his plane had a new prop installed. The crew chief explained the prop had been ground checked and asked the pilot if he would perform the flight check prior to his scheduled acrobatic mission.

All was well on runup and takeoff. At cruising altitude, the prop checked satisfactorily, so the pilot proceeded on his mission.

An hour and a half later, he found the prop had stuck in fixed pitch. All emergency procedures failed to change the blade angle, so the pilot headed for his home base.

Seven miles from the field, he called the tower on Channel B for clearance for an emergency landing.

The tower received the message approximately 30 seconds after a C-54 had been cleared to take the runway for takeoff.

The controller, taking into consideration that the F-47 would make a tactical approach prior to landing, believed the C-54 had time to take off before the fighter reached the final approach.

Therefore, he cleared the F-47 for an emergency landing.

To make things more complicated, the C-54 was working the tower on Channel A (VHF) and was not aware of the emergency landing about to take place. Also, the tower was unable to transmit on all channels simultaneously because of an inoperative relay; thus the controller, to transmit to both aircraft, had to switch rapidly between Channels A and B.

With this situation prevailing, the F-47 came over the end of the runway on the initial approach. He noticed the C-54 rolling on the taxiway as he peeled off to the left.

The C-54 pilot, still unaware of the emergency, taxied out to takeoff position and, rolling slowly down the runway, requested takeoff clearance.

The tower controller advised the C-54 to expedite his takeoff, but the C-54 crew claimed the transmission was garbled, so the pilot again requested clearance. The tower repeated its instructions and told the C-54 pilot an emergency was on the approach. Again, these instructions were unintelligible.

Seeing the C-54 on the runway as he turned on the final approach, the F-47 pilot asked the control tower to "get that 54 off the runway."

At this time, an instructor in the C-54 advised the pilot to hold until he could receive an understandable tower clearance. The pilot braked to a stop, and the instructor again requested tower clearance on Channel A.

Seeing the C-54 stop, the F-47 pilot told the control tower to hold the C-54 where it was so he could land over it.

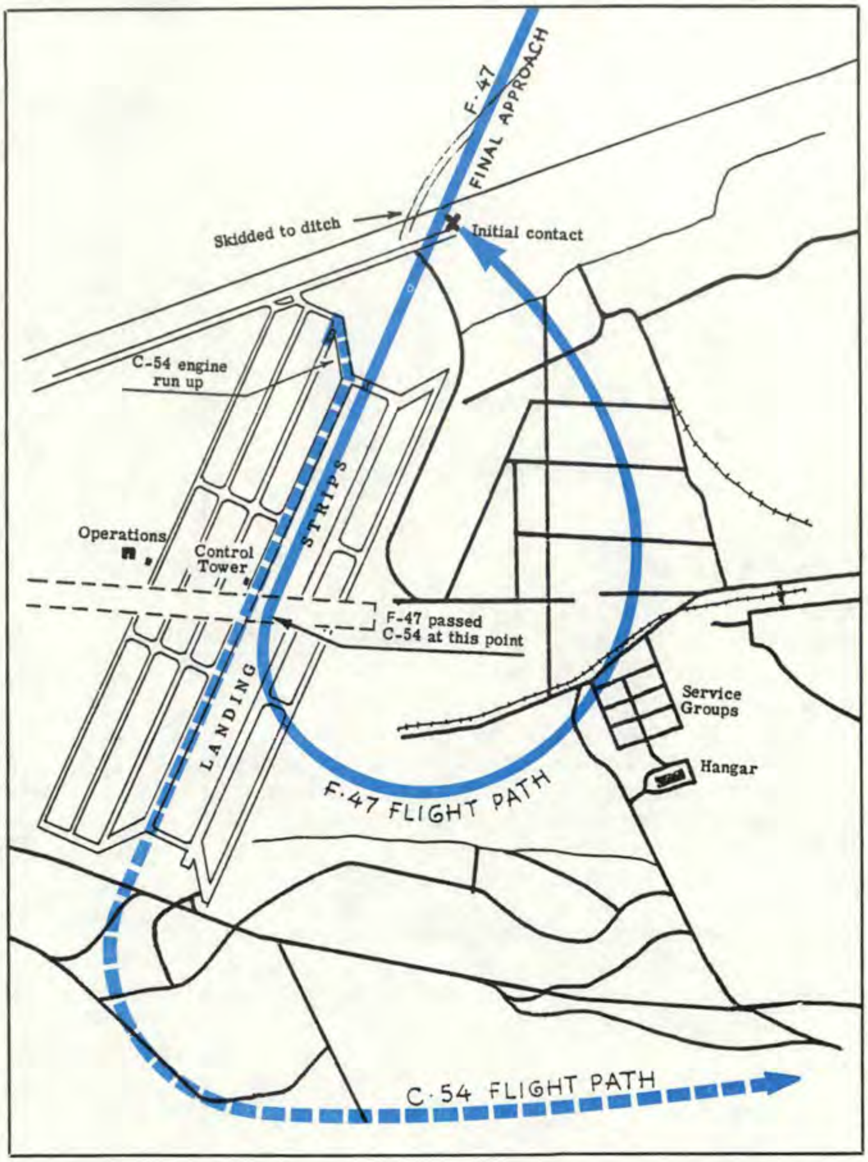
But during this transmission the tower was telling the C-54 pilot to expedite takeoff and he did.

After this, the tower called the F-47 pilot and advised him to go around. He had no alternative, so he started retracting his gear for a go-around, utilizing the 1,800 RPM and 30" Hg available.

Noting the F-47 sinking rapidly toward the C-54, the tower controller changed his mind again and fired a red flare in front of the C-54, but it was well on its way. The F-47 passed a few feet off the left wing of the C-54 while the latter had an altitude of approximately 2 feet. The C-54 continued its normal climb out of traffic, but the F-47, with insufficient altitude and airspeed, crash landed.

The pilot was knocked unconscious by the impact, but was otherwise uninjured. The aircraft was a total wreck.

With more errors in this mishap than in a doubleheader ball game, the percentage error ran 10% maintenance error, 60% supervisory error, and 30% error on the part of the C-54 pilot.



Maintenance error was evident because the brushes had not been centered on the slip rings of the newly-installed prop. This improper contact and resulting arcing and burning effected complete severance of electrical connection to the propeller control mechanism, making it impossible for the pilot to change pitch in any way.

Supervisory error was that the tower controller failed to refuse to work the C-54 on Channel A, failed to notify the C-54 pilot of the emergency until he had taxied onto the runway, cleared the C-54 for takeoff at the last moment, and he failed to use the Aldis lamp to control the C-54.

Pilot error was attributed to the C-54 pilot because he used Channel A instead of B in violation of established communications procedures. Also, he taxied onto the live runway without clearing the approach properly. Only the alertness and skill of the F-47 pilot prevented a major tragedy. In fact, the F-47 pilot was the only one using sound judgment, even though he was the guy behind the eight ball, as is often the case. ■

— Reprinted from *Flying Safety*, Oct 48.

OPS

A Pain in the Back

■ During his third ACT engagement at 450 knots and 7.5 Gs, the F-16 pilot felt a "pop" in his lower back accompanied by moderate pain. After the engagement was terminated, the pilot returned to base for an uneventful landing where he was grounded for 3 days for a minor lower back strain. The injury was most likely caused by a loose lap belt which allowed the pilot to arch his back prior to the high-G slice maneuver.

Remember to make sure you have a good body position before performing high-G maneuvers. A loose lap belt makes it much harder to maintain a proper position. Better to have a little pressure on your backside than pressure on a misaligned back.

Pin Sense

An F-4E crew was scheduled to fly in support of an ORI practice exercise. Everything was normal through briefing, preflight, and strap-in. The crew chief pulled the WSO's ejection seat face curtain pin, and both he and the WSO noticed something seemed wrong with the pin.

They looked closer and saw the pin had failed at the top, just below the head containing the pin release button. The pin stem remained in the seat. This did not disable the seat, but did render the overhead ejection handles inoperative. This unusual pin failure could have resulted in a disaster if the upper ejection handles had been needed for an ejection.

Alert action by the crew chief and WSO prevented a possibly serious problem from developing. How alert are you?

Pins don't break very often, but the potential is there. Sometimes the streamer comes off and the pin or plug remains in place. Conversely, installing the pin incorrectly or installing the wrong pin can lead to some real problems.

Pay close attention when removing or installing pins. A mistake could ruin your whole day.

Tree Strike

A UH-60A was being flown on a local pilot upgrade mission. The crew was practicing remote operations and made multiple approaches into a remote site. After an uneventful landing, the IP took control and brought the helicopter to a 10-foot hover. The IP then asked the flight engineer (FE) to clear the aircraft to the rear so the IP could reposition the helicopter for a simulated minimum power takeoff.

The FE looked out the right gunner's window and cleared the IP to the rear. As the helicopter backed toward the other side of the remote site, the FE told the IP to stop because he could see part of a tree under the stabilator. Unknown to the crew, the tail rotor blades struck several branches, some as large as 1.5 inches in diameter. All four tail rotor tip caps were damaged by the tree strike.

There were no vibrations or changes in flight characteristics, and the training flight continued for another 1.1 hours. The tail rotor damage was discovered during postflight inspection.

Safely backing a helicopter in remote operations such as this requires a scanner for each side, and they should use the cabin door so they can get a good view. This crew was lucky. You might not be.

TOPICS

Loss of Helmet

All crewmembers are told to keep their helmet chin straps tight in ejection seat-equipment aircraft. Some do, and some don't. During a recent Class A mishap, a pilot was forced to eject. His chin strap was loose, and his helmet was pulled off by the windblast. You might think that's no big deal, but consider this.

As the helmet departed, the oxygen hose pulled up on his CRU-60/P connector on his parachute harness and raised the torso harness. The right life preserver located under the pilot's armpit lifted his right arm away from his body into the airstream. The result was a dislocated shoulder and a broken arm. The pilot will be DNIF for approximately 45 days.

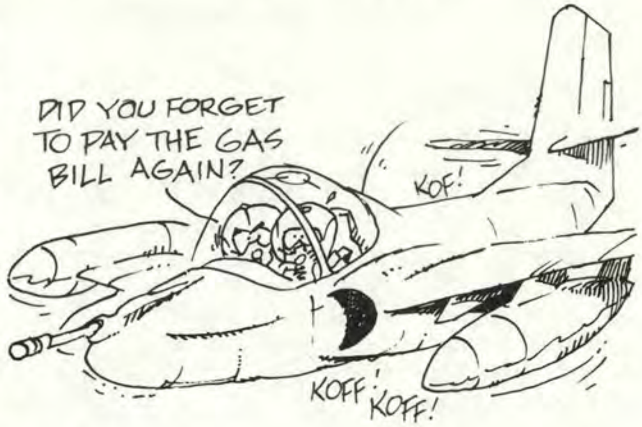
An otherwise successful ejection was marred by injury because of an improper adjustment of a chin strap. Let your life support equipment work for you by using it properly. Make sure everything is adjusted and functioning properly on every flight.

Stuck Blinker

Passing 5,000 feet on initial climbout, the T-33 pilot performed an oxygen system check and found everything working normally. Passing 18,000 feet, the pilot noticed the oxygen blinker was stuck open. Since he was feeling fine, he continued the climb. At 20,500 feet, the cabin altitude was 15,000 feet, and the pilot began experiencing symptoms of hypoxia.

The pilot selected 100 percent oxygen, and his symptoms immediately cleared up. He descended and accomplished an uneventful straight-in landing.

Another case of a pilot who got lucky. You should never press on with a known oxygen system malfunction just because you don't feel hypoxic. Sure, we all receive training in recognizing our personal hypoxia symptoms. But, we also know the onset can be very insidious and hard to recognize. What happens if the hypoxia starts when we're already task saturated by an aircraft malfunction, traffic conflict, or any number of other things? You may not be lucky enough to recognize the hypoxia symptoms before it's too late.



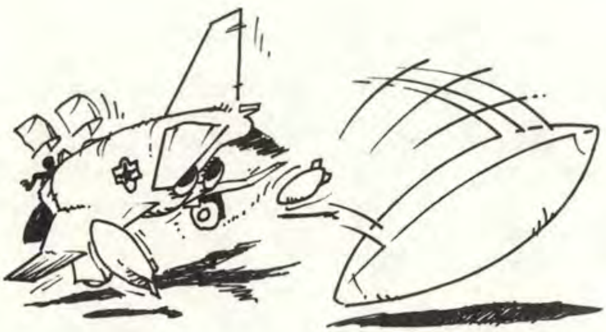
Low Fuel

Two pilots had been airborne about 30 minutes in an OA-37B and were still using external tank fuel. They were on the crosswind leg of a GCA and passing 1,800 feet for 2,500 feet. During a routine fuel check, the crew found the fuselage fuel quantity reading at 150 pounds with a total internal quantity of approximately 1,100 pounds. The IP immediately selected gravity fuel and set the throttles at minimum necessary to maintain altitude. Within about 5 to 6 seconds, the fuselage quantity indicated full, and the total fuel had increased.

The IP declared an emergency and made a full stop landing with the fuel selector remaining in gravity. No fuel system warning lights illuminated until gravity fuel was selected, at which time the gravity fuel light came on. Maintenance discovered a faulty float switch assembly and replaced it.

A good practice of regular fuel checks by this alert crew prevented what could have been a serious mishap. Had they not discovered the low fuselage fuel quantity, they probably would have soon been faced with a double engine flameout while low and slow. The chances of successfully recovering from such a situation are not good. Good heads up flying! ■

tech topics



THE REST OF THE STORY

■ After the external wing fuel tanks were hung on the F-4, two weapons specialists reported to the aircraft to perform system jettison checks. The first individual checked the forms for any power restrictions, noted a "dearmed" writeup, and continued his walkaround. His assistant also performed a walkaround, removed the centerline safing pin, but didn't check the breeches. Individual number one entered the cockpit, applied power, selected the switches, and depressed the "jettison" button. Bam! The centerline fuel tank, full of fuel, hit the ground!

Investigation revealed the aircraft was armed the previous day and flew three sorties with a centerline tank. At the end of flying, the aircraft crew chief performed a combined preflight/basic postflight (BPO) inspection while maintenance was being conducted by specialists. The crew chief transferred all open writeups onto an active 781A. Assuming his jet to be dearmed (due to past experiences of weapons arming/dearming without the availability of the forms), the crew chief entered an unauthorized "aircraft dearmed" writeup into the 781A. After the wing tanks were installed on the following day, the weapons folks were asked to perform a jett check.

As a famous radio commentator would say, "And now you know the rest of the story!" Cost of the external centerline tank was $3,062 while the 600 gallons of fuel cost $474.

This whole mess could have been avoided had the crew chief not entered the erroneous "dearmed" writeup in the forms. Although the weapons technician checked the 781A, he failed to check the breeches for a dearm verification, as required by the tech data.

In the final analysis, the only way we'll prevent incidents such as this is for people to follow tech data and document their own work, not what they assume someone else may do.

FOLLOW THE RECIPE

If you've ever had the unfortunate experience of eating someone's cooking when instructions were not followed, then you know why each step in the recipe is important. And so it is with checklists. If you leave out a step or deviate from a checklist, the whole job might very well end up looking like a fallen souffle.

One load crew found this out the hard way. They had been given the job of performing a system jettison check following an engine change and centerline pylon installation on an F-15. Technician one was seated in the cockpit operating the switches, while technician two operated the test equipment on the ground. The "jett check" was accomplished, and the centerline system checked good.

Prior to shutting down the aircraft power, the ground technician started to install the impulse carts in the pylon breeches but had not safety pinned the pylon. After rotating both breeches in by hand, he began to tighten one breech with a ratchet when the cartridges fired, slamming the pylon to the ground. Unknown to the man on the ground — who failed to install the pylon safety pin after the jett check — his buddy in the cockpit accidentally pushed the selective jettison button.

This crew was decertified, but it would only be fair to mention the other circumstances involved. For one thing, they were working in cold, rainy weather, and it was their last work order of the day. This led to the "press-on, must-get-it-done" attitude which seems to be at the root of many explosive-related incidents. Sometimes this attitude is intensified when people are deployed, away from their usual supervision and normal routine. Since a great deal of aircraft maintenance, especially our "jettison system checks," are performed at night in cool weather, extreme caution becomes a vital ingredient. So use your recipe (tech data): You'll get the job done right!

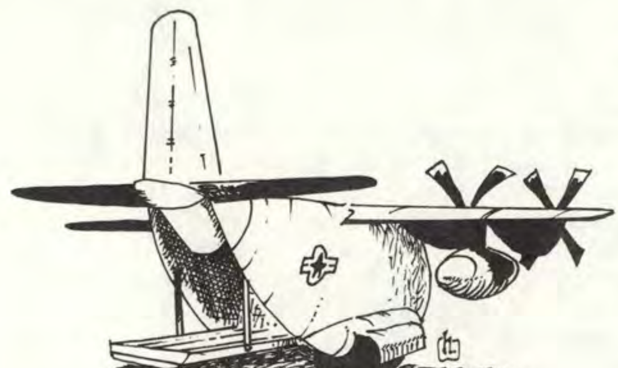
tech topics

F-16: FLASHLIGHT FOD

The F-16 was scheduled for its second sortie of the day. During the backup fuel control (BUC) check just after engine start, the crew chief noticed small pieces of black plastic exiting the engine exhaust area and directed the pilot to shut down.

The investigation soon determined the engine, which had to be pulled and shipped to overhaul, had tried to swallow a six-volt flashlight. After checking his tool box, the crew chief discovered a missing flashlight — the same flashlight that he used during the thruflight inspection following the previous flight.

Here's a lesson for both aircraft operators and maintainers. For the maintenance folks, it's a good idea to account for all tools prior to engine start, and then again prior to aircraft taxi. And pilots and maintenance alike need to remember it takes the eyes several seconds to adjust from bright sunlight to the relatively dark intake.



C-130 MISSED "CAUTION"

After completing the lube cards on a C-130 undergoing isochronal inspection, a maintenance technician proceeded to retract the ramp using the aircraft hand pump. Closing operations went smoothly until he noticed a 12-inch gap between the ramp and the aft cargo door. He continued operating the pump, when suddenly a loud "pop" was heard! A quick inspection revealed a 36-inch crack to the right lower longeron assembly.

What caused this $11,000 ground mishap? No one adhered to the "CAUTION" in the TO which states: "Visually inspect the ramp locks to ensure they are all fully retracted prior to raising ramp to closed position."

Once again, we remind all maintenance personnel to be aware of the importance of tech data "WARNINGS" and "CAUTIONS." Let's not damage aircraft or hurt someone by failing to adhere to these key words.

CAREFUL WITH THE SEATS

Two egress systems technicians were moving an ejection seat from a dolly maintenance stand within their shop. After installing the JAU-3 initiator, they placed the seat on a work bench. Suddenly, they heard the initiator fire.

Why did it happen? The egress technicians didn't install the safety pins into the ejection seat handles. The full weight of the bucket resting on the handles enabled them to rotate, causing the initiator to fire.

Here's another incident. After pulling a seat from an aircraft on the flightline, the two egress technicians took it to their shop for an inspection. Upon close examination, they found several cracked nutplates which required disassembly of the seat.

Technician one removed the explosive items from the seat and noticed the sear on the guillotine was bent. He told his shop chief who directed the removal of the sear for further inspection. At this time, the cartridge was not in the guillotine.

Technician one returned to the maintenance bay, reinserted the cartridge into the guillotine for "safe keeping until he could obtain a cart can," but did not install the safety pin.

Technician two, unaware the cartridge was now installed, directed his assistant to pull the sear. The first technician handed the guillotine to technician two who, assuming it to be safe due to the lack of the safety pin, pulled the sear. The cartridge fired, impacting technician two's right hand and stomach. Fortunately, he was only hospitalized for 3 days and was able to return to duty.

The best in technical data is available for our use. Strict adherence to the TO procedures will prevent any possibility of egress system incidents such as these. The safest way to perform any maintenance task is to follow the book. Egress system errors can be prevented if supervisors require strict adherence to tech data. Even the most simple maintenance should never be attempted without it.

continued

tech topics

F-16 MISSING AXLE SPACER

The F-16 pilot aborted at end of runway (EOR) for an equipment hot light. While taxiing back to his parking spot, he felt a thump followed by a severe nosewheel vibration. He stopped the aircraft and shut down on the taxiway.

Examination of the nosewheel revealed the axle nut had backed off, allowing the nosewheel to come loose. Prior to the attempted flight, a crew chief removed and replaced the nosewheel assembly, and a 7-level technician signed off the red X. Not only was the spacer installation step in the TO skipped, but a local in progress inspection (IPI) had also been overlooked. Once the wheel assembly is installed, there is no way to determine if the spacer is in place — until the pilot feels a thump followed by a vibration during taxi!

Last year, another Falcon pilot heard a thump, only his unusual sound happened during gear retraction after takeoff. With a red light in the gear handle, he gave a heads up to his flight leader. After lowering the gear and seeing three green lights, he was told by the lead that the nosewheel assembly was missing. Through skillful maneuvering, the mishap pilot slid the F-16 along the runway for 6,000 feet, stopped and got out of the jet safely. Here was another spacer that was left off during a previous nosewheel change, allowing friction to back off the axle nut and the wheel to fall off.

Once again, it's the small things that contribute to mishaps: A missing spacer, a skipped IPI, no last look before leaving the job. When you finish a task, take that extra minute to think: Did I follow the TO? Is everything in place? It'll be one of the most important, profitable minutes you'll spend all day.

PORTABLE OIL ANALYZER READY FOR USE AT REMOTE SITES

The Air Force has a new, portable system to enable its technicians to check for wear on aircraft engine components. Known as the Portable Wear Metal Analyzer, it was developed by Aeronautical Systems Division's Aero Propulsion Laboratory (APL) at Wright-Patterson AFB, OH.

Air Force technicians regularly check aircraft engine wear by analyzing the engine oil. Through analysis, they find out exactly which metals, and how much of each, are present in the oil, indicating which parts of the engine are wearing. Oil analysis is required in forward, austere operating locations, as well as at established bases, and, for some aircraft, on an after-each-flight basis. The decision to continue or to cancel further flights is often based on these analyses.

Remote site oil analysis can be plagued by costly, cumbersome logistics. Now there is a way to perform oil analysis quickly and easily in the field, without the support of a stationary laboratory.

Operating the portable analysis instrument, a technician, using a specially-designed tool, merely injects a 10 microliter oil sample into a miniature furnace. He pushes a button on the analyzer and, within 4 minutes, gets a printed readout of the wear metal content in the oil (the electrical power required by the device may be supplied by a portable generator).

The Portable Wear Metal Analyzer consists of two rugged, suitcase-size containers (see photo). One, the furnace-optics case, houses the graphite furnace and its power supply; two multi-element lamps; special optics; and a dispersion device called a polychromator. The other is called the electronics-argon case assembly.

With this portable system, it's now possible to provide timely oil analysis at any time in any location.

It contains a tank of nonflammable argon gas which, among other functions, prevents the carbon from oxidizing. It also houses the microcircuit electronics and printer which give the technician the analytical results.

When set up and connected by a cable, the two portable "suitcases" are transformed into a functional spectrometer system, making possible the identification and quantification of nine specific elements used in various components of the engine: Silver, aluminum, chromium, copper, iron, magnesium, nickel, silicon, and titanium.

Responsibility for the program is with the San Antonio Air Logistics Center (ALC), Kelly AFB, Texas. For further information on the Portable Wear Metal Analyzer, contact Mr Henry Solar at AUTOVON 945-6408.

— Courtesy of *Mr. Mike Wallace*, Wright-Patterson AFB, OH ■

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UNITED STATES AIR FORCE

Well Done Award

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

CAPTAIN
Dietmar Amelang

CAPTAIN
Byron H. Wall

48th Tactical Fighter Wing

■ On 25 November 1985, Captains Amelang (Pilot) and Wall (WSO) were flying low level in an F-111F aircraft when several unrelated caution lamps on the master caution panel began to flash. Captain Amelang immediately began a climb. Shortly thereafter, the left bleed duct failure caution lamp and the left engine fire warning light illuminated.

Captain Wall, relying on his dead-reckoning and astute situational awareness, immediately gave Captain Amelang a heading toward the nearest emergency divert airfield. Although Bold Face emergency procedures for fire indications had been accomplished, the left fire light remained on. En route to the emergency field, the crew learned strong wind conditions and a wet/icy runway would prohibit a direct approach and landing.

With the left fire light still indicating the possibility the aircraft was on fire, the crew could not dump fuel. They maneuvered their very heavy aircraft for a single engine approach to a wet and icy runway with no arresting gear. To complicate their situation further, on short final, the cockpit filled with smoke and fumes. Despite the increasingly severe situation, Captain Amelang flew a perfect approach and landing.

The outstanding airmanship, sound judgment, and expert knowledge of procedures and systems demonstrated by Captains Amelang and Wall prevented the loss of a valuable aircraft and possible loss of life or injury to themselves. WELL DONE! ■

Mirror, Mirror on the wall
Time and Stress affect us all.