flying

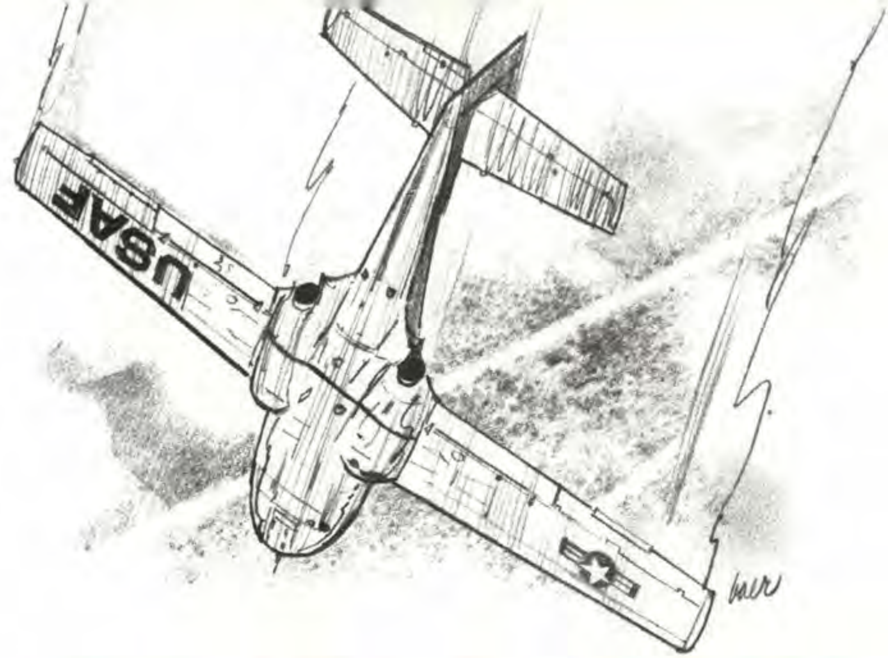
SAFETY

OCTOBER 1984

Winter Operations

Cold Facts

The Professionals



THERE I WAS

■ The sky was crystal clear with scattered "puffies" from 4,000 to 10,000 feet, and I couldn't believe the Air Force paid us for doing something I enjoyed so much. Having just passed 500 hours as an IP in the mighty "Tweet," I felt nothing could go wrong that I couldn't handle.

My student was scheduled for his spin orientation ride, so after a thorough ground briefing we leaped off (if you can say "leap" in a T-37) into the wild blue yonder. The mission was normal, and the student was doing quite well for this phase of training. I started the spin instruction as we had briefed on the ground and after the "tell and show" portion, I let the student have a go.

We all remember the apprehension each student has during his first spin in an aircraft. Today was no different. I took control of the aircraft a few times until he finally got it right. When the student achieved the desired level of proficiency, I decided to finish up by showing him some aerobatics, then "head for the barn." Since the day was still VMC and I could see the base, I started the descent without accomplishing the "descent checklist."

The scattered "puffies" proved too good to be true; so I started to whip in and out of the clouds, dragging a wing tip in the clouds during each high G turn. The student was eating it up, and before too long he asked if he could try it. "No sweat, GI," and I gave him control. The first few descending turns were a little meek, so I told him to G it up a little or we wouldn't get down in time to enter the VFR entry point. The next thing I knew he pulled 4 Gs to the left, and into the clouds we went. I took control immediately and went to the instruments. What I saw sent a cold chill down my back. All the instruments seemed to be spinning — nothing was right — I had forgotten to do the instrument checks after the spinning and aerobatic maneuvers (descent checklist).

When was the last time you had to use the turn and slip indicator for real? I couldn't get it to work right. "I'm in real trouble now!" I thought. I felt the aircraft shudder — airspeed falling off — altitude climbing — "When am I going to pop out of this cloud?" I froze the controls to let the aircraft settle down.

The next thing I saw was airspeed increasing and altitude rapidly unwinding. All I could think was "The cloud isn't that thick, and we're going to break out soon." Those few seconds seemed like a lifetime and I had decided that, if we reached 5,000 feet — still in an out of control condition — ejection was the next step. However, as luck would have it, we broke out passing 5,200 feet in a high speed drive. I recovered the aircraft and headed for home.

The cockpit was very silent while I was thinking how stupid I had been. First, the use of checklists is always required in any type of weather. So use them! Second, I had violated the VFR rules, and that had almost caused me to "buy the farm." Needless to say it hasn't happened again — I suppose this is what they mean by *experience!* ■

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IBC Well Done Award

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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WINTER OPERATIONS —
Keep It Clean

A clean, uncontaminated aircraft is required to achieve certified takeoff performance and handling characteristics and is a precept of good airmanship. This is the fundamental basis of the Federal Aviation Regulations "Keep It Clean" requirements.

A.R. MULALLY — Technology Chief Engineer, 707/727/737 Production Programs
M.D. SHIRKEY — 737 Stability and Control Staff Lead Engineer
C.R. HIGGINS — 727 Aerodynamics Staff Lead Engineer

Introduction

■ Airplane contamination has been the topic of many articles in the past. This article expands on the effects of frost, snow, or ice contamination on airplane performance and handling characteristics using data obtained with the 737. Taking off with an airplane contaminated with snow, ice, or frost can be dangerous, is in violation of Federal Aviation Regulations (and Air Force directives), and should be avoided. The purpose of this article is to provide the operator further insight into the importance of the "Keep It Clean" ground maintenance and flight operations philosophy. In addition, operational procedures are suggested that increase safety margins in the event of undetected contamination. Boeing has conducted wind tunnel, flight, and simulator tests with the 737 to better understand the effects of wing and horizontal tail contamination on airplane performance and flight characteristics. The results of these studies indicate that contamination significantly reduces wing lift capability, increases stall speeds and decreases climb capability. Consequently, a pilot may encounter buffet, pitch and roll pre-stall flight characteristics before stick shaker warning during a normal takeoff maneuver as a result of wing and tail contamination.

Simulated Contamination Configuration Tested

The characteristics of ground contamination vary as widely as the atmospheric conditions under which contamination accumulates. To permit contamination is to lose control of the aerodynamic configuration because the flight characteristics of the aircraft are then unpredictable to the pilot. A clean, uncontaminated aircraft is required to achieve certified takeoff performance and handling characteristics and is a precept of good airmanship. This is the fundamental basis of the Federal Aviation Regulations "Keep It Clean" requirements.

Contamination configurations that can be detected, and should be removed prior to takeoff, were simulated and tested. Two levels of contamination are discussed and are identified as "Frost A," and "Frost B." Frost A is roughly equivalent to sandpaper in the 40- to 60-grit range. Frost B is roughly equivalent to 16- to 24-grit sandpaper. Typical surface characteristics of these contamination levels can be observed from the actual photographs shown in Figure 2. The simulated Frost A contamination was created by spreading epoxy potting compound over 3M Brand general-purpose safety walk and then roughening the surface with a texture paint roller to create peaks and valleys. A second coat of epoxy potting compound was applied and fur-

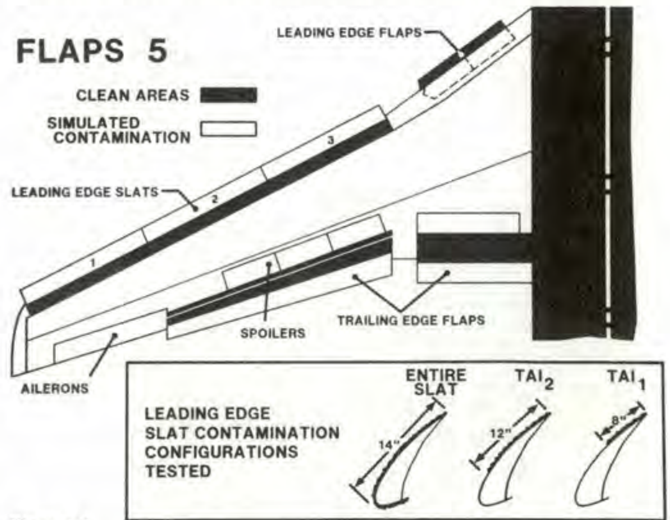


Figure 1
Simulated contamination configurations tested. (A) entire slat contaminated (B) TAI$_2$ effect at 0°F ambient (C) TAI$_1$ effect at 20°F ambient.

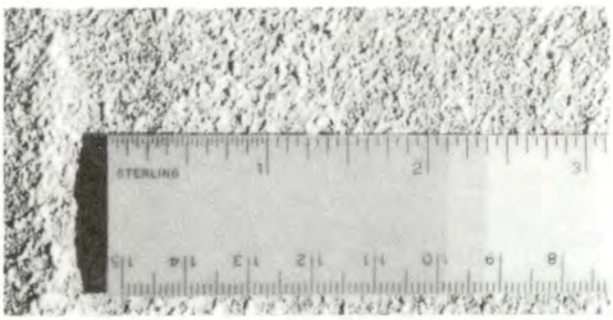
ther roughened to achieve the Frost B surface.

Figures 1 and 3 illustrate the wing areas that were covered by the simulated contaminations. The areas noted as "CLEAN" are not exposed when the flaps are retracted, and since it is common practice in adverse weather to taxi to the takeoff point with the flaps retracted, these areas are not subjected to contamination on the ground. The effect of partial cleaning of the leading edge slats through the use of a ground-operable Thermal Anti-Ice (TAI) system was also evaluated during the tests. This was done by removing the contamination from the leading edge of the slats in steps while leaving the upper wing surface contaminated.

The first step, labeled TAI_2 on Figure 1, corresponds to the predicated de-icing capability of the ground TAI system at 0 degrees Fahrenheit. The second step, labeled TAI_1, represents operation of the ground TAI system at 20 degrees Fahrenheit.

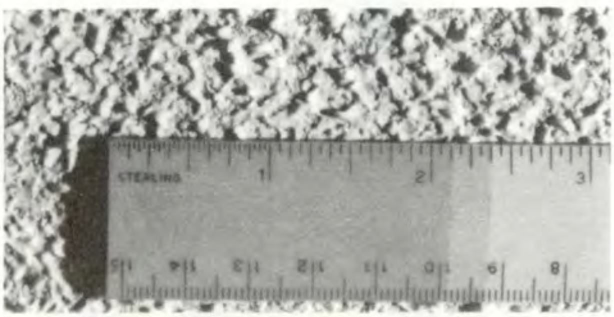
continued

Figure 2 Simulated frost close up.



Frost A — approximately equivalent to 40-60 grit sandpaper.

Frost B — approximately equivalent to 16-24 grit sandpaper.



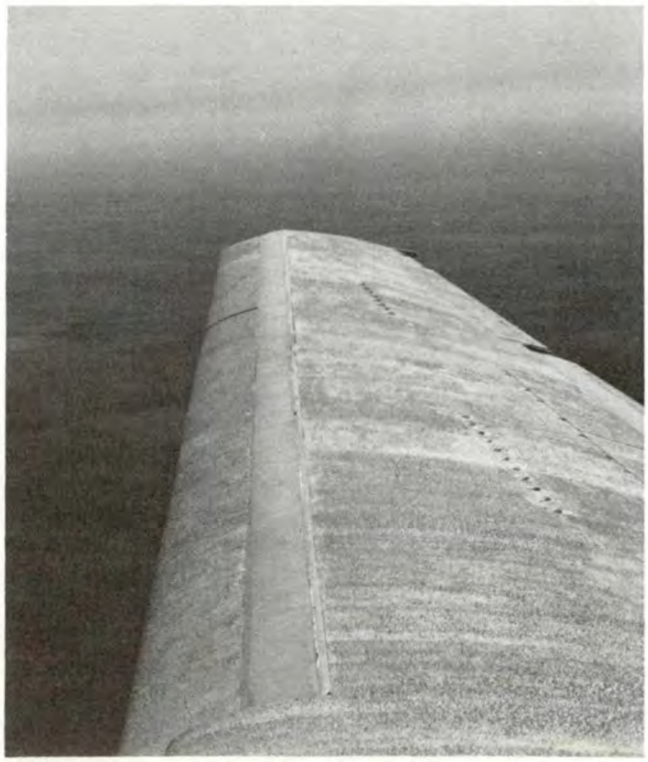
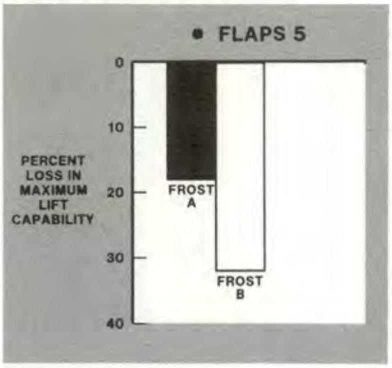


Figure 3

Frost B inflight.

WINTER OPERATIONS . . . continued

Figure 4
Contamination degrades maximum lift.



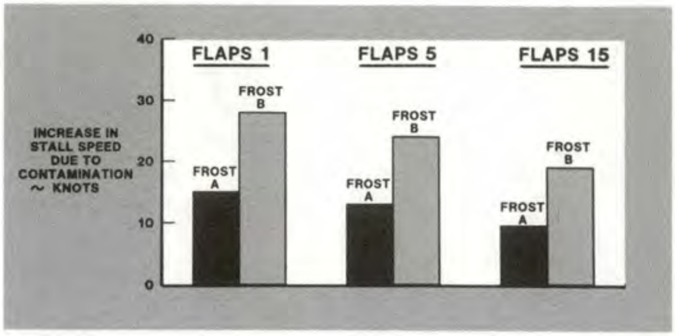
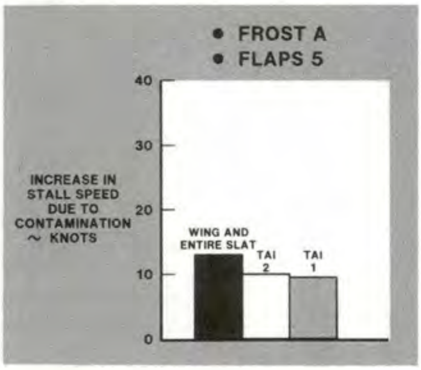


Figure 5
Contamination increases stall speeds.

Figure 6
Effect of ground operable TAI on stall speed increases.



Contamination May Result in Impending Stall Flight Characteristics Before Stick Shaker Warning

During any winter takeoff, when atmospheric conditions are conducive to contamination, the pilot should be aware that increasing buffet, pitch, and roll activity may be an indication of premature stall caused by wing contamination. These indications are an immediate signal to recover from an impending stall consistent with ground proximity regardless of whether or not the stick shaker has activated. This situation can be understood by reviewing the general characteristics of airplane stalls.

"STALL ONSET" is the region preceding a full stall where the airplane's flight is characterized by ever increasing buffet, pitch, and roll activity. The magnitude of the buffet, pitch, and roll activity varies with airplane type and flap setting, but the "STALL ONSET" region exists on all airplanes. The "STALL ONSET" sequence

Figure 7
Contamination reduces stick shaker margins.

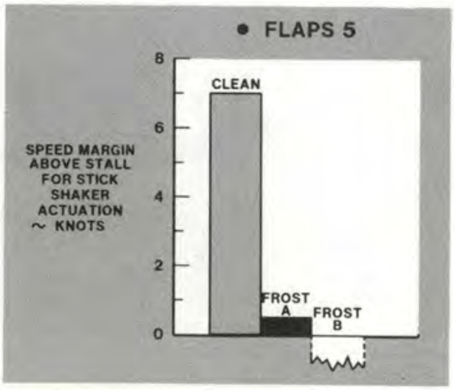
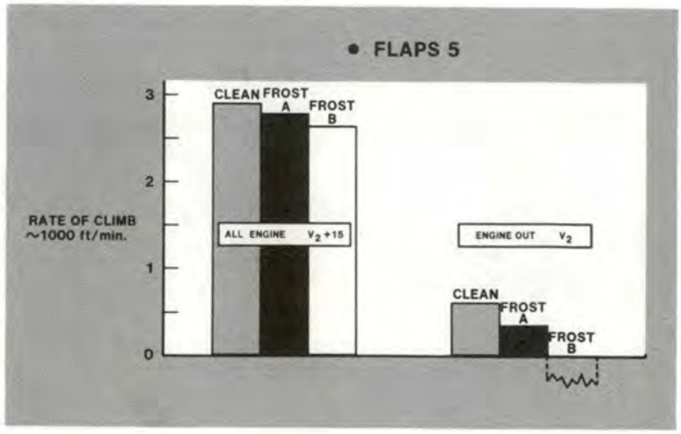


Figure 8
Contamination decreases rate of climb capability.



typically consists of four distinct events. Usually, the first sign of an impending stall on a modern jet transport is the activation of an artificial warning device as shown in Figure 9. All Boeing aircraft use an electrically actuated column shaker for this artificial stall warning to alert the pilot before "STALL ONSET" flight characteristics are encountered. Activation of this stall warning stick shaker is based on a preset angle of attack. Second, as the airspeed is further reduced (and angle of attack is increased) toward stall, the airflow cannot remain attached over the entire wing and will begin to momentarily separate near the wing trailing edge. A buffeting, or mild shaking of the aircraft, results as the lift force on the aircraft begins to fluctuate. The buffet intensity will increase as the airspeed is decreased further (and angle of attack is increased) and the areas of separated flow expand. Third, as the stall progresses, and the separated flow region further expands, the center of lift moves forward, requiring less control force from the pilot to continue raising the nose and decreasing the airspeed. This pitch activity, which indicates "STALL ONSET," is typically referred to as reduced pitch stability or stick-force lightning by flight test pilots. A fourth characteristic of "STALL ONSET" is a noticeable increase in roll activity and a corresponding increase in the lateral control action required by the pilot to maintain wings level. Initially, this roll activity and the associated lateral control action are caused by asymmetries in the fluctuating separation patterns on each wing. However, as the "STALL ONSET" progression continues, the lateral control action required to keep the wings level increases as the separated flow regions expand to include the ailerons and spoilers, causing them to be less effective. The Federal Air Regulations require that all certified airplanes have sufficient pitch and roll control capability to recover at any time during a stall maneuver.

When the wing is contaminated, the "STALL ONSET" buffet, pitch, and roll activity flight characteristics are similar to a clean wing. However, these "STALL ONSET" flight characteristics may now occur within the clean airplane's normal maneuvering envelope, before stick shaker activation, as is shown in Figure 9. This is a result of the early flow separation caused by contamination. Consequently, the stick shaker may not provide warning of "STALL ONSET" flight characteristics for the contaminated airplane. Of course, the details of the contaminated wing "STALL ONSET" flight characteristics will vary as widely as the possible variations in the contamination accumulation. Buffet, pitch, and roll activity "STALL ONSET" flight characteristics are immediate signals to recover from an impending stall consistent with ground proximity, whether or not the stick shaker has activated. Test results indicate that even with the worst contamination tested, the pilot's pitch and roll control capabilities were not significantly degraded. These ample control capabilities allow positive recovery from "STALL ONSET."

Contamination Exposes the Pilot to "STALL ONSET" During a Normal Takeoff Rotation Maneuver

The Boeing Engineering Flight Simulator was programmed with contaminated airplane aerodynamic characteristics based on the results of the wind tunnel and flight test programs. A number of simulated takeoff maneuvers were flown, with and without the effects of symmetric contamination included. The simulator results indicate that pilots may encounter "STALL ONSET" flight characteristics during a normal takeoff rotation maneuver when an airplane is contaminated

continued

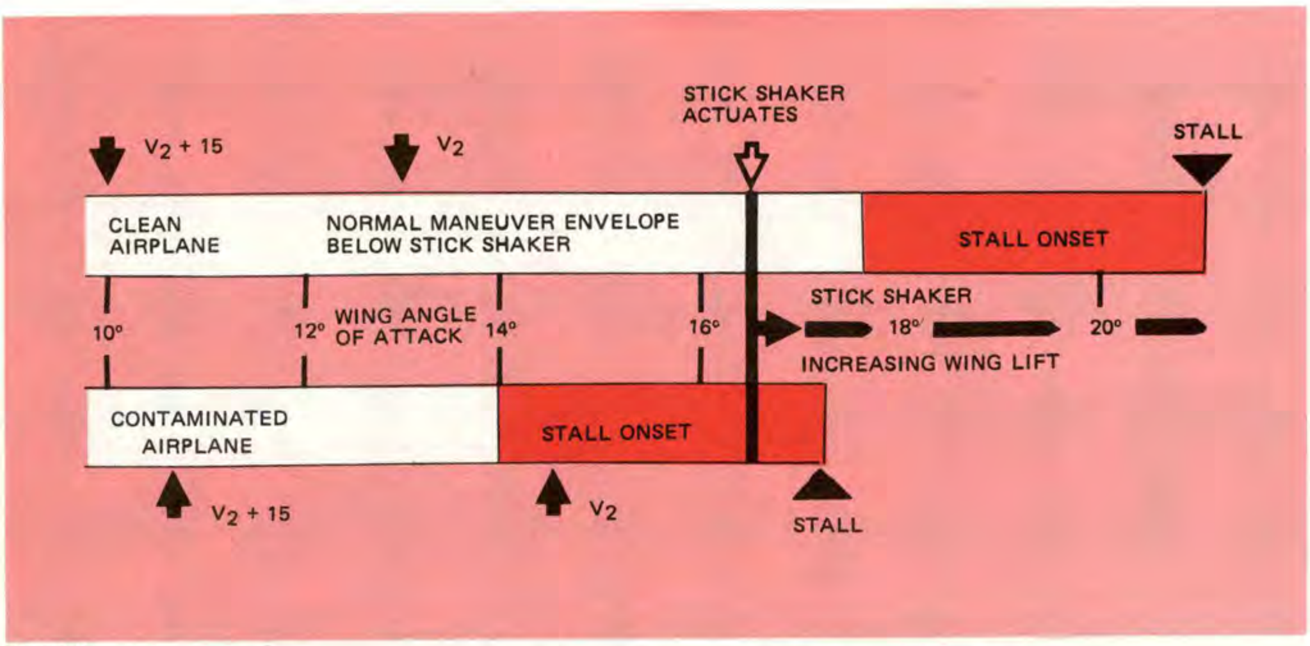


Figure 9

Contamination results in "stall onset" flight characteristics before stick shaker.

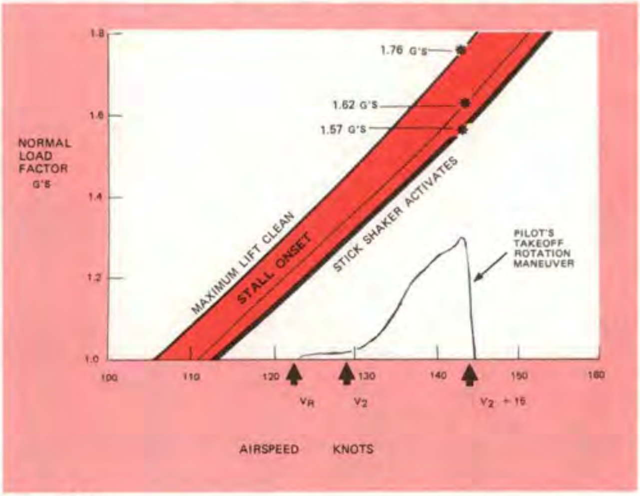


Figure 10

Clean airplane.

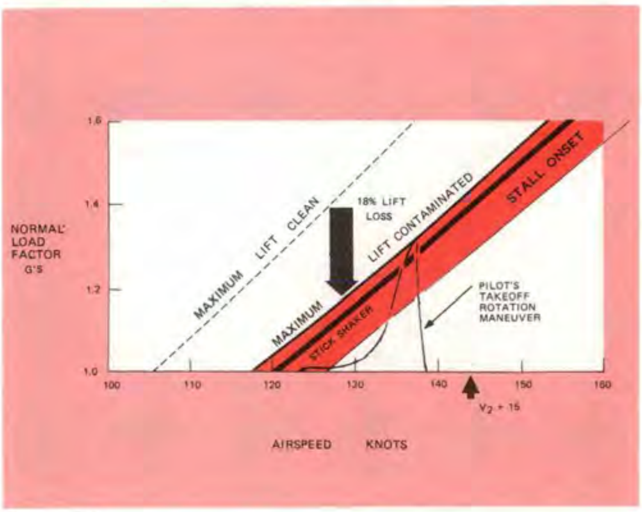


Figure 11

Contaminated airplane wing and tail.

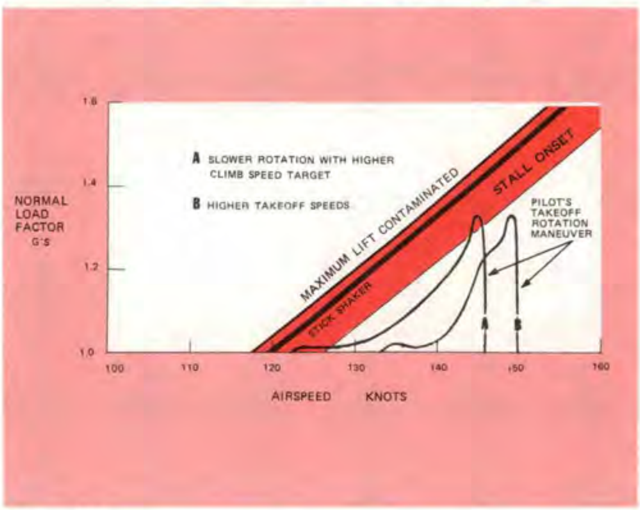


Figure 12

Contaminated airplane wing and tail.

if pitch rate and attitude are not adequately controlled.

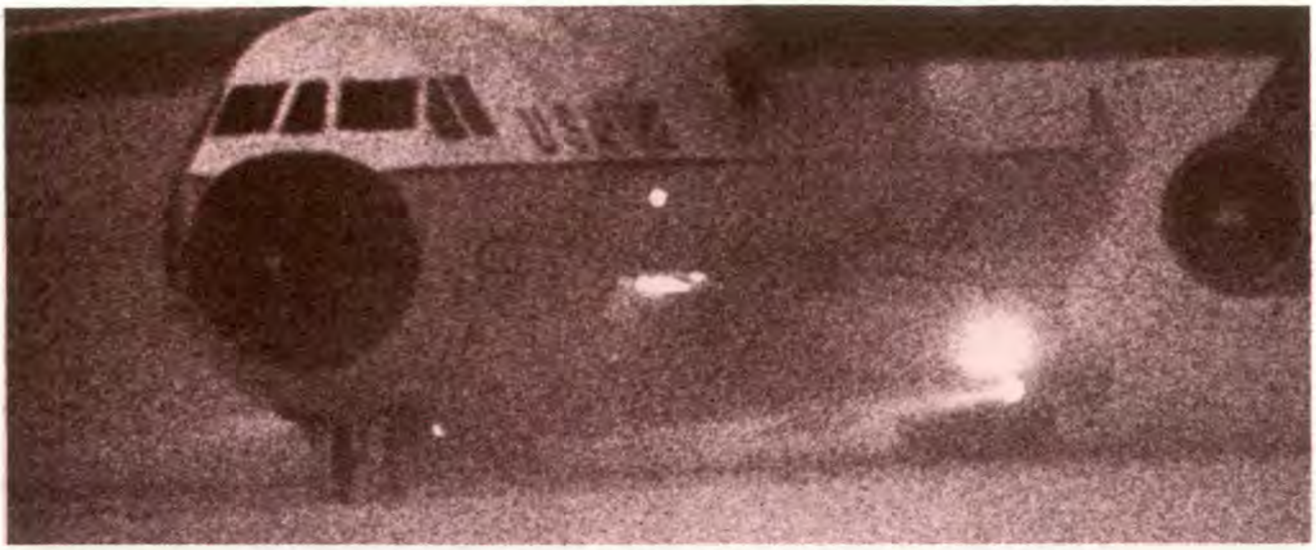
With a clean airplane, the pilot has learned to make a stick force input which results in a smooth pitch attitude and speed transition to the climb targets. The pilot further expects the airplane to be "in trim" for climb with essentially zero stick force.

With a contaminated airplane, the pilot's customary stick force input results in a pitch response that is different than anticipated. As pitch attitude approaches the climb target, it continues to increase, requiring a push force to capture the desired climb target attitude. In addition, the pilot must hold a push force to counter an apparent mistrim condition. Airspeed, although not alarmingly low, falls below the desired climb airspeed target. During the pitch overshoot, the contaminated aircraft actually penetrates the contaminated airplane "STALL ONSET" region where buffet, pitch, and roll activity occur. The flight characteristics associated with a contaminated airplane may be more or less severe, depending on the nature and symmetry of the contamination accumulation.

The pilot penetrated "STALL ONSET" with the contaminated airplane because wing and tail contamination:

(1) Reduce wing lift capability and result in the "STALL ONSET" flight characteristics in the normal takeoff maneuvering envelope before stick shaker;
(2) Cause the airplane to be mistrimmed in the airplane-nose-up direction; and
(3) Reduce the airplane's pitch stability.

A fourth contributing factor is the time required for a pilot to react to the airplane flight characteristics that have been changed by the contaminated wing and tail. As was shown in Figure 9, contamination moves the "STALL ONSET" region closer to the normal takeoff speeds and eliminates the "STALL ONSET" warning provided by the stick shaker. The release is calculated to put the clean aircraft "in trim" for climb. When the wing and tail are contaminated, the aircraft trim characteristics are changed, creating an airplane-nose-up mistrim condition during the rotation maneuver. The decrease in pitch stability and mistrim caused by contamination results in higher rotation rates for the same stick force input. The pilot expects his aircraft to be free from contamination after approved ground maintenance procedures and it takes him time to recognize that his aircraft is not responding normally and to take appropriate corrective action. The combination of the pilot's reaction time with the higher rotation rates results in the pitch attitude overshoot by the pilot of the contaminated airplane. The simulator studies further indicate that when the pilot suspected contamination and was aware of how contamination affects the airplane's pitch response, the pilot used less stick force to rotate the airplane which minimized pitch



Test results provide further insight into the importance of a comprehensive winter operations maintenance program.

attitude overshoots. Test results indicate that the airplane was controllable in pitch and roll throughout the takeoff maneuver. The climb target airspeed is undershot because of the higher drag created during the pitch attitude overshoot.

Operational Procedures Can Increase Takeoff Margins

Further insight into the effect of contamination on the takeoff maneuver is provided in Figures 10-12, which present available maneuver margins. Starting with the clean airplane as a baseline, Figure 11 shows the maneuver capability of the airplane to stick shaker activation, "STALL ONSET," and maximum lift. At the target climb speed, a pitch maneuver generating 1.57 Gs would result in stick shaker activation. At 1.62 Gs the "STALL ONSET" region indicates that further increases in load factor will produce buffeting, pitch, and roll activity. At 1.76 Gs, maximum lift is achieved and the clean aircraft would experience a complete stall. The "PILOT'S TAKEOFF ROTATION MANEUVER" between VR and V2+15 shows the load factor required to maneuver the airplane during a typical takeoff rotation which stabilizes on the target climb speed. A maneuver margin of 0.3 Gs exists from the pilot's peak load factor and "STALL ONSET." This ample "G" margin is available to maneuver the clean airplane over and above the requirements of the takeoff rotation maneuver without encountering "STALL ONSET" flight characteristics.

A similar analysis is shown for an airplane with a contaminated wing and tail in Figure 12. Note that the 18 percent loss in maximum lift due to contamination reduces the maneuver capability available at any speed by 0.3 Gs. As previously explained in Figure 9, the "STALL ONSET" region now has correspondingly moved down before stick shaker activation, into the normal takeoff maneuvering envelope. The shape and location of the "PILOT'S TAKEOFF ROTATION MANEUVER" for the contaminated airplane is also different as a direct result of the pitch attitude overshoot described above. The peak load factor is slightly higher and occurs at a lower airspeed. The deep penetration of the "STALL ONSET" region during this takeoff results in buffet, pitch, and roll attitude excursions.

After approved maintenance procedures are completed, margins can be increased by (1) rotating slower while targeting higher airspeed; and (2) increasing the takeoff speeds. Both of these operational procedures move the "PILOT'S TAKEOFF ROTATION MANEUVER" to higher speeds, away from the "STALL ONSET" flight characteristics as shown in Figure 12. The use of increased takeoff speed must be accounted for in dispatching the airplane. This will ensure that the airplane can take off at the higher takeoff speeds within the available field length. Winter weather operational procedures are contained in the T.O.s for each aircraft.

Conclusions

These test results provide further insight into the importance of a comprehensive winter operations maintenance program that results in clean airplanes during takeoff. Proper ground maintenance procedures and pilot awareness need to be emphasized. Frost or ice on the aircraft can seriously reduce climb and maneuvering capabilities and expose the pilot to "STALL ONSET" flight characteristics during the critical phase of takeoff without a normal stick shaker stall warning. With awareness of these hazards, the flight crew can assure safe takeoff margins by rotating slower and using increased takeoff speeds when operating in atmospheric conditions that are conducive to contamination. If contamination is suspected at any time prior to the takeoff roll, particularly if lengthy delays occur after de-icing is completed, the aircraft should be returned to maintenance for clean-up prior to takeoff. Safe winter operations will be assured with continued alertness to potential icing conditions; rigorous adherence to the "Keep It Clean" ground maintenance philosophy; flight crew awareness of the hazards associated with contaminated aircraft operations; and the use of operational procedures that increase margins. — Adapted from Boeing *Airliner*, Oct/Dec 83. ■

Cold Facts

Got a second? Take the special one question quiz below. If you answer it correctly, you may be a winner.

Circle The Correct Answer:

You are cruising at FL 370 and the flight is proceeding normally. You notice an altimeter reading of FL 375 and attempt to correct back to FL 370 by retarding power and pushing forward on the controls. To your bewilderment, no effect is noted on either your indicated altitude or VVI; additionally, you note a steady increase in your airspeed even though you continue to retard the throttles and you extend the speedbrakes. You lower the gear and you apply further back pressure on the controls but the airspeed continues to increase. So, what's the problem?

A. You've just entered a jet stream.

B. There is system malfunction resulting in erroneous instrument readings.

C. The engineers are working at peak efficiency generating excessive thrust.

D. The pitot static system is blocked with ice.

LT COL GARY L. STUDDARD

■ Based upon the limited information I've given you either B or D would be the most probable explanation. If a descent is started and upon reaching a lower altitude, all instruments return to normal, then D becomes the most obvious answer.

In a recent Class A mishap, the aircrew was faced with the circumstances cited above. Unfortunately, the mishap never progressed to the point where a descent was accomplished to an altitude low enough to allow the ice to melt. In this mishap, the sequence of events led to the aircrew's preoccupation with the airspeed increase, to the point that the aircraft was slowed to a stall condition and the aircraft departed controlled flight. The crew successfully ejected, but one more aircraft bit the dust. The investigation revealed that during a prolonged aircraft down time, the base experienced heavy thunderstorms, and water most likely entered the pitot static system of the mishap aircraft. As the flight progressed at FL 370, the outside temperature caused the water to freeze, resulting in the vertical velocity indicator and the altimeter being captured at the existing readings and the airspeed indicator to increase.

The computer at AFISC contains numerous reports of in-flight loss of pitot static indications as a result of icing. Most were recognized for what they were and the pilots safely recovered the aircraft. Periodically, however, history does repeat itself and an aircraft accident is caused by the insidious loss of aircraft instruments as a result of icing. Prevention of icing, which on the surface seems relatively simple, could have averted these mishaps. Modern day aircraft are equipped with sophisticated systems to prevent icing; however, year after year these types of reports keep coming in as evidenced by the following:

Shortly after level off at FL 390, the F-106 pilot reported loss of all pitot static system instruments. Climb to altitude had been accomplished through areas of heavy rain. Loss of the altimeter and vertical velocity were followed shortly thereafter by loss of airspeed. An aircraft was scrambled to provide assistance. After rejoin, and during the descent, the aircraft's pitot static problems cleared and indications returned to normal. Investigation revealed the pilot inadvertently left the pitot heat switch off for the initial portion of the flight.

During the climbout in instrument conditions, while passing FL 210, the airspeed in the F-4D went to zero. Climb was continued to VMC on top using inertial ground speed and angle-of-attack indicators. Join-up with another F-4 was made. During a wing approach, the

Air Force and command regulations are explicit in regard to operation of anti-icing systems when flight conditions warrant their use.

airspeed indications returned. Cause of the mishap was the pitot-tube heater was inoperative and subsequent ice blockage of the pitot system occurred.

The student pilot in the T-38 noted an airspeed reading of 550 knots. He confirmed his actual airspeed at 300 knots with another aircraft. The altimeter showed an altitude of FL 285 when actually at FL 200. The VVI was unreliable. Later investigation revealed that while on the ground, following heavy rainfall, water had collected aft of the pitot static heater resulting in sticking and erroneous instrument readings when the system was subjected to below freezing temperatures at higher altitudes.

Without becoming too academic, it is easy to see many variables can impact icing problems. In the first example, the F-106 pilot failed to utilize the pitot heat until late in the mission. Not much can be gleaned here except Air Force and command regulations are explicit in regard to operation of anti-icing systems when flight conditions warrant their use. In example two, the pilot had selected pitot heat but the system malfunctioned. The key point here is that when the capability exists, always verify the system is functional during pre-takeoff checks. The last example points out the necessity to ensure that all moisture is purged from pitot static systems prior to takeoff. In each case cited above, the ability to properly interpret the situation led to successful recovery of the aircraft which leads me to my next point. Probably the instrument most often affected by icing is the airspeed indicator.

Following a crash of a Boeing 727 in 1974, investigators determined the cause was ice-clogged pitot probes which resulted in the airspeed indicators behaving like altimeters.

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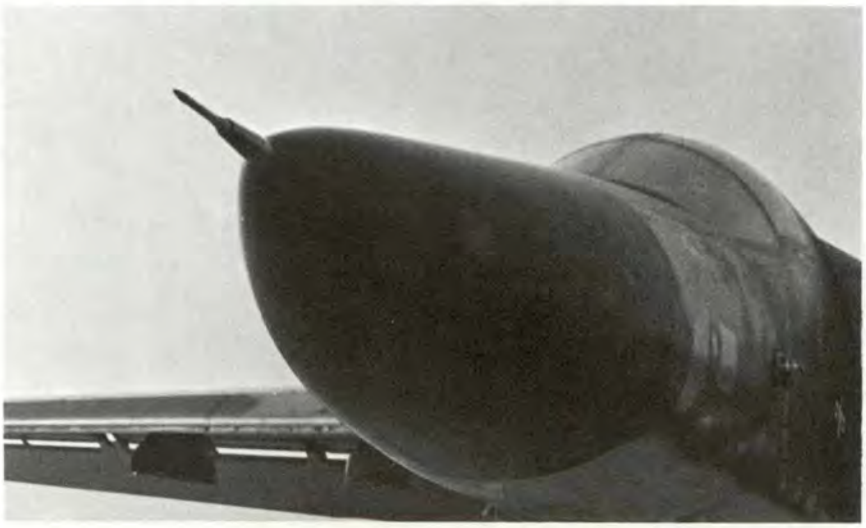


When the capability exists, always verify the system is functional during pre-takeoff checks. Ensure that all moisture is purged from pitot static systems prior to takeoff.

Cold Facts

continued

During the climb, airspeed steadily increased. The pilots continued to increase pitch in an attempt to arrest what appeared to be a dangerously fast airspeed. As altitude increased, so did the indicator airspeed. The pilots continued to raise the nose until the aircraft stalled. Later, several professional pilots were subjected to simulator profiles duplicating the profile of the mishap aircraft. More than half of them fixated on the erroneous airspeed indicator. The study went on to conclude that in a pinch, pilots tend to revert and react to airspeed indications. To refresh you on the pitot static principles as they relate to airspeed, here is a quick review.

Airspeed measurement is merely a comparison of pitot pressure and static pressure. If the static system is operational, but the pitot system becomes blocked with ice, then the airspeed indications will increase as the aircraft climbs or decrease as the aircraft descends. This was the problem encountered by the 727 aircrew. Conversely, if only the static system is affected, then airspeed will indicate lower than it should as you climb and correspondingly, higher than it should during descents. And finally, for aircraft which have the static source located on the pitot tube, a blockage of the pitot tube affects both systems. Most often the airspeed will remain constant at the speed at which the system was blocked.

To say that your airspeed will either increase, decrease, or remain constant based upon the system which is blocked, is in the category of a real "astute observation." However, a good understanding of the symptoms will probably lead to quicker diagnosis of the problem.

While I'll be the first to admit that talking about icing is not one of the more interesting subjects, the fact remains that this phenomenon is a major weather hazard which manages to take its toll each year. The solutions to icing avoidance, or countering its effects, definitely require expertise, talent, and astute awareness. Here's hoping that the only ice you ever encounter is in your favorite drink. — Reprinted from *Aerospace Safety*, October 1979. ■

No article is complete without a concluding list of reminders. So, here once more (and they will most likely be repeated in similar articles in years to come) are some *Points to Remember on Icing.*

Points To Remember On Icing

1. Icing may occur during any season.
2. Don't rely on the weather guy to always be accurate in his forecast.
3. Have systems purged of any moisture prior to your leapoff.
4. Use pitot heat (if the capability exists, accomplish a ground check and ensure circuit breakers are in).
5. Avoid areas of possible icing (clouds above mountains, freezing rain, and areas of clouds immediately above the freezing level).
6. The first indication of icing may be false flight indications.
7. If icing is encountered, depart the area as soon as possible. (Climb above clouds or to temperature below -20 degrees C, or descend to areas of warmer air.)
8. If you suspect icing, establish a known pitch attitude and power setting. Crosscheck the attitude against the standby attitude indicator and cross check the angle-of-attack.

Get assistance from other aircraft/controlling agencies concerning your aircraft parameters.

Know your aircraft anti-icing systems and their limitations.

Report all icing conditions so your fellow aviators can avoid the area.

(Editor's Note)

Even if you did not answer the quiz correctly, your knowledge of icing can make you a "winner" in flight this winter.

STRESS TEST

PETER GARRISON

■ The prize for the worst piece of publicity for general aviation in recent times probably goes to the inflight disintegration of a Partenavia P68 during an air show in Plainview, Texas, in September of last year. The whole event was captured on videotape and broadcast nationally, complete with narration — giving way to horrified screams — by a close friend of the pilot.

The picture quality was excellent. The Italian high-wing twin was seen approaching from the left in a shallow descent at high speed and moderate altitude. It passed the camera. Smoke trails appeared at the wingtips — part of the act — and an instant later, in apparently perfect synchrony, both wings folded up and backward and separated from the airplane outboard of the engines. The empennage was wrenched around and hung limply. The airplane mushed, went inverted, spun slowly one way then the other, and settled, with ghastly deliberateness, to the ground.

Television viewers had various perceptions of what had happened. Some reported that the airplane was just entering a loop when it disintegrated, others that it was simply making a level high-speed pass. Because the airplane did not appear to be maneuvering when its wings parted company with it, there was speculation that flutter might have been responsible. In any case, for millions of electronic witnesses the precise cause was unimportant; what had happened was simply the common nightmare, dating back to Icarus, of a flying mishap: the wings fell off.

To somebody with knowledge of airplane structures and operations, "the wings fell off" is more of a question than an answer. Wings aren't supposed to come off, and when any do, the reason is of great interest to anyone who owns or uses a pair. In this case, the reason turned out to be a simple one: the pilot pulled the wings off himself, making use of the control systems provided with every airplane. And it wasn't one of those inadvertent yanks on the yoke by a startled visitor in a thunderstorm; the pilot had had everything more or less under control.

Since the investigators at the National Transportation Safety Board had at their disposal a luxury rare in accident reconstruction — a professional videotape of the accident — they could study, frame by frame, the flight path of the airplane. From its change of azimuth with respect to the camera, the NTSB was able to determine that at the moment of its disintegration the P68 was traveling at 220 knots indicated airspeed, and that it was pulling up with an acceleration of about eight Gs.

The exact process of disintegration was visible: the outer panels of the wings twisted up and backward, the left slightly before the right. One wing struck the fuselage just ahead of the leading edge of the vertical fin, severing it; the empennage remained attached to the Partenavia's fuselage only by its control cables.

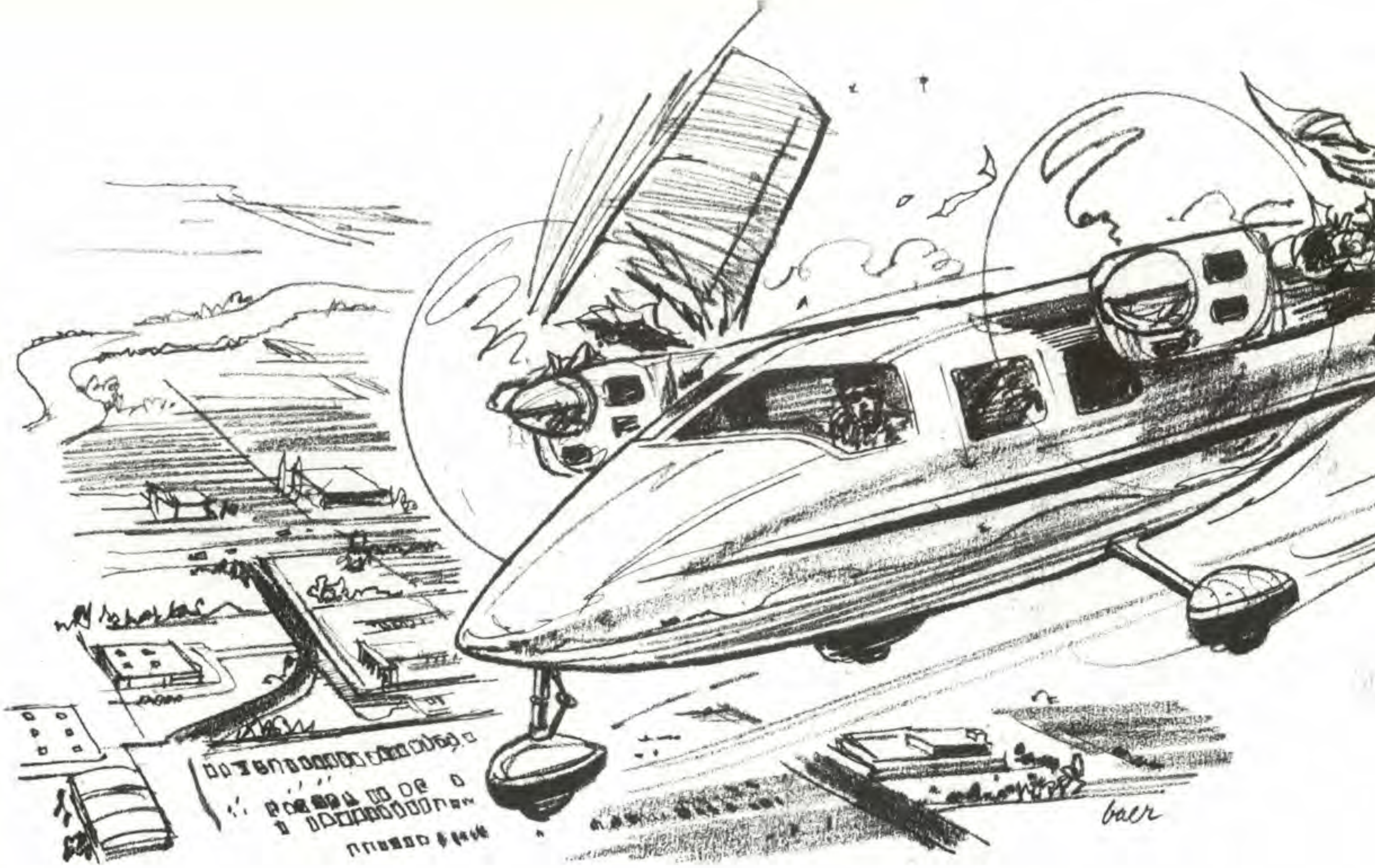
The pilot, Wes Winter, who had been giving aerobatic demonstrations in the P68 regularly on the airshow circuit, had lately been practicing a maneuver usual for an airplane of this type: a four-point hesitation roll at the top of a loop. The problem inherent in such a maneuver is to have sufficient speed for the roll at the very point in the loop when you're liable to have very little excess speed at all.

Rolling over the top of a loop isn't itself impractical — you just hold approximately zero G, a ballistic curve, as the airplane turns — but to look good a hesitation roll requires sufficient aileron authority for crisp stops between segments of the roll. Aileron authority, particularly in a light twin not designed for aerobatics, means speed; and speed at the top of the loop means lots more speed at the bottom.

The best angle of attack for the uphill portion of a loop is the angle of attack for minimum power (or what a sailplane flier would call minimum sink); it is the angle of attack at which the least energy produces the most lift. At the beginning of the maneuver, the pilot would like to make as rapid a transition as he can from high-speed, low angle of attack flight to an angle of attack of around eight or nine degrees. The constraint upon the rapidity of the pull-up is the structural strength of the airplane.

Winter started the loop with 220 knots indicated — about 30 knots above the airplane's never-exceed speed. His angle of attack in level flight was probably about one to 1.25 degrees. If, at the start of the loop, he pulled up instantaneously to the ideal angle of attack — this is impossible, of course, but let's say

continued



it for argument's sake — then he would have pulled 8 to 10 Gs.

In fact, he could not change his angle of attack instantaneously; but he could not change his airplane's flight path instantaneously either, and so a brisk pull-up at 220 knots indicated could produce an acceleration very close to the theoretical value. G loadings of this sort are far beyond what the P68's airframe was designed to sustain; it is a normal-category airplane, with a nominal positive load limit of 3.8 Gs at gross weight.

Before the fatal flight, Winter had taken up a reporter and cameraman from the same local TV station that taped the disintegration. He did several rolls and loops, narrating them calmly and expertly for the viewers, emphasizing that everything was safe and completely under control, and insisting repeatedly upon his adherence to limiting speeds and loadings. He never did anything in a show, he said, that he had not done a hundred times in practice.

STRESS TEST

continued

This may have been almost true. Eight Gs sounds like a lot for a normal-category airplane, but to a show pilot it may not seem an inconceivable loading. To begin with, the limit loading of 3.8 Gs required for normal-category airplanes is a loading that must be sustained without permanent deformation of the structure; there is another design loading, called "ultimate," which is at least 1.5 times limit, and is the loading the airplane must be able to sustain without *failure.* There is no requirement, and certainly no guarantee, that failure — breakage of a primary structural part, like a wing spar — will be preceded by groans, creaks and premonitory deformations; metal structures, because they often fail either by cracking or by compressive instability, are particularly prone to sudden, complete failures unless they are designed according to "fail safe" principles, which small airplanes aren't, and aren't required to be.

That light airplanes aren't designed to fail-safe does not mean that they aren't adequately strong. They are generally agreed to be somewhat stronger than they are required to be. For various reasons, their structures tend not to be shaved down to within a few percent of the design load. To do so would require more laborious engineering and testing and more stringent quality control during manufacture, and would produce a significant loss of safety margin while yielding only a nugatory saving of weight.

So it would not be unreasonable to suppose that the P68 might sustain five or six Gs without failure and even without *perceptible* permanent deformation; and in an aerobatic demonstration it might sustain still more because the cabin would be empty except for the pilot, and

the wing bending moment per G would therefore be well below its maximum value. Winter may have done many six- or seven-G pull-ups in the past; and the load that broke the wing may have been only slightly greater than that which it had borne before.

Flying is an activity in which one often moves by tiny increments closer and closer to some more or less clearly recognized danger. Each new plateau of risk, when first attained, seems to be the last; but, as we grow accustomed to it, a new horizon beckons. What insulates us from fear as we approach the danger is simply habit; the familiarity of the point we have reached and all the points we've left behind. Until one steps too far, it's often hard to tell a difference between recklessness and skill. The test pilot who enters the spin with greater and greater abandon, the instrument pilot who picks up a little more ice or dips a little farther below minimums, the traveler who runs lower and lower scud in hillier country, the drinker who allows himself less and less time between bottle and throttle, the boyfriend who permits himself ever more exciting buzz jobs — all are encouraged in each escalation by the success of the last.

The escalations may be minute, even imperceptible; but sooner or later they must reach some absolute limit. The history of test-flying is full of airplanes that did 50 perfectly routine spin entries and recoveries, and on the fifty-first went flat and wouldn't recover. Eventually the clouds and the hills may clamp shut on the scud-runner; the ice will build with unprecedented suddenness, or a church steeple will poke up inopportunely close to the glidepath; the drinker may become disoriented; the boyfriend may look back to gauge the impression he has made, and inadvertently stall. Two maneuvers that feel the same and look the same are never exactly the same; two airplanes that come off the same assembly line cannot be absolutely identical. With homebuilts and ultralights there is far greater uncertainty. Two hundred canard homebuilts display an apparent inability to spin, and just when the design is about to be declared "characteristically incapable of spinning," one spins.

Airplanes come with all kinds of limits; some are published, some are taken for granted. None are frivolous. There are a few limits, to be sure, that exist to satisfy certain formal requirements, and that, in one airplane or another, may have little practical meaning. But in general, a limit exists because a little way beyond it there lies a danger. Sometimes people become carried away with the idea that the published limit is not absolute, but provides a certain unspecified "margin." They fly to the limit, or a little beyond it; and each new transgression produces, in their mind, a new, empirically established limit, which comes into being equipped with its own margin, also unspecified, and also begging to be encroached upon.

It was evident from the narration of Wes Winter's demonstration that it was intended to sell airplanes; the emphasis was on the Partenavia, not on the maneuvers. Surprisingly often, salesmen or owners boast of airplanes in terms of the margins supposedly built into them, and pilots try to inflate their reputations by telling stories about how far they went beyond the limits. The implication, I guess, is that if they can handle the extraordinary, then the ordinary — just banking 60 degrees, or pulling 3.8 Gs, or descending to minimums and no farther, or getting home in reasonable weather — cannot give them the slightest difficulty.

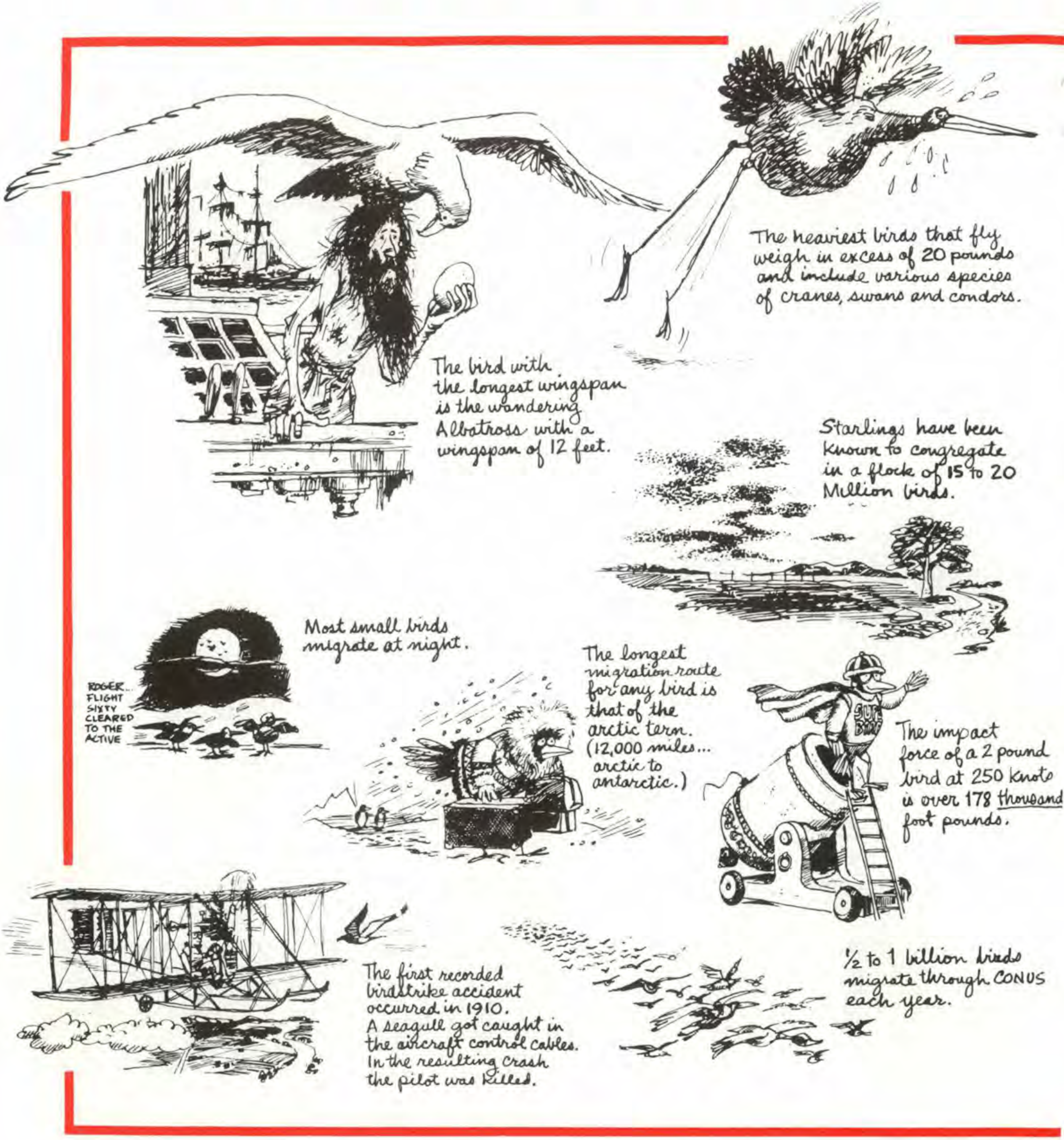
I know the feeling well; I myself have been guilty many times of pushing myself and my airplane too far, and then of boasting of it. I thought it fine to have done more with less than others might have. But I've been getting more lily-livered, and now I look back and see not always good flying, but often bad judgment. I won't disown all my follies — many grand things have been done by fools — but I no longer think that I am magnified by recklessness.

The question of whether it is a good idea to pull eight Gs in the Partenavia P68 in order to interest people into buying it is not of very general application; in light of the happening at Plainview it would seem that the answer is no — should anyone be tempted to do the same thing again. But it points to a much more fundamental question that every pilot has to ask — and answer — every time he is tempted to exceed his airplane's limits or his own: what purpose justifies what risk? There are certainly purposes — even including self-education — that warrant risks; some warrant considerable ones. But accident reports seem often to record risks taken for no reason other than to show that they can be. This, I think, is one of those, and it shows, instead, how empty, how contrary in effect to what was intended, the ill-considered taking of a risk can be. ■ — Courtesy *Flying* magazine.

This article is based on the National Transportation Safety Board's report of the accident and is intended to bring the issues raised by that report to the attention of our readers. It is not intended to judge or to reach any definitive conclusions about the ability or capacity of any person, living or dead, or any aircraft or accessory.

Taking risk is an inherent part of military flying, but the true professional knows the risk, evaluates the limits and does not recklessly exceed them. There is no other acceptable conduct in flying.

FEATHERY FACTS FOR FL



LYERS

Have you ever wondered what is going through a bird's mind when it finds itself eyeball to eyeball with an object many times larger, thousands of times heavier and traveling, oh . . . 20 times as fast? We can't really answer that because we haven't yet learned how to plumb a bird's mind. But we do know something about those feathery creatures with which we have to share the sky, and with which we occasionally have traumatic and even fatal (for both parties) encounters. Herewith, then, are a few things you ought to know about birds, if you are going to share their domain.

ODD STRIKES

- A Snake at 3000'AGL
- A Chicken at 800'AGL
- A Mouse at 8000'AGL
- A Flying Squirrel at 5000'AGL

In 1983 there were 2300 reported birdstrikes

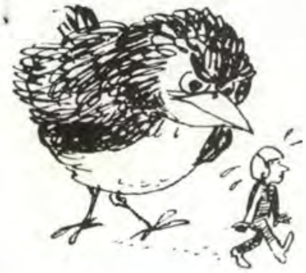
The largest known flying creature is the reptile Pteranodoningens with a wingspan of over 27 feet. Fortunately it is extinct and pilots need never worry about meeting one in flight.

The highest recorded birdstrike occurred at **37,000** feet.

Several Air Force bases are built in the center of bird breeding or nesting or on major grounds or on major migratory routes.

Birdstrike rates per landing/sortie/hour have all at least doubled since 1969.

Since 1980 FOUR aircraft have been destroyed by birdstrikes.



The smallest bird in the world is the Bee Humming bird It weighs 1/10th of an ounce.

We now average over 2000 birdstrikes a year.

Human Factors Happenings HYPNOSIS

ANCHARD F. ZELLER, Ph.D.
Directorate of Aerospace Safety

■ Hypnosis is a party game, a form of professional entertainment, and a serious medical technique. Almost anyone can become a hypnotist, and almost anyone can be hypnotized. It would seem with such broad recognition that it would be a subject about which everything that could be known is known. The opposite is true. Even now, what hypnosis actually is, is only a state of conjecture with varying specialists projecting different opinions.

Why and how an individual can induce himself into a general state of hypnosis is the subject of many questions. That he does it to himself is evident as the hypnotist does little more than serve as a catalyst for the condition developed. Because of the widespread knowledge and acceptance of the phenomenon, it is quite natural that it would be suggested as a technique in mishap investigations.

Those within the Air Force that make such a suggestion, note that its use is prohibited by regulation in mishap investigation and that it is further prohibited even for medical purposes if crewmen or persons under the personal reliability program are involved.

A brief review of the background which has led to the prohibition seems appropriate. In the early 1950s, a young hypnotist was engaged by a group of crewmembers to induce hypnosis in an attempt to improve their bomb scores. The fact that this arrangement existed wended its way through channels until it reached the desk of a major command commander noted for his positive opinions and positive actions. The message which came back was immediate and positive.

No Air Force crewmen will be subjected to hypnosis. At that time, there was no prohibition against hypnosis for mishap investigations. On the basis of this event, and with the sympathetic concurrence of the project officer who had long been an active hypnotist, the prohibition against the use of hypnosis for accident investigation was incorporated in the appropriate Air Force Regulation, 62-14, which has since become 127-4.

As would be expected, the policy was challenged, even violated. The violations were ironically enough useful in re-establishing the policy as either no information was obtained or information which was obviously at variance with what other sources had developed. In the mid-1960s, there was a major reconsideration involving extensive Air Staff coordination, including The Surgeon General and The Inspector General. The policy as originally developed was reasserted.

As recently as last year, suggestions that the policy be changed and that hypnosis be used in safety investigations have again surfaced. Air Force Regulation 127-4 has been revised so that the prohibition is now in Chapter 3, Paragraph 3-5d.(1). Parenthetically, it should be noted that the use of hypnosis outside of the Air Force is also under constant re-evaluation.

Last year, the California Supreme Court precluded the use of evidence obtained under hypnosis. Hypnosis is not a toy or a plaything. It is a serious intrusion into an individual's innermost thoughts and emotional process which may be useful, but which may cause harm.

Now . . . relax completely and imagine you are falling asleep . . . you are falling, falling, falling . . . just watch my finger. . . .

With these and countless other techniques, practitioners of the art of suggestion are persuading others to enter a world commonly described as "being hypnotized." In many, if not most, instances, neither the hypnotist nor the subject is clearly aware of what is actually taking place. Indeed, sometimes neither is aware that anything is taking place. The charming and persuasive salesman, as well as the inspiring statesman or politician, may well be, perhaps knowingly, practicing the same art as the stage magician or serious student of hypnotic phenomena. It is perhaps small comfort to any of these to know that many of the same effects can be elicited by some completely inanimate object, such as a swaying bush, a flickering light, or a white line in the middle of the road.

It should not be surprising, therefore, to find that almost anyone can become a hypnotist with only a few minutes' practice. Proficiency, of course, varies. To paraphrase: some people can hypnotize some of the people some of the time, but no one can hypnotize all of the people all of the time. Neither do those who are hypnotized always respond in the same way. Some are deeply affected to the point of seemingly abandoning all self-control; some literally fall asleep; some are only mildly influenced; and there are those who are openly negative.

In spite of these variables and limitations, a "good" hypnotist and a "good" subject develop a situation which is most impressive. The subject is seemingly totally responsive to every whim of the hypnotist. He performs feats of strength, endurance, and memory which he would never be expected to do under normal circumstances. The list of documented phenomena is indeed impressive: recitation of long "forgotten" material and memory of events of early childhood back to the time of birth, and, for those who accept a concept of reincarnation, beyond. This latter phenomenon best emphasizes one of the problems; namely, how can an outsider objectively prove or disprove what is reported. If an outside reference is available, it is relatively simple to compare what is reported with what was originally recorded. With-

continued

Now . . . relax completely and imagine you are falling asleep . . . you are falling, falling, falling . . . just watch my finger . . .

HYPNOSIS continued

out this, proof rapidly deteriorates to an exercise in faith.

Not only are events of the long past difficult to document, but also events of any time period which can only have been observed by the individual being hypnotized. If he is unwilling for some reason to report this information, hypnosis might seem like a good vehicle for overcoming this reticence. Unfortunately, if he is unwilling to report, he is also probably not willing to cooperate in the hypnotic episode. This is not necessarily true either, however, as some people can be hypnotized while actively (seemingly at rest) resisting.

If the individual is willing to report but can't because the material under consideration has been forgotten, or more dynamically, "repressed" (a psychoanalytical term which implies forced forgetting for emotional security), then hypnosis would seem a method for eliciting the desired material. This situation is also subject to limitations and problems. In the first place, the individual may never have observed the required facts in the detail desired. He may, on the other hand, have observed them incorrectly so that no matter how accurate the report, the information is erroneous.

There are also a great number of studies which document forgetting as a real phenomenon so that even once available, through the erosion of the forgetting process the detailed information is irrevocably lost. On the other hand, because a good hypnotized subject is usually very anxious to cooperate with the hypnotizer, he may through concentrated effort supply a great deal of factually accurate detailed information.

This desire to cooperate in itself is conducive to another problem. In his desire to please, the subject may well supply details which are logical, but which have been fabricated because of his desire to please. Another consideration which must not be forgotten is that if the forgetting is emotionally toned it may be that only a long series of therapeutic sessions can overcome the emotional overtones to the point that the individual can accept the material in a conscious state. In this regard, it is of some historic interest to note that Sigmund Freud, the father of psychoanalysis, was originally a hypnotist who abandoned the process for his famous free association technique. His rationale, simply stated, was that he obtained as valid and detailed information as fast with none of the complications of hypnosis. Although Freud is by far the best known of those who have abandoned hypnosis in favor of some other technique for eliciting information, he is by no means the only one.

Parenthetically, it should be pointed out that when hypnosis is used for medical purposes, there is one freedom which does not apply when it is used for the development of factual information. Truth as objectively measured is of little importance, medically speaking. If review of the repressed or forgotten information results in an emotional catharsis and an improved outlook, the truth or falsity of the released information is of little pertinence or actual interest to the hypnotist. The critical factor is whether the individual himself thought it to be true or not. When attempts to obtain factual information are involved, it is obvious that mis-information obtained by the use of hypnosis contributes no more than mis-information obtained by any other means.

Another facet of the hypnotic episode is the willingness of the subject to perform acts or to perpetuate ideas long after the actual hypnotic session has ended. These posthypnotic suggestions are commonly used by entertainers for the amusement of an audience and by therapists for the good of the patient. A question which naturally arises is whether this can be used for the devious ends of the hypnotist to the detriment of the subject. There are many who emphatically state that such misuse is not possible. These persons point out that an individual will not do anything against his basic moral principles.

The argument then comes down to what are basic moral principles. Some people are obviously more lax

than others and some emotionally disturbed people who have created and perpetuated a facade of normalcy may well use the hypnotic episode as a means of escape from their self-imposed false emotional stability. There are other experimenters, however, who will assert, without referring to basic moral values, that some hypnotized subjects may be directed to and will perform immoral or illegal acts either during a hypnotic session or as a result of post hypnotic suggestion.

The use of hypnosis as an interrogation technique is not new. In a classic case carried to the Supreme Court of the United States, a confession obtained under hypnosis was declared invalid as legal evidence. As any experienced hypnotist will affirm, some subjects are extremely attuned to the hypnotist and will respond to his slightest suggestion, whether intentionally or unintentionally given. False confession and false reports are often the overt result of fantasied experiences which the hypnotized person reports faithfully and factually. Any relation to verifiable truth is, however, at best, tenuous.

A question which repeatedly arises is why the Air Force has a strict prohibition against the use of hypnosis in mishap investigations. There are certainly instances in which emotional amnesias have been removed and factual information developed. Even in these instances, however, it should be realized that the amnesia served some emotional purpose to the individual and unless this need is met in some other way, the release of the emotional material may well create major emotional/mental problems for the subject. There are, of course, many more cases where hypnotized individuals suffer no apparent ill effects, so the question is again repeated, why does the Air Force specifically preclude the use of hypnosis in mishap investigation?

The answer is based on a weighing of the advantages as opposed to the disadvantages. The advantages are rather clear. The hypnotized individual might provide useful information regarding the cause of the mishap. The disadvantages: he might provide logical or false information if he thinks this is what is wanted. The process itself also could create problems for the individual which would be to his emotional detriment.

With adequate safeguards and precautions all of these "ifs" would seem to about even out, perhaps with an edge one way or the other

depending on the biases of the viewer. There is one other variable to be considered, however. Air Force people collectively and Air Force crewmen specifically are very special people. Many, by the nature of their positions, routinely have access to critical information or may have direct access to some of the most awesome weapons on earth, and anything which even might compromise the integrity of these individuals, and anything which might subject them to outside influences must be avoided at any cost. These considerations were carefully and objectively studied at the highest Air Force levels.

The result was a pro and a con analysis which resulted in a directive that AFR 127-4 (then 62-14) include a statement specifically prohibiting the use of hypnosis as a mishap investigation/prevention tool. At the same time it was specifically recognized that this decision should in no way be worded or interpreted to preclude the use of hypnosis by a physician for the good of the patient.

Like most directives, this one has occasionally been violated. Like most which have been in existence for any length of time, it also has been challenged. Evaluation of each deviation and each challenge has resulted in the reaffirmation of the validity of the original decision. For now and unless and/or until some new persuasive evidence is furnished to change this policy, it remains as stated in AFR 127-4, Paragraph 3-5d.(1): "Witnesses may not be administered truth serums, hypnotic techniques, drugs, or polygraph tests." ■

OPS

Off We Go . . .

■ . . . *Into the Wild Blue Yonder,* says the old song, so reminiscent of the brave and blithe young tigers on their way to give their best in the good fight. Today the Blue Yonder is a more peaceful and more disciplined environment, even with its vastly increased traffic and its much more severe controls. And today's descendants of the young tigers must share the airspace with their civil counterparts. From its beginnings, the Aviation Safety Reporting System (ASRS) has received staunch support from USAF and Navy safety programs; each service sends us all official reports in which there has been military/civilian involvement.

Many military pilots and organizations receive *Callback* and other ASRS research material, and many of the pilots take the trouble to submit ASRS reports in addition to fulfilling their own service reporting requirements. There is value to us in what may, at first, appear to be duplication: the official reports are depersonalized, third party accounts, while those individually submitted give the pilots' own views in their own words. This affords us the opportunity to observe the human factors at work, and amplifies the bare facts.

Not infrequently we receive personal accounts on ASRS forms and later the official transcripts. We appreciate and encourage this. As might be expected, these accounts usually describe potential conflicts between military aircraft and civilians who have, for whatever reason, flown into or near military fields and operating areas. Here's a typical one:

• Military trainer was working the western portion of the Military Operating Area (MOA) at 13,000 feet when the pilot observed a twin-engine aircraft at his 12 o'clock position on a collision course. He immediately climbed and the twin passed directly below within 200 feet. The center was unable to locate the twin on their radar; no flight plan or departure information could be linked to the aircraft. Conclusions: the light twin was cruising through the MOA without radio or radar contact with any controlling agency. The operation of an aircraft in an area of high intensity jet traffic without radio and radar contact is a hazardous practice. . . .

This was a NMAC that shouldn't have been. "See and Avoid" is still the watchword, but there are other aids to safe flight and pilots would be well advised to take advantage of every available method to avoid conflict. It stretches credulity to imagine that the light twin lacked radio and transponder and that the pilot was unaware of his position (in the center of an area with a high concentration of military training bases and well within range of several facilities willing and able to provide radar traffic advisories). And, unless he was climbing or descending, at an altitude not in conformance with the hemispheric rules and where an operating transponder is required. Thanks to an alert student military pilot, the Blue Yonder remained relatively tame that day. — Courtesy ASRS *Callback,* Mar 84.

A Pain In The . . .

During the first engagement of a defensive maneuvering sortie, an RF-4C WSO felt a burning sensation and pain in his abdomen. The pain ceased as the G loads relaxed.

The WSO thought his harness buckle was causing the pain. He re-

TOPICS

arranged his harness and prepared for the second engagement.

This time the pain was worse, so he called "knock it off," and the aircraft returned to base.

The flight surgeon diagnosed the problem as muscle inflammation from heavy exercise. The WSO stated that he had started getting back into shape the night before by weight lifting and doing exercises.

Loose Seat

An A-10 pilot was setting up for a confidence maneuver with a negative G check for loose items in the cockpit. He found one.

During the maneuver, the ejection seat slid upwards and struck the canopy. The pilot recovered to 1 G flight and returned home, landing from a straight in approach.

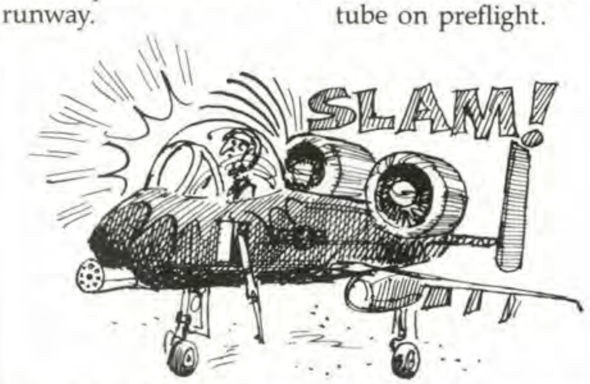
Investigators found that the vent line nipple had not been attached to the seat during PDM. It is possible that the seat may not have fired in this condition.

Debug the Airspeed

An Aero Club member had flown to a cross country airport for a two day layover. All preparations for the return trip were normal, and the fully loaded (but not over gross) Piper Archer started its take off roll.

At the 2,000 foot point, the pilot checked the airspeed and saw 40 knots. Expecting 60 knots at this point, the pilot elected to abort. He was unable to stop the aircraft on the runway, and the aircraft rolled to a stop in a ditch 370 feet past the end of the runway.

After the incident, investigators found the pitot tube clogged by dirt from a mud dauber wasp. The pilot admitted that he had not used a pitot tube cover nor had he checked the tube on preflight.



Keep the Rails Clear

After stopping his A-10, the pilot raised the canopy. For some reason, the canopy actuator failed, and the canopy slammed shut.

The investigator recommended that, because such failures are "insidious and without warning," pilots should keep their hands and arms clear of the canopy rails. Sounds like a good idea.

Hey — They Look Pretty Close!

■ While en route, a near miss with two fighter aircraft occurred. Center advised traffic at 12 o'clock, two miles, FL 190, two fighters. When the aircraft were first sighted they appeared to be at my altitude (FL 180), 12 o'clock, in a slight left turn, less than one mile. Both fighters passed un-

continued

OPS

der my left wing 200 to 300 feet below me. I called Center and questioned the altitude of the traffic. Center replied that the last they heard, the fighters were at a blocked altitude of 190 to 210. . . . After checking in with the next controller I again asked about the altitude of the fighters. They replied that there was a refueling operation in progress in an assigned altitude of FL 190 to FL 210. I informed Center that I was level at FL 180 and that the two aircraft had passed below me 200-300 feet . . . Upon arrival I called the Flight Service Station to file the report . . . En route I had been told that refueling operations were in progress at 190-210 and I agreed to accept 180 as a final altitude. After arrival, I received a phone call from a military pilot who said he wanted to explain what had happened. The military pilot said he was at FL 190 looking for the tanker, when he spotted me. He thought I was the tanker, but that we were not at "co-altitude," so he descended to FL 180. When he saw his mistake he dove to pass below me.

— Courtesy ASRS *Callback*, May 84.

Did The Birds Have Route Clearance?

The pilots of two A-10s were flying a low altitude tactical navigation mission. Lead saw a flock of birds co-altitude and called a warning to the chase aircraft.

The chase pilot did not see the birds in time to take evasive action, and the aircraft flew through the flock. Birds struck the aircraft on the windscreen, both engines, left vertical stabilizer, and the VHF/FM antenna.

The pilot was able to make it to a nearby air base where, after landing, maintenance repaired damage to the engine shrouds, stabilizer, elevator, and antenna. (They also washed the windscreen.)

Air Force To Develop Advanced Ejection Seat For The 1990s

The Air Force has initiated a new program to develop an advanced aircraft ejection seat to meet the demands of high performance fighters and bombers of the late 1990s.

Maj Gen John W. Ord, commander of Air Force Systems Command's Aerospace Medical Division, Brooks AFB, Texas, named the contractors for Phase I of the Crew Escape Technology (CREST) aircraft ejection system. They are: Boeing Military Aircraft Company of Seattle, Washington, and Douglas Aircraft Company of Long Beach, California.

The CREST contracts call for both companies to develop system specifications and produce initial designs for the next-generation ejection seat. This includes seat designs for aircraft with both high altitude and low altitude missions, and a demonstration model to be developed, built and tested.

Structured in three phases, the CREST program will seek to provide protection for aircrews during flight maneuvers as well as after ejection from the aircraft. A special feature for the new seat is aircrew protection as Air Force requirements demand future aircraft to fly at greater speeds at both extremely low and high altitudes. The CREST seat, for example, will be designed to provide aircrew protection during ejections below 500 feet and as high as 70,000 feet altitudes.

Current military aircraft, such as the A-10, F-15, and F-16 are equipped with the Advanced Concept Ejection Seat (ACES) II which has lessened the number of major injuries and fatalities during emergency ejections compared to older seat systems. Fighters of the future, however, will fly radically different maneuvers, e.g., sideward acceleration, not envisioned when the ACES II seat was designed.

The CREST seat also will restrain crewmembers better, offer increased

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windblast protection, permit varied control of thrust after ejection, use digital flight control electronics for seat stability and "steering," and incorporate sensing of the aircraft's speed, altitude and attitude independent from the aircraft's sensing system.

The seat will incorporate advanced technologies addressing multiple rocket propulsion with selectable thrust and attitude control for the safest ejection speed and trajectory.

The CREST seat could be adapted for multiple ejection systems — for more than one aircrew member — where trajectory steering would avoid aircrew members hitting each other or the aircraft as they eject.

CREST seat design also calls for a seat that can be removed easily from the aircraft's cockpit for maintenance purposes — even in combat field stations.

Full-scale engineering development for the CREST seat is scheduled for April 1989 with production decision planned for 1994 or 1995.

FAA Studies Wind Shear Detection System

The Federal Aviation Administration in cooperation with the National Center for Atmospheric Research (NCAR) has begun an operational evaluation of a wind shear forecast and detection system based on the use of Doppler radar, in the Denver-Stapleton Airport area.

FAA Administrator Donald D. Engen said NCAR meteorologists will issue a daily microburst forecast and keep FAA controllers up to date on actual and potential microburst activity within a 5-mile radius of Stapleton Airport. Air traffic controllers can then issue necessary advisories to pilots.

A microburst is a violent downward rush of air that flattens out when it hits the ground and spreads in all directions, creating wind shear conditions. Aircraft caught in these conditions first encounter a head wind that causes extra lift as it moves over the wings. This is suddenly replaced by a tail wind that produces a sharp loss of lift that can cause aircraft at low altitude to lose flying speed.

Doppler radar has proven effective in detecting microburst activity in research situations. Unlike conventional radar, it can "see" inside storms and measure changes in wind speed and direction.

The evaluation will help to develop the procedures for using Doppler radar data and to validate microburst forecast techniques. It will run for 45 days.

Denver was selected because of the high incidence of microbursts in the area. The last reported incident there was on May 31, when a United 727 lost lift and struck an antenna on takeoff from Stapleton Airport. Fortunately, the aircraft was able to return to the airport and make a safe landing. No one was injured.

FAA is conducting additional research, in cooperation with the Massachusetts Institute of Technology, the University of North Dakota, and the South Dakota School of Mines, into the application of Doppler radar detection of wind shear at the Memphis, Tennessee Airport. The FAA's terminal weather radar test bed located there will be in place for approximately 6 months. Present plans call for moving the system to two other locations in order to gather additional data.

A Test Flight?

An F-16 pilot was moving from close to tactical formation on a normal mission when he found that the engine of his Fighting Falcon was stuck at 85% rpm. The throttle was not binding, and the pilot moved the throttle from idle to mil four times before he could get the rpm to respond. He then set the power at 80% and returned to base setting up for a high key. While holding to burn down fuel, the engine hung up again at 77%. After several attempts, the pilot again regained control of the engine rpm.

At this point, it was decided that the problem was serious enough to warrant an immediate landing. During the SFO, the rpm would not go below 74-75% at idle. The pilot was able to stop prior to taking the barrier. ■

The Professionals

One good measure of a professional, experienced aircrew is their ability to anticipate problems and prepare in advance to handle them. All too often, we in the flying safety business must document the errors and mistakes of aircrews. Therefore, it is always a pleasure to print a story about a crew that did it right.

CAPTAIN GUY J. WILLS
8th Tactical Deployment Control Squadron
Tinker AFB, OK

■ Our squadron transports staff inspection teams, communication teams, and battle staffs to different parts of the world on a regular basis. The average flying time among the crewmembers is 2,900 hours of -135 time. This particular mission was to Thule AB, Greenland, to pick up a staff assistance team and return them to Peterson AFB, Colorado. A thorough mission planning session discussed various subjects including runway environment, possible compass problems, and necessary fuel reserves to our worst case alternate.

That morning, the weather dispatcher gave forecast winds of 140/20G30. No problem. The active runway at Thule AB would be Runway 16. Are the winds on the weather 175-1 *true* winds or *magnetic* winds? The answer is *true* winds. We normally don't think too much about this because in the United States or lower latitudes the variation is normally 5 to 10 degrees. Thus, our winds are approximately 215/20G30 (magnetic), with an RCR which is normally wet and never any greater than 18. A sporting situation, but you have to be *tough* to fly the heavies, right?

The pilots had approximately 2,700 hours apiece. They were familiar with the air base, and one of the pilots had been there the previous week. The runway is 10,000 feet by 150 feet — an old SAC runway. To the south of the field is a bluff that rises approximately 600 feet. Approaches are only to Runway 16, and you have to circle south of the field to land the opposite direction. One hour prior to landing, we contacted Thule Metro, who gave us winds of 110/10G18 (true winds). We expected Runway 16 with a left cross wind.

We planned a normal ILS approach to Runway 16. Approach Control was giving us winds of 210V230/20G30 (magnetic winds). Switching to tower, the winds were also called as 220/20G30 — not the left cross wind we were expecting. Aircraft control on the approach was normal. Airspeed during the approach was not, because of the gusting winds. We did not know that the winds on the bluff were from the south, 70 to 80 knots. We did realize this when we compared the INS winds and ground speed with approach/tower winds.

This is a prime example of a wind shear, and the aircraft acted accordingly. During the approach, the crew had briefed the possibility of wind shear, and we were well ahead of the situation. Despite being prepared, the loss of airspeed and slight descent below ILS glidepath still made us keenly aware of the present conditions.

All of these factors created a sporting approach and landing. Good crew coordination and a thorough mission planning session enabled us to arrive safely and complete our mission. However, I feel the lesson to be learned above all else, is that you can never be too well prepared or familiar with the landing environment. Read FLIP, the Enroute Supplement, Foreign Clearance Guide, call Base Ops, and glean the knowledge of the other crewmembers around you. The experience you gain from them could help you in the future and mean the difference in the worst of conditions. ■

To Err Is Human: To Be Observed Is Now Computerized

■ Air traffic controllers are human, too. Most find no glee in calling official attention to the pilot misdemeanors they observe.

Reports to Aviation Safety Reporting System (ASRS) attest that they avoid doing so when possible; nevertheless, deviations from mandated performance — particularly those contributing to loss of required separation between aircraft — must be reported and investigated. In the past, such deviations were detected by "seaman's eye" — a controller's estimate of the radar targets on his scope.

The "Conflict Alert" feature of the ATC computer/radar signaled a possible impending anomaly in time for application of corrective measures, but no precise mechanism existed for immediate, prompt identification of separation loss and accurate measurement of actual distance. Things are changing.

ATC has established a stringent Quality Control Program (QAP) in an effort to improve performance in general and to minimize separation compromise in particular. A key feature of QAP, known as "Computer Detected Error," is a new application of existing equipment which provides a positive and accurate indication of questionable situations.

Many Air Route Traffic Control Centers have instituted the new procedure (all soon will have done so). Controllers have coined ironic nicknames to describe this new capability. It is known, in various ATC facilities, by such sobriquets as "Big Brother," "Squeal-a-Deal," "Lie Detector," and "Snitch Patch."

A concerned and thoughtful controller has submitted an ASRS report which illustrates the new era and may provide information useful to pilots:

■ Aircraft A was northeast bound to a nearby destination in another Center's area. Aircraft B was north-northwest bound to another destination in the same Center area as Aircraft A. Aircraft A came on my frequency at Flight Level 250, Aircraft B at FL 180. "A" was cleared to descend and maintain FL 190. Each aircraft was pointed out to the other as traffic. "A" acknowledged clearance correctly. As "A" was passing behind "B" the Conflict Alert was activated and the altitude readout indicated FL 186. Pilot of "A" was immediately queried as to his altitude and his clearance altitude was reiterated. Pilot acknowledged that he went through the altitude assigned (FL 190) and that the autopilot was recovering . . . Another aspect of this incident is that the receiving Center has, as ATC personnel refer to it, a "Snitch." (In case you're not aware of it, this is a computer feature that immediately reads out any situation where there is less than required separation. . . .) Conflict Alert merely indicates the possibility of less than adequate separation impending; Snitch says it has occurred. In the past, deviations could be overlooked if nobody complained; with Snitch it is impossible to overlook the situation.

Pilots should be made aware of this, since their mistakes could result in action being taken against them regardless of how the controller feels about the situation. In this case there was more than two miles horizontal and 400 feet vertical separation at the closest point, so there was no real danger — but who knows what could have happened? As the controller, I was completely in the clear but I think pilots should be made aware of Snitch . . .

As a general rule pilots and controllers have a good relationship. In situations like this it was not the controller who turned the situation in, but Snitch. If pilots suffer penalties in situations like this (suspension, etc.) don't blame the controller . . . It is out of the controller's hands.

Pilots may sometimes feel that a minor clearance deviation should not warrant a violation action. The report quoted above and others like it illuminate the hazard possibilities in non-compliance. QAP is now on the job. It should be viewed as an aid to ensure professional performance by both pilot and controller communities. Remember — QAP will be observing and noting lapses. ■

Courtesy ASRS *Callback*, Apr 84.

Unchanging Scenario

Human factors is a relatively new concept in flying safety, but the problems addressed are not. Here is a letter from a World War I pilot in France to his father. It cannot be said better than he did.

■ "Dear Dad,

"You asked about the danger of flying and the number of mishaps that occur over here that result in fatal injuries. Relatively few of our craft are destroyed by enemy action. I would say that complacency or a false sense of adequacy causes more crashes than any other factor.

"Aviators attempt unauthorized maneuvers, run out of fuel, become

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"Aviators attempt unauthorized maneuvers, run out of fuel, become disoriented or lost, fly low level and crash into obstacles or attempt takeoffs or landings that are not within the capability of their aircraft."

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"The loss of aircraft to the enemy is accepted risk and is the nature of war, but at times it's difficult to understand why, with the inherent risks of combat always present, our aviators make such stupid, that is the only way to describe them, stupid mistakes.

"I imagine that as long as man experiences the exhilaration and the freedom of flight, and the need to foolishly exhibit his manhood and mastery of his machine, accidents will continue.

"A competent aviator must realize both his own and his aircraft's capabilities and limitations, especially in a combat situation. A loss of an aircraft, whether by enemy action or by accident, is still a loss to our cause.

"To better answer your question, no, it is not dangerous to fly; our machines are adequate. It is the human who is dangerous." – Courtesy Army *Aviation Digest*. ■

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The After Effects Of Alcohol

COLONEL GRANT B. McNAUGHTON, MC
Directorate of Aerospace Safety

■ Review of toxicology in Air Force mishaps seldom reveals a positive blood alcohol. The reason is due to the fact that alcohol is metabolized at a constant rate; the 12-hour bottle-to-throttle rule allows the body time to clear the blood. (We know of one mishap where the crew was drinking up 'til 9 hours before take off, but no remains of the primary crewmembers were ever recovered from the crash, which occurred in the ocean 40 minutes into the flight.) Review of the 72-hour histories, however, reveals a high percentage of crewmembers that admit to or were observed taking some form of alcohol 12 to 18 hours before take off. Since the members were "legal," alcohol as a factor has almost always been discounted, with an occasional exception.

One of these involved a fighter pilot who drank sufficiently at parties Friday night to require being driven home; who drank at home Saturday night; and who drank 15 to 17 glasses of wine on a wine tasting trip which ended at 2130, Sunday. After his usual breakfast of coffee and possibly a bread roll, he took off, aerial refueled, shot one low approach, then entered the low level route. While still heavyweight, he had maneuvered around a town, through a valley, and initiated a 70° banked 4-5G turn into the low lying morning sun when he hit the trees on subtly rising terrain. His remains were negative for alcohol, but then it had been at least 14 hours between his last drink and the crash. The Safety Investigation Board noted as contributing factors, fatigue, judgment, and glare, and wondered what role, if any, was played by the residual effects of alcohol.

Though the answer to that will never be known, it is known that alcohol does leave measurable residual effects. One recent study by Dr. Leon Wise,[1] Chairman of the Psychology Department, Heidelberg College, Tiffin, Ohio, is revealing in this regard. Dr. Wise set out to determine what, if any, residual behavioral effects could be observed when alcohol ingestion was combined with a fairly simple flight-related task — that of a preflight check, in a flight simulator.

For control-comparison, Dr. Wise tested his subjects in three states: No alcohol; 30 minutes post-ingestion of sufficient alcohol to produce a blood alcohol level of 0.08% (legal driving limit in Ohio is 0.10%); and 14 hours post-ingestion. In this study, the measure of alcohol effects was based on oversight errors during the pre-flight. Before each subject entered the simulator, the experimenter had preset the following errors:

- Landing gear handle placed up.
- Speed brake switch — deployed.
- Wing flaps set at 50% (excessive for "take off" in this "aircraft.").
- Fuel selector placed to tip tanks. (This is a three-position switch: TIP TANKS, OFF, MAIN TANKS. Were the pilot to move the switch one detent in the proper direction, he would shut off his fuel).
- Parking brakes were left off.
- Altimeter mis-set 1,000 feet high.

The subjects were provided with a checklist, which, if they followed carefully, would have uncovered each error. The results were interesting:

Condition	Subjects Missing At Least One Preset Error (%)
No alcohol	10
30 minutes later	89
14 hours later	68

Dr. Wise observed that responses at 14 hours were much closer to those at 30 minutes than to the no alcohol state. The subjects did not anticipate errors; hence they found none. Dr. Wise was careful *not* to say that these subjects were hungover. In fact, they were not suffering from any of the symptoms associated with hangover. They were feeling no different than the guy who knocks back two or three at the bar the night before a morning hop.

The observation that these subjects did not *anticipate* errors is astute, and worrisome. In the hierarchy of human cerebral functions, the ability to anticipate is right near the top. One of the reasons for the frontal lobotomy of the 1950's was to cut the circuitry that was somehow involved in anticipation; the patients no longer anticipated bad things, hence they became placid and complacent.

More research is undoubtedly needed to classify the basic biochemical-neurologic-psychological interactions, but suffice it to say, there are more likely than not some residual effects of alcohol which are not conducive to good piloting. The 12-hour bottle-to-throttle rule may satisfy the legal constraints but not necessarily the physiologic. Keep that in mind if you've got a demanding go in the morning. ■

[1]Wise, Leon M., "Residual Effects of Alcohol, *"Flight Crew"* Vol 5, No 4, Fall 1983, pp 54-56.

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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 Accident Prevention Program.

MAJOR
Charles G. Jordan, Jr.

MAJOR
Kurt J. Wisecarver

1st Military Airlift Squadron
Andrews Air Force Base, DC

■ On 8 November 1983, Majors Jordan and Wisecarver were flying a local instructor upgrade mission in a C-6A originating from Andrews AFB with transition landing at several local airfields. After accomplishing the fourth touch and go at Frederick Municipal Airport, Maryland, the right main wheel came off during gear retraction. The airport manager advised the crew by radio that something had fallen off the aircraft. A visual inspection confirmed the lost wheel assembly. The aircraft was flown back to Andrews AFB, and enroute, Majors Jordan and Wisecarver discussed the situation with a factory representative and a Stan Eval pilot present in the control tower. Since the gear could not be retracted, the decision was made to land with the left main and nose gear down and only the strut on the right side. The approach was planned using full flaps for landing to minimize ground roll and to feather the right engine on short final to alleviate prop damage during the landing. The right over wing escape hatch was opened on final to allow for a rapid egress in case the primary exit door jammed upon landing. Fuel was reduced to 300 pounds for the landing to minimize the potential dangers of a fire. The left side of runway 01R at Andrews was foamed from 2,000 feet past the threshold for approximately 3,000 feet. A single engine approach was made in VFR conditions. Touchdown was smooth with the right main strut in the foam just to the left of the runway centerline. Controllability was very good with Major Jordan able to hold the right strut off the runway until approximately 50 knots. He used reverse thrust and braking on the left side to maintain a straight ground track until about 25 knots, when the aircraft pulled slightly to the right of the foam and came to rest 5,000 feet down the runway. Total damage to the airframe was limited to the right strut assembly, main gear tire, and a dent to the flaps when the wheel assembly fell off. The airframe was in flyable condition within days. The professionalism and aerial skills exhibited by Majors Jordan and Wisecarver during this emergency were outstanding examples of excellence in airmanship. WELL DONE! ■

It Was Warm Down Here . . .

But It Isn't Up Here!

How Are You Dressed?