SEPTEMBER 1956

FLYING SAFETY

UNITED STATES AIR FORCE

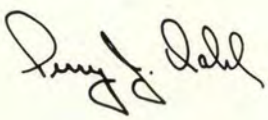
Winter, Just Around the Corner . . . page 4

FLYING SAFETY

VOL. TWELVE NO. NINE

File Thirteen

As depicted by our cover, winter is upon us. It may not arrive at your base for a bit, but best dig out those ear muffs and be ready . . . . . . A reminder if you drive a jet. On an IFR flight plan, direct or on airways, you must report at least every 200 miles. The reporting points selected must be entered on the 175. This also goes for recips that are IFR, direct, off airways . . . . . . The ACIC folks tell me that the Standard and Jet Pilots Handbooks will soon carry a notice that "circling ceiling provides the required clearance of 300 feet within 1.7 nautical miles only from the approach end of all runways." Seems there have been a rash of violations filed against pilots for using the circling minimum outside of the 1.7 mile zone. . . . Major John R. Phillips from Eglin, probably holds the record for the lowest, successful ejection. He recently went out of an F-89 at about 300 feet. Space prohibits a blow-by-blow account, but he had full automatic equipment, did things in the right sequence and came out with only a sore shoulder and back. . . . Next month we'll have something on the F-102 winter tests and a story on flying the KC-135. It's quite a bird. . . . See you then.



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USAF PERIODICAL 62-1

How Well Can You Remember?

If you miss more than four you had better check those back issues.

July

1. The normal search period for airmen downed over the water is approximately:
   a. 2 days.
   b. 6 days.
   c. 10 days.
   d. 14 days.
2. Above..............feet, the only adequate defense against low atmospheric pressure and abrupt decompression is partial pressurization of the body.
   a. 35,000.
   b. 45,000.
   c. 50,000.
   d. 60,000
3. What is the record for the longest survival at sea (on a flexible life raft)?
   a. 17 days.
   b. 21 days.
   c. 33 days.
   d. 47 days.
4. What action should you take if you find an error in a Radio Facility Chart—or better yet, want to suggest an improvement?
   a. Submit a UR.
   b. Write a Disposition Form to your Commander.
   c. Fill in the prepared post card.
   d. Notify Flight Service.
5. What is the primary cause of the turbulence created behind an aircraft?
   a. Wake.
   b. Rotation of prop or turbine.
   c. Wing trailing vortices.
   d. Vortex generators.

August

6. The B-66 is equipped with what engines?
   a. J-47.
   b. J-65.
   c. J-71.
   d. J-79.
7. The most recent weather report broadcast takes place:
   a. 15 minutes after the hour.
   b. 45 minutes after the hour.
8. You can assume that if there is anything wrong with you, the Flight Surgeon is going to find it during the examination phase of your annual physical.
   a. True.
   b. False.
9. The main reason for calculating a "Line Speed" is to determine:
   a. If engine is performing properly.
   b. Acceleration rates and runway distances.
   c. Engine thrust available.
   d. Distance required for takeoff roll.
10. What is the average length of time it takes a pilot to decide whether to abort a takeoff and then react?
   a. One second.
   b. Three seconds.
   c. Five seconds.
   d. Seven seconds.

September

11. You are flying your jet in icing conditions. It has retractable inlet screens, so you should be certain they are:
   a. Extended.
   b. Retracted.
   c. Left set where they are.
12. Inlet duct icing can occur without the formation of ice on the external surfaces of the aircraft.
   a. True.
   b. False.
13. A technique known as "throttle burst" is used on some aircraft to:
   a. Maintain cockpit temperature at a given level.
   b. Keep fuel lines from freezing.
   c. Prevent icing in air inlet.
   d. Facilitate an emergency go-around.
14. Control surface buffeting caused by ice accumulation cannot be distinguished from buffeting caused by approach to a stall.
   a. True.
   b. False.
15. The thrust attenuators on the T-37A . . .
   a. Reverse thrust for landing.
   b. Cut down thrust on final approach.
   c. Restrict airflow to the engines.

ANSWERS

1. b	6. c	11. b
2. b	7. b	12. a
3. d	8. b	13. c
4. c	9. a	14. b
5. c	10. b	15. b

LETTERS TO THE EDITOR

Record Time

Have you any record of the maximum number of hours flown by a B-25 type aircraft during a 30-day period? We are interested in bettering any record set by any other Air Force unit.

M/Sgt Vincent P. McGann
1403d Flt Line Maint Sq
Andrews AFB, Maryland

That's a nice record to shoot at, but let's not forget, the best one is maximum "accident free" time. We have no info on max. hours flown.

★ ★ ★

Food For Thought

I would like to take issue with you on your standardization article, "You . . . From the Same Mold," in your June issue. Stand boards are great stuff, as such, when they stick strictly to business, which is making sure that people follow the Dash One and supplements thereto, but invariably they cannot do this and start branching out. They tend to grow, like Topsy. They then tend to go to the point of dictating what you will say on the interphone, where your hands will be placed on takeoff (besides covering your eyes, if you're a CP). I have yet to see a stand board that did not do this. They also start publishing little *billets-doux* called SOPs, which normally don't quite agree with what AMC or someone else has already published and then the arguments start. When you start arguing, you've shot a large hole in your board and you may as well cancel the whole thing.

It is impossible to standardize a batch of pilots to the degree which some of your articles call for because we are not all stamped from the same mold. (How dull it would be, if we were!) It is possible to make sure everyone is doing as per the "company handbook" which is all the airlines ever demand or desire of—to drag in that overworked phrase, the "professional pilot." Basically, I think this is all you are after, but quite a few of the boards I've been on and under, go off the deep end on this stuff and some of your articles just stimulate this tendency.

Well, I've had my mumble; hope no feelings are hurt.

Capt. R. R. Lawrence
6000 Ops Sq, APO 704

I figure this will stir up some kind of a hornets nest. But you certainly have a point. You can overdo anything. And thanks for your mumble!

★ ★ ★

Commander at Work

This Headquarters reviewed with extreme interest the article, "You . . . From the Same Mold," prepared by Lt. Colonel Mitchell J. Mulholland, and published in the June 1956 issue of FLYING SAFETY.

The message which Colonel Mulholland's article contained and the effective manner in which it was presented made widespread dissemination throughout this group mandatory. To insure that each pilot availed himself of Colonel Mulholland's thoughts on standardization, an individual letter was dispatched, together with an extracted copy of the article in question . . .

. . . This Headquarters wishes to express its sincere appreciation to the Director of Flight Safety Research and to Lt. Colonel Mulholland for the capable and professional presentation, "You . . . From the Same Mold." We are convinced that articles of this nature will do much to strengthen all echelons of the United States Air Force. The ultimate benefit in operational equipment and lives saved is incalculable.

Col. Marshall H. Strickler, USAF
Commander, 9th Air Rescue Group

Words such as these makes our efforts in the flying safety business seem more worthwhile.

★ ★ ★

Dim, Dim the Lights

Having been a reader of FLYING SAFETY for many moons, I have picked up some of the most helpful hints that no T.O. has ever included! Don't misunderstand this statement, but a T.O. can't give technique. Anyway, Crossfeed is a real source of information and helpful hints so here is a note perhaps worthy and perhaps not. Action may have been taken by now but I haven't seen any results at our strip.

It was a field grade night and yours truly had the hop from Webb AFB down to El Paso on a navigational weekend flight. While breezing along in the old T-Bird newer model with the individual lighting on the gages, I noticed two sets of instruments, the regular ones on the panel and the addition of a faintly glowing red set which covered about half of the windscreen by virtue of reflection. This wasn't too disturbing until I found that my eyeballs had become accustomed to the red glow on the screen and when an airliner was overtaken I suddenly discovered that the red flasher light on the tail of the big bird was not part of the reflection on the screen.

Although it wasn't close this time, it might well have been and it could happen on one of those "clear as a bell" VFR nights when the driver gets a little "too accustomed" to too many red lights. So . . . why not modify the new T-33s and put a three or four-inch hood above the panel like those on the F-86s and other birds? Wouldn't cost too much and might just help some guy who is getting a little beat from a long, long flight.

Just a suggestion for anyone who might be interested and not a device to dispute the most sensible words, "Keep the head on a swivel and always look around."

Again, I say there is no other magazine that I know of which will give the airplane drivers more useful information than yours does. If possible, I'd like to get a personal subscription if there is such a thing.

1st Lt Robert L. King
Hq 3645th Plt Tng Wg
Laughlin AFB, Texas

Thanks, Lieutenant, for the generous words about FLYING SAFETY.

As for the hood, it is available for the '33, although it isn't normally installed. It does eliminate glare on the canopy for night operation but because it partially obscures some instrumentation, a lot of T-bird drivers don't want it installed.

Perhaps you may be flying with the lights turned up too high. Suggest you try turning them down and see if you can strike a happy medium that will provide instrument reading as well as forward visibility.

For a year's subscription to Flying Safety Magazine, just send $2.50 to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

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Plain, Old Socks

Read with interest your article on wind shear. Here's my suggestion: Just plain old, humble wind socks (erected and maintained serviceable).

Educate pilots to take at least one glance at them, to help break up that fixed stare at the gages and so-called magic area.

T/Sgt H. Davis
3513th CCTS
Randolph AFB, Texas

Tall oaks from little acorns grow. Actually, the wind shear problem is a little more complex than merely knowing the surface wind direction. To be effective, the wind sock would have to be rigged on a pole some 300 feet in the air, with three or four socks located up and down the pole.

Thanks for writing, Sarge. Often it is a simple idea like this that solves some of the most complex problems.

★ ★ ★

The Penlight

I have read Colonel Ross' article in the May issue about a pilot losing his flashlight. He suggests that the pilot tie a string around the flashlight and hang it around his neck. Why doesn't the Air Force procure the Flashlight: penlight w/lanyard (Navy BuAer R-17-F-13475). It's a must for all Marine pilots.

T/Sgt Roy E. Bonnot, USMC
H&HSq (StaOpns Mat.) MCAS
Kaneohe Bay, Oahu, T. H.

The Air Force considers the penlight unsatisfactory for its varied operations. Among other objections, it is not of sufficient intensity for seeing ice formation on the wings, aileron trim position and such. FLYING SAFETY *certainly is not criticizing the Marines' equipment. We're sure it has proved satisfactory for your particular needs.*

★ ★ ★

Look Right

Although I enjoy your magazine a great deal, I haven't the training to offer much constructive criticism on its articles.

I did, however, note a slight error in the July issue. In the "Rex Says" section there is a letter defining prevailing visibility. It presents a situation in which the visibility is two, three, four and five miles in the four quadrants and goes on to say that in such a case three miles would be reported. This is incorrect, as prevailing visibility is that distance which can be seen throughout half *or* more of the horizon. Therefore, in this case your answer would be four miles. Just a detail, but as Rex says, "It's the finer points . . ."

As I said before, I enjoy reading FLYING SAFETY and feel that it's an outstanding publication.

Anthony Skey, A/2C USAF
20th Weather Sq

You are correct. The originator of the letter to Rex was in error. The Manual of Surface Observations states, "Prevailing visibility is the greatest visibility which is attained or surpassed throughout half of the horizon circle, not necessarily continuous."

Thanks for setting us straight and for your nice comments regarding the magazine.

★ ★ ★

Better Paint Job

While reading the article, "Bouncing Thru the Boondocks" in the March issue, pertaining to accidents resulting from undershooting runways, I pondered the cited proposed solutions.

I understand the undesirable aspects of painting a touchdown point to serve as a landing target, but please consider this: Paint the 200 to 500 feet of runway at the approach end to blend with the terrain (brown, adjacent to dirt, and green to grass, and so on) until we get to snow. Now, there's a small detail I haven't worked out but then I'm pretty far south.

But, seriously, it seems we need an approach area which is physically a part of the runway, same composition, with no lip or shoulder, and one that psychologically is not considered a part of the runway.

A good job of camouflage may be the answer to preventing some of these accidents.

R. D. Smith
Quality Analysis Div
Brookley AFB, Alabama

Not a bad idea. When you get the snow problem solved, let us hear from you. Some commanders have already moved the runway thresholds in some 500 to 750 feet, where runway length has permitted.

WINTER WEATHER HAZARDS

Major U. H. Nenon
Air Weather Service

It may come as a surprise, but winter is just around the corner. From now on through the winter months, FLYING SAFETY will carry a special winter section in each issue. Stay ahead of the game by starting to think about winter weather flying now, for it won't be long.

NEVER UNDERESTIMATE the power of a woman. The woman in this case is Mother Nature. The old gal really has a nasty disposition in the winter season, but like many another man who contracted for better or worse, you can learn to live with her. Accident rates prove this; they are not much worse in December through February than in other months. You just have to be considerate, that's all. Don't fight it; it's bigger than both of us.

Of course, things can get awfully difficult. When the airline operators see the figures on IFR weather in January, they shudder like a husband confronted with a full-page ad for mink coats. It all hurts that old bank balance in the end.

Figure 1 shows, in generalized fashion, the incidence of really stinking weather of the United States (ceilings less than 500 feet and/or visibility less than one mile). With the exception of some local areas notorious for persistent ground fog, these poor flying conditions are mostly associated with frequent storms and a com-

Structural icing is just one winter hazard.

bination of troubles. For most of the country, it is obvious that things aren't extremely tough very often. Just remember on a low approach, one miss can make a miserable mess.

Surface Winds

Since surface wind is by far the most common weather factor involved in accidents, don't think you're safe just because the wheels are touched down. Although that gusty blow-hard, the thunderstorm, has gone south for the winter, there is still plenty of turbulence in the strong, rough winds that zip across the northern states in winter with the cold air outbreaks. There is a marked preference of notably strong surface winds for the region north of the seasonal mean 180 days-of-frost line. Great Falls, for instance, has surface wind 25 mph or more, 11 per cent of the time in January. When the demand for careful landing and ground handling technique is complicated by snow and ice on the runway, a precarious situation results. The extent of this region requiring special care is indicated in

If your bird has propellers, watch for ice.

If you plan your flight carefully and know something about icing, you can avoid this.

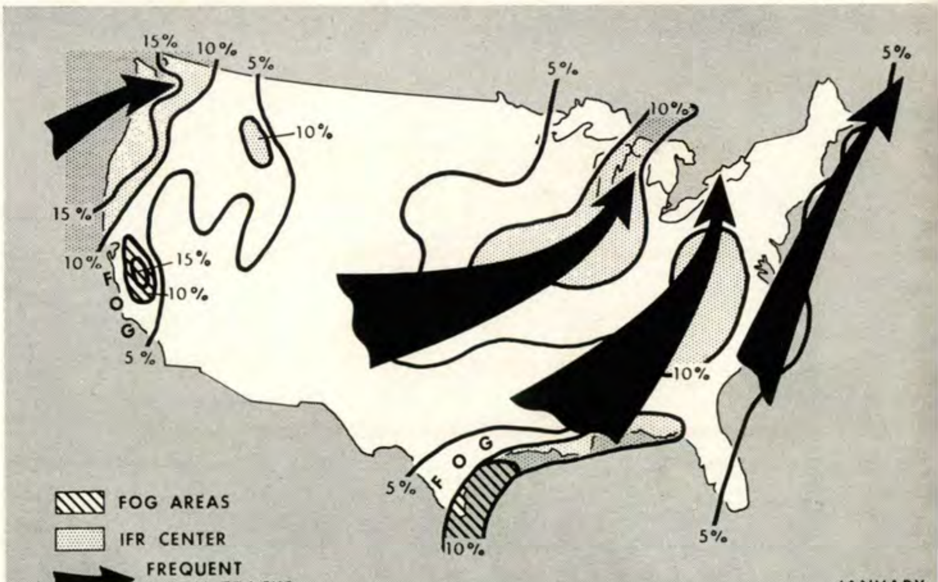


FIG. 1

Above, frequency of ceilings and visibilities of less than 500 feet and/or one mile. Below, shows area of gusty winds and slick runways. Notice the 180-day frost line.

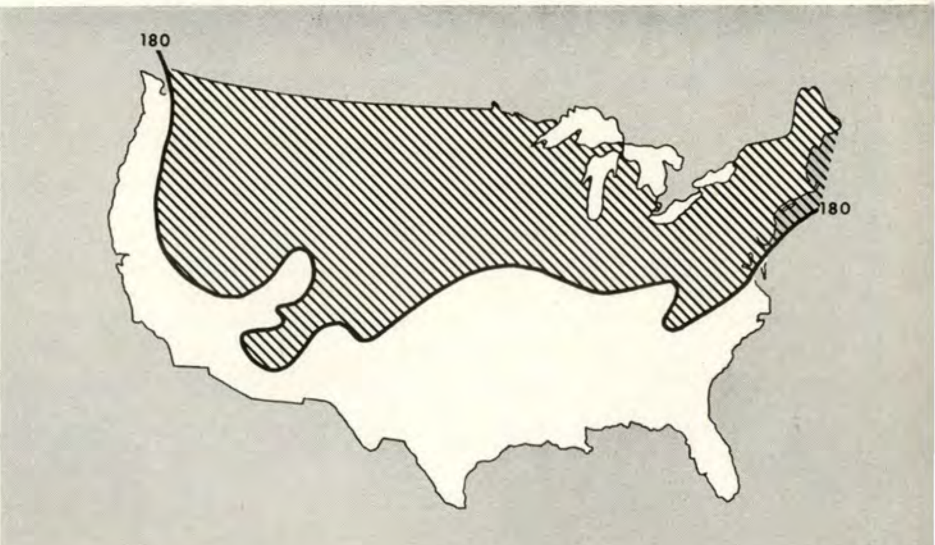


FIG. 2

FIG. 3

Left, indicates mean heights of zero degree temperatures above which icing can occur.

Below, shows mean heights of coldest temperatures. Icing is present below these levels.

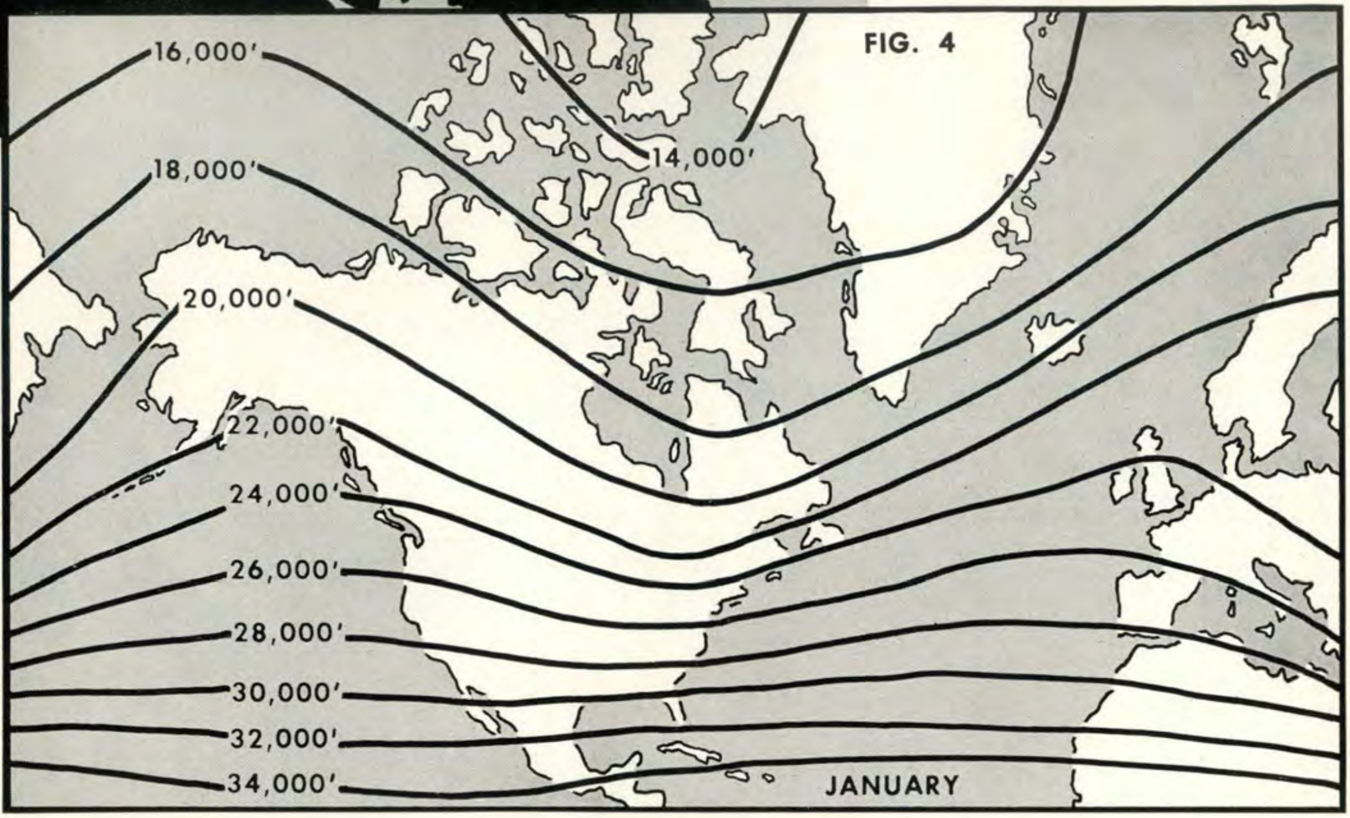


FIG. 4

the Figure 2. Beware that low blow with a snow job.

Nobody knows for sure just what is the potential incidence of aircraft icing. The accumulated figures are biased because pilots are biased; they avoid the stuff. There are just not enough old, bold pilots collecting that kind of hairy frost on their "punkin" heads to make a fair sample.

Recent Tests

During a recent winter, however, over 600 icing encounters during routine flights over North America were assembled and analyzed. The conclusions are interesting, and here they are. Read and heed.

50 per cent of the icing conditions were intermittent.

90 per cent extended over a distance less than 120 miles.

90 per cent of unbroken icing conditions extended less than 50 miles.

90 per cent of vertical icing cloud traverses were less than 4500 feet.

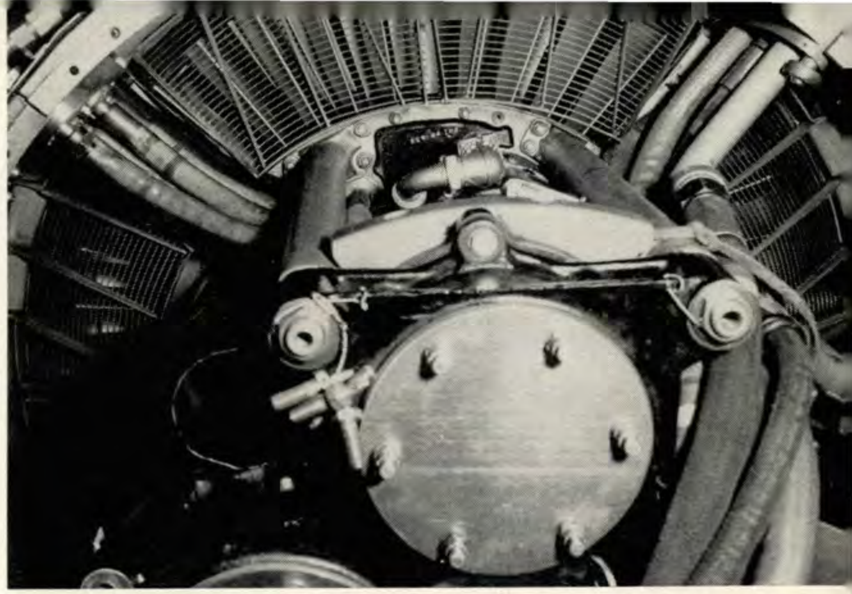
93 per cent of the ice accumulations would have been two inches or less in thickness.

90 per cent of the temperatures in icing were above −15°C. (+5°F.)

Greatest observed potential ice accumulation (without removal) was six inches; longest flight in icing conditions was over 400 miles.

Since most difficulty with ice in flight can be expected in clouds or rain at temperatures just below freezing, the map of mean freezing level heights, Figure 3, shows you where to expect this layer in January. The companion map, Figure 4, of mean heights of −40°C., indicates the levels above which you can reasonably expect to avoid icing (for average conditions). You would collect no ice at these high altitudes because the moisture should all be ready-frozen. Actually, planes should be free from icing quite a bit below these altitudes; the lowest icing temperature found in the 600 cases discussed was −27°C.

Do you have enough fanny-freeze protection? Check with your local forecaster. ●



With extended screens, severe restriction of airflow can occur in 15 seconds.

ICE . . . in the mill

IT HAS BEEN some one-half decade since a gaggle of F-84s took off from a midwestern base, entered the clouds and began smartly flinging pieces of turbine wheels (in assorted shapes and sizes) all over the State of Indiana. Now this proved disconcerting to others as well as to the '84 chauffeurs involved. In fact, it was reported that the incident brought about an orderly, yet considerable, increase in "early out" requests among the hard hat set.

Investigators, quick to realize the seriousness of the personnel situation, pulled out all chocks and came up with the accident cause (and solution to same) in record time. It all centered around jet engine icing.

Anything that will cause an aircraft to suddenly fall out of the sky is a rather important, as well as frightening, thing. Such is the case with jet engine icing.

When it comes to being a ready-freddy for this sort of thing, one can't beat knowing the Dash One. Therein you will find the procedures and equipment that applies to your particular bird. But, regardless of what you fly, there are a couple of major icing problems applicable to most models of axial flow engines. Either one of these problems can make the mill go all to pieces. (Centrifugal type engines are relatively immune to icing and will not be discussed.)

The first one is the formation of ice on the induction or engine components which greatly restricts airflow to the engine.

The second major problem is the swallowing or ingestion of chunks of ice by the engine.

Airflow Restriction

Let's dig into the airflow restriction first and see what happens and what we can do about it. This is the type of engine icing that snafued those Thunder Jugs.

As the hot pipe you are herding noses through the soup, ice may form on the fixed inlet screens or the inlet guide vanes, thus restricting the flow of air to the engine. This causes a loss of thrust along with an increase in exhaust gas temperature. The fuel control system, sensing the power loss, automatically increases the fuel flow. This increase in fuel and reduced airflow causes a severe overheat condition in the turbine section and unless immediate corrective action is taken, the turbine buckets make like .50 calibre slugs, *tout de suite!*

Ice build-up on inlet screens can cause severe restriction of airflow in as little as 15 seconds and turbine wheel failure in less than one minute. Almost all of the inlet screens now in use are retractable and should never be extended when icing conditions seem evident.

The restriction of airflow caused by ice on the inlet guide vanes takes a little longer but can still louse up the works (engine). Blocking of the air passage between the vanes can occur within four minutes. The indications are the same high exhaust gas temperatures and all too often this is the only indication prior to complete engine failure.

Inlet duct icing can occur without the formation of ice on the external surfaces of the aircraft. When you make good a true airspeed of less than 250 knots at a high power setting such as during climb, the intake air is sucked rather than rammed into the compressor inlet. This suction causes a decrease in temperature of as much as 5°C. Thus, air that is above freezing may be reduced to subfreezing temperatures as it enters the engine and inlet duct icing will occur.

Ice Ingestion

The compressor failure problem due to the swallowing of ice happens when ice formations break from the cowl lips or nose dome and are swept into the engine by the airflow. The damage occurs when a chunk of ice passes between the inlet guide vanes and hits a rotor blade. The impact causes blade oscillations and it is possible that the leading edge of the blade will scrape the trailing edge of the inlet guide vanes, bending or chipping the rotor blades. It also is possible that the blade will snap off, and there you are—a foreign object kicks through the compressor, causing disintegration.

An example of ice ingestion damage occurred in a B-47 during an icing test flight. After flying through icing conditions, the pilot pulled up above all clouds and noted about an inch of ice on the engine nacelle lips. A few minutes later the ice broke off, entered one of the air intakes and caused engine compressor failure. The pilot landed the aircraft safely and the other five engines were examined. All of them showed ice ingestion damage. The best of the five engines was placed on a test stand and it ran all right at low rpm. However, when it was run up to 92 per cent, the engine compressor failed in approximately two minutes.

Ice ingestion damage, therefore, can take two forms. It can cause immediate compressor failure or it can result in compressor failure at some later date. This type of icing is insidious because it can result in engine damage even after the aircraft leaves the icing condition and flies in the clear.

Anti-icing Systems

To eliminate engine damage caused by icing, anti-icing systems have been devised for most Air Force aircraft. One system incorporates an alcohol spray mechanism to eliminate or prevent ice formation and the other system heats the induction and engine components by electrical means or compressor bleed air. The latter is the most common.

In the aircraft using compressor bleed air, the problem is not entirely solved. At low engine rpm the anti-icing system usually becomes ineffective because of the reduced pressure and temperature of the compressor bleed air. During a letdown with the throttle retarded, it is possible for ice to form on the inlet components. As a result, a technique known as throttle-burst has been developed. This is nothing more than shoving the go-handle forward every minute or so. This introduces a surge of heated air through the components. Keep in mind that this "burst" must be done often enough so that the ice does not build up and become a potential ice ingestion hazard.

No doubt about it, icing danger to the power plant of your jet bird is real, and its results drastic. If your aircraft has protection, be sure to use it, and keep an eagle eye on that tailpipe temperature. If it starts to make its move, get on that throttle, reduce power as necessary and change your altitude to get out of the clouds. T. O. 1-1-469, "Operation of aircraft with jet engines under icing conditions" has a lot of information on the subject. Comply with it, along with your Dash One and reserve the ice for the tall glasses—not your jet engine. ●

Regardless of the bird you fly, know your anti-icing procedures. They are in the Dash-One.

ON THE SURFACE

W. B. McVeigh
Douglas Aircraft Company

Don't be fooled into thinking ice or snow on the surfaces of your aircraft will melt or blow off. Don't settle for less than a clean, ice-free wing.

WINTER WEATHER is demanding, both on our man-power and our flying machines. If you're the member of a crew who has neglected the common sense precautions and procedures for dealing with ice and snow, it's nine chances out of ten you'll be in the midst of a real action-packed drama before very long.

An airplane covered with snow is a booby trap. Don't be fooled into thinking the stuff will be blown off before the monster becomes airborne. Facts taken from the case histories of many winter accidents disprove such wishful thinking. Ice is where you find it, and in all probability you will find it on the surfaces under that nice, white blanket if you're smart enough to look.

Prevention

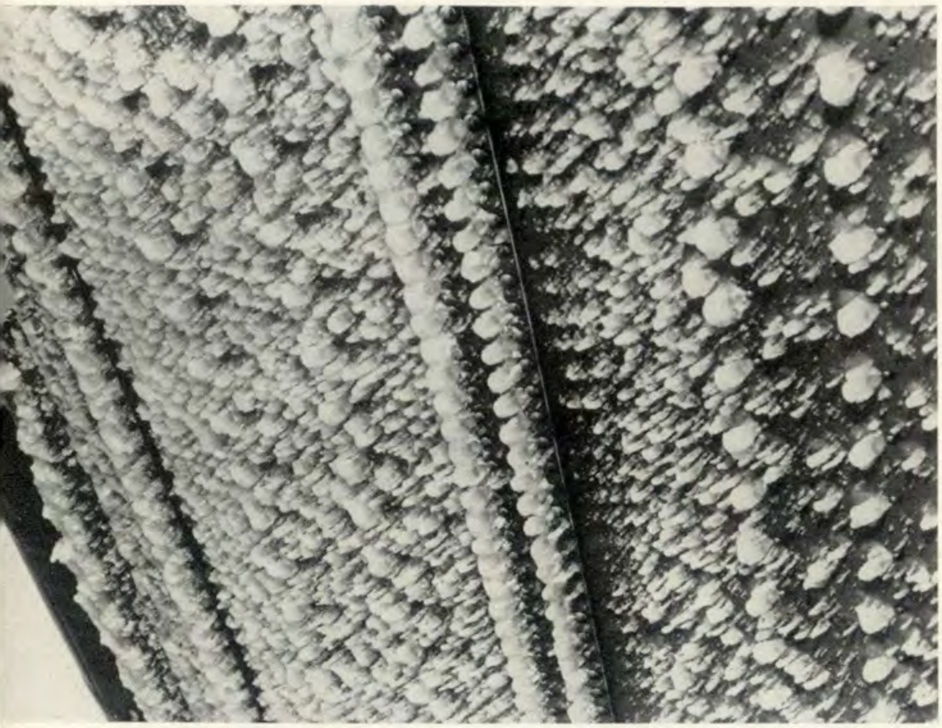
The old adage "An ounce of prevention is worth a pound of cure" most certainly applies to frost, ice or snow, where aircraft are concerned. A preventive measure to be taken in lieu of inside storage, is the use of fabric covers or some other suitable protective covering on the aircraft surfaces. A little time spent in covering the surfaces in the face of adverse weather will be repaid a hundredfold when the airplane is readied for flight.

The effect of snow or ice in all forms is very difficult to predict and too many variable factors are involved which would make any such prediction unreliable. As we all should have learned, the airplane is dependent upon smooth, uninterrupted airflow over all of its surfaces for safe, efficient flight. Then, and only then, is the human element in complete control of the aircraft.

The main effects of ice or snow on an airfoil are to disturb the normal airflow over its surface and alter the distribution of weight. This can result in increased drag, loss of lift, decreased control, flutter of the surface or all of these factors combined in varying degrees. The vital factor is the distribution of the ice or snow formation on the surfaces rather than the additional overall weight increase to the aircraft. The formation of ice or snow creates changes in airfoil contour, control and servo-tab surface mass unbalance which may lead to separation of airflow and in some extreme cases, dynamic instability of the surface.

If the ice formation is unsymmetrical, then large differential loads between two lifting surfaces may develop to a point that the aircraft may no longer be controlled. Ice formation on the leading edge of a control surface or servo-tab also creates a potential buffeting condition. This is particularly true at surface deflections where the iced portion of the control surface leading edge protrudes above or below the trailing edge of the primary surface.

Control surface buffeting caused by an unbalanced condition should be readily and easily distinguished from



The vital factor is the distribution of ice formation rather than the additional weight increase.

buffeting of the surfaces caused by the approach to a stall. If the condition is eliminated by decrease of airspeed, it is indicative of structural shake which may be attributed to control surface unbalance (inertia effects) rather than aerodynamic disturbance (stalling) of an airfoil section. Stall buffet is generally eliminated by increasing rather than decreasing the airspeed.

In addition to the many other adverse effects of ice accumulation on control surfaces, it is evident that the resultant tail heaviness and subsequent loss in flutter stability deserve special attention.

Let us consider a recent incident involving a C-124 Globemaster. Indications are that the difficulty occurred as a result of elevator ice accumulation prior to take off from Misawa to Tachikawa, Japan.

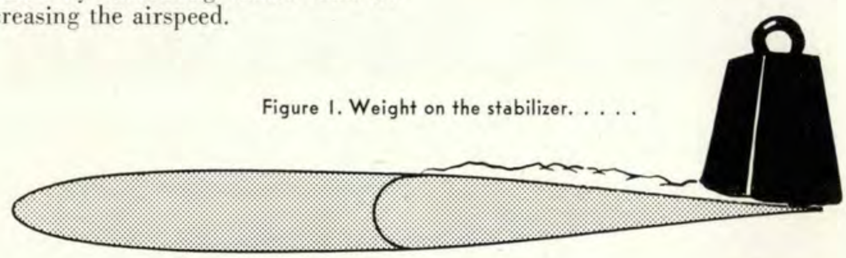
The gross weight of the aircraft was 156,656 pounds. It had been on the ground at Misawa for approximately two hours in blowing snow, at an outside temperature of 33°F. The right wing heater did not operate on the ground and no action was taken to remove the snow and/or ice which had accumulated on the aircraft. The pilot indicated he did not believe sufficient accumulation existed on the surfaces to warrant removal.

Takeoff

The takeoff speed appeared normal and as the aircraft climb approached 500 feet altitude, with gear and flaps retracted, engine power reduced to METO and at approximately 150 knots IAS, a light to moderate "shake" was felt and described by the pilot as being in the horizontal rather than the vertical plane. Immediately, five degrees of flap was extended and the "shake" ceased. After a change of flight altitude was granted at 8000 because of icing, the climb was continued to 10,000 feet. At 8,000 feet, the right wing heater came into operation and all heaters were then operating normally. Shortly after leveling off at 10,000 feet cruising altitude with cruise power and 175 knots IAS, a violent "shake" in the horizontal plane was experienced. Power and airspeed were reduced immediately to 165 knots IAS and flaps were again extended to five degrees, after which the "shake" ceased, and the flight continued to Tachikawa without further incident.

Upon inspection of the aircraft immediately after the flight, shearing of the right elevator torque tube bolts

Figure 1. Weight on the stabilizer. . . . .



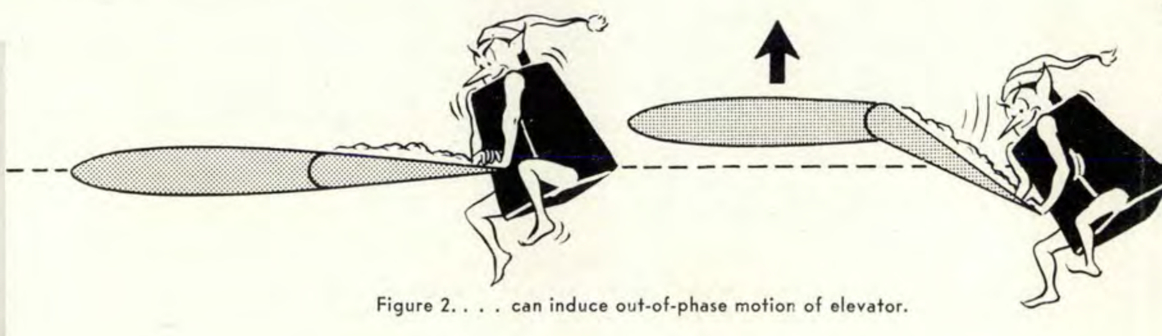
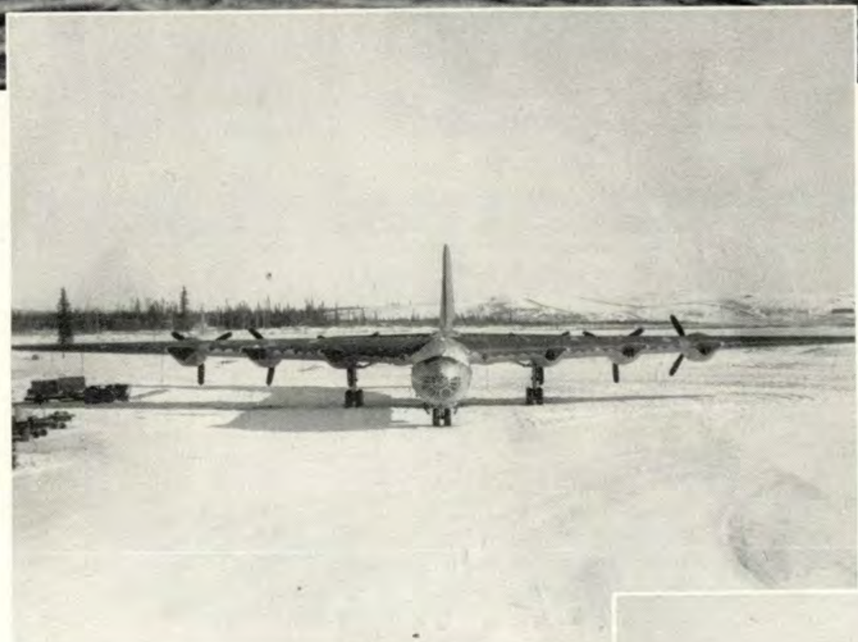


Figure 2. . . . can induce out-of-phase motion of elevator.

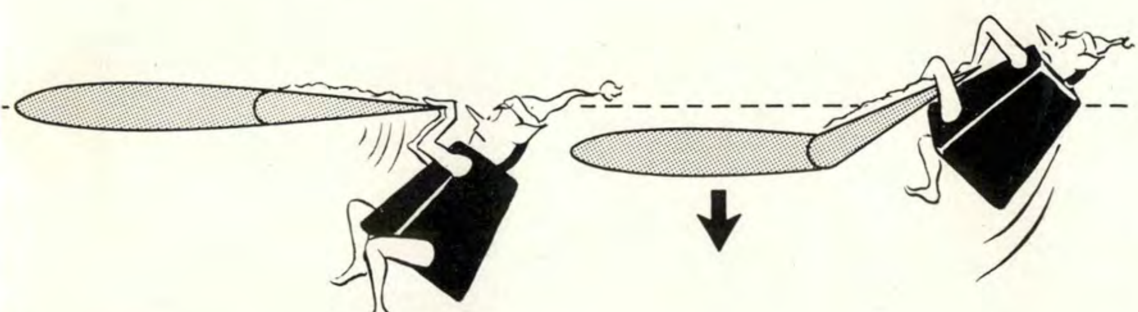
If you have wing covers available, better use them. It is easier and safer than the broom treatment.



was revealed, and severe major structural damage to the fuselage shell was in evidence in the empennage area.

The conclusion drawn after a thorough investigation of all the facts surrounding this accident, was that the most probable cause was icing of the horizontal tail surfaces which resulted in surface mass unbalance and dynamic instability of the surfaces. A flutter analysis of the stabilizer-elevator system including the effects of ice accumulation, discloses the following highly probable sequence of events responsible for this incident:

• Prior to takeoff, approximately 0.15 inches of ice accumulated on the elevator surfaces. This caused the



Taking off in a big iron bird or a sleek, fast fighter requires a wing clear of ice and snow.

center of gravity of the surface to shift seven inches to the rear of the elevator hinge line.

• At the reported 150 knots IAS, elevator flutter was experienced. This occurred as a result of a coupling between the tail-heavy, anti-symmetric vibration mode of the elevator at four cycles per second, and the anti-symmetric fuselage torsion-horizontal tail bending mode at three cycles per second. (Anti-symmetric refers to the port surface moving opposite to the direction of motion of the starboard surface.) The resultant flutter was primarily reflected in large amplitude oscillations of the elevators, leading to the failure of the torque tube between the surfaces reported subsequent to the incident.

• Upon failure of the torque tube bolts, the loss in restraint between the two surfaces dropped the frequency of the anti-symmetric elevator mode below the frequency of the fuselage torsion mode and resulted in momentary stability.

• As the speed was increased to the reported 175 knots IAS, flutter was encountered once again at a somewhat lower frequency of the fuselage torsion mode. The resulting large amplitude bending oscillations of the horizontal tail and associated torsional loads imposed on the aft fuselage caused the structural failures reported in that area of the aircraft. The fact that the flutter did not lead to the destruction of the tail and stopped abruptly, must be attributed to the ice breaking free of the elevator surfaces, thereby stabilizing the system.

Flutter

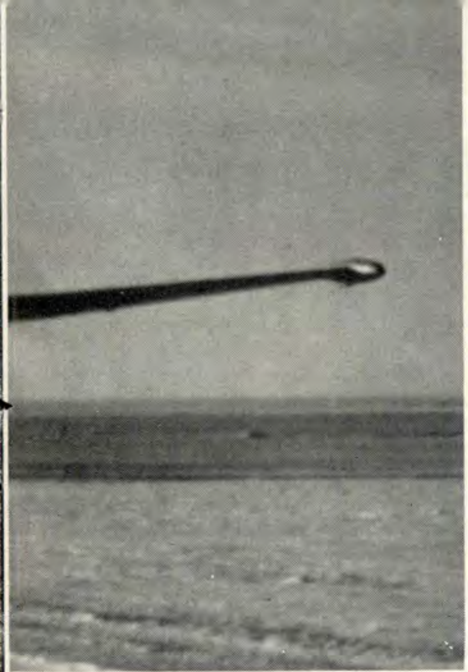
In an attempt to explain the forces at work in the mechanism of stabilizer-elevator flutter, let us consider a cross section of the horizontal tail surfaces with a weight placed at the trailing edge of the elevator as shown in Figure 1.

When the stabilizer translates (bends) up and down, the trailing edge of the elevator tends to remain fixed, due to the presence of this weight as shown in the series of movements in Figure 2. The relative motion of the elevator to the stabilizer is observed to be "out of phase," i.e., when the stabilizer bends upward, the elevator effectively rotates trailing edge downward and vice versa.

This "out of phase" motion of the elevator produces an aerodynamic lift force on the stabilizer which tends to drive the stabilizer in the same direction that it is moving. The phase relationship between the aerodynamic force and the motion of the stabilizer causes a net amount of energy to be fed into each cycle of oscillation. As a result, the amplitude of the stabilizer deflection increases with each cycle and may lead to the total destruction of the surface.

When the elevator is "mass balanced" the center of gravity of the elevator weight is made to act through the hinge axis, thus preventing the "out of phase" elevator to stabilizer motion responsible for this type of "tail wagging the dog" flutter. The control surface mass balancing "fix" has been standard aircraft design practice since the problem was first encountered on the World War I vintage aircraft.

The importance of clean airfoil surfaces cannot be emphasized too strongly. As previously stated, it is practically impossible to predict the



effect of foreign substances on aircraft surfaces, even water. To illustrate this point let us turn to the accident reports and take the case of the C-47 pilot who, upon preflight inspection, observed the airplane to be covered with a thin layer of water. Discounting the danger of water, he loaded 21 passingers aboard and took off. When approximately 15 feet in the air, the plane lost altitude and started a turn to the left; the pilot applied right aileron and pushed the throttles forward. The left wing came up, but the right wing immediately dropped. The airplane then made contact with the ground about 200 feet beyond the end of the runway with the gear still extended and crashed into a snow-bank. The water on the surfaces of the aircraft had frozen when it had entered a colder layer of air above the runway, spoiling the ability of the wings to produce lift. Another case of ice wresting control of the aircraft from the pilot. If a thin layer of ice would have such a disastrous effect on control of the aircraft, it can readily be seen what hazardous proportions any appreciable building-up might have.

Complete Removal

There are many conditions which enter the problem of prevention or removal of ice, snow or frost deposits. It is not the intent of this article to elaborate further on these conditions, except to say that appropriate and systematic plans should be promulgated and followed which will insure safe, uninterrupted flight operations during any adverse weather conditions. Personnel who must cope with the problem should be thoroughly familiar with all the aspects which are entailed to aid them in making the proper decision.

The removal of foreign deposits from critical surfaces should be complete. Broken or irregular pieces of ice remaining may create a greater disturbance than the original formation. The best policy is to remove *all* deposits from both top and bottom of wing and tail surfaces and from the fuselage as well. *Dry snow should not be left to blow off during the takeoff run.*

Experience shows that dry snow tends to cling to airfoil surfaces and usually will prevent a successful takeoff. So far as controls are concerned, snow can sift into the smallest openings and either freeze the controls in one position or become packed so that movement may be restricted later. It also might be well to remember that even though the aircraft is outwardly clear of ice and snow and takeoff is attempted on a slushy runway, it is good practice to actuate the landing gear through at least one complete cycle after climb has been established. Otherwise, slush thrown into the wheel wells may freeze and prevent extension of the gear for the next landing.

It cannot be emphasized too strongly that, in addition to the regular preflight inspection, a thorough examination for ice and snow deposits be made of the *entire* aircraft just prior to flight. Be sure that—

- All skin surfaces are clean and entirely free of frost, ice or snow.
- Propeller blades and hubs are inspected and any frost, ice or snow are removed.
- All control hinge points and control surface openings are checked for freedom from ice and snow.
- All antennas and antenna fittings are free of snow and ice deposits.
- Nose and main landing gear assemblies, including drag linkage, uplatches and door operating linkages, are clear of ice and snow.
- All heater and supercharger air intake duct openings are clear of snow and ice deposits.
- Engines are warmed up in an area free of slush and moisture, lest the propellers pick it up and throw it back over the wings, tail surfaces and fuselage.
- After engine warm-up, all flight controls are checked through their full arc of travel to make certain that they are not restricted by packed ice or snow in areas where visual inspection is difficult. ●

A fast, one-way trip to them Pearly Gates can be the result of trying to fly with a load of snow.

...OOPS... *WRONG* .... *SWITCH*

Lt. Col. Mitchell J. Mulholland
Safety Research and Analysis Div., D/FSR

This is the fourth of a series of articles prepared for FLYING SAFETY by Lt. Colonel Mulholland. This month he discusses a built-in hazard that affects all of us.

WHEN A PILOT bobbles the ball in any way and an accident results, we normally write it up as pilot error and go on our merry way. Corrective action in these cases frequently consists of such positive and glittering little gems as, "This accident will be discussed at the next flying safety meeting." In other words, the pilot goofed—rap his knuckles, waggle your finger at everybody else, go back to work and wait for the next one to happen.

What have we really accomplished here? Nothing. We have already discussed, in a previous article, the mechanism of human error. Now let's look a little further. We know that man is prone to error. Why then should we knowingly design and tolerate unnecessary booby traps that make human error more likely? And if a human pilot makes an error that is traceable to a built-in booby trap, where does our responsibility lie for corrective action? What do we do—spank the pilot or remove the cause?

A trap to be most effective must be concealed or camouflaged. You would hardly expect an elephant to fall into a pit unless it was covered with grass. It's the same way with the traps that catch the unwary pilot. He doesn't realize they are there. In fact they were designed with something else in mind. The point is, once they are recognized they should be eliminated as quickly as possible before they catch more people.

Some booby traps are so simple and obvious that it almost looks as though they were deliberately built for the purpose. We have seen aircraft with gear and flap controls right next to each other and exactly alike. This simple juxtaposition paid off in innumerable accidents until somebody wised up and relocated the controls. The tiptank fuel system on some of our jets has rolled a lot of pilots into the ground when one tank would feed and the other wouldn't. Assuredly, pilot error has been the primary factor in these accidents, but why the error? Because it was set up, waiting for a pilot to come along.

When we look at an accident to determine its cause, we have to go all the way. It's an absolute obligation that we track the cause factors down so they can be eliminated as causes of future accidents. Obviously, we can't shut the investigation down when we discover pilot error, as if that was the end of the road. What led this pilot to bobble the ball? Did we build something into this airplane or into the procedures that tripped the pilot up? Flying an airplane can be a complicated business at best without stacking the deck against the pilot. So it's our responsibility to find these things and correct them.

First of all, we can't stop at the obvious things, the handles in the wrong places, the familiar "bugs." We have to follow through the whole operation, the whole sequence of events from the pilot's viewpoint. If we find something poorly designed or a procedure poorly planned, there are two things we have to do immediately—take steps to get the thing corrected, and get the word to everybody to watch for this trip until it's corrected. If we slip up on either of these steps we're not doing our job.

Here's How

How does it work? Let's see. Take a twin-engine airplane that crashes after a double engine failure. Investigation shows that only one engine failed and the crew feathered the wrong engine. A pretty gross error, you say? Our job is to figure out *why* such an error was committed—why the pilot booted this one so badly. First, let's find out whether he really *knew* which engine failed. If he can't tell us for sure, let's duplicate the condition to find out.

Take a similar bird up, concentrate on the gages and have the pilot chop one on you. Right now—quick! Which engine? If you get the least bit mixed up, analyze why. Figure out what kind of an instrument or control configuration would eliminate confusion. If there's no question in your mind as to which engine quit, go on from there, remembering that the pilot in an emergency is under strain. Where does he reach for what? What does he do? Is there a trap lurking along the way? What would lead him to shut down the wrong engine and feather?

Remember the old fuel shut-off valves in the B-25? Instead of being side by side—left and right, self-ex-

When IFR, duck your head down and to the side to select channel. A perfect set-up for vertigo.

planatory, they were installed along the side wall to the left of the pilot, one in front of the other. As the pilot turned his head to look at them, he would rather expect to find the right shut-off toward the front and the left toward the rear. But they weren't that way—they were just the opposite. Try that for size on a night climbout sometime, with an engine fire cooking up. Act fast—shut off the fuel—oops! Wrong engine. This was corrected, but it took time—actually too much time.

A gadget in the cockpit may seem perfectly harmless and simple to operate—*until* we consider the circumstances under which the pilot is going to use the gadget. Look at the radio installations in some of our fighters. Way down on the right side of the cockpit. Sure you can reach it, you can see it, you can tune it in when you're sitting on the ground. But get up in the soup some night making a penetration in rough air. You're watching those gages like a hawk, making descending turns—then you have to change frequency. Maybe it just means changing a UHF channel, maybe it means retuning the ADF. Whatever it is you have to get off the gages, duck your head down and to the side, and try to see the gadget. A beautiful set-up for vertigo, disorientation or downright confusion.

That same line of thought applies to emergency procedures or emergency systems. By its very nature an emergency system is going to be used in a time of stress, so a little applied psychology should be used in designing it. Its operation should be simple and logical. When something fails, the subsequent action of the crewmembers concerned should be natural and in a sensible sequence. Handles that have to be pulled, switches that have to be engaged should be clearly labeled, logically located.

The attitude should be this: The pilot's in a jam, let's make it as easy as possible for him. More than that, let's look at it this way—the equipment we gave the pilot was supposed to work for him. If it has failed, are we going to compound his troubles by giving him a complicated, and

A trap to be most effective must be concealed or camouflaged.

confusing emergency procedure to contend with in his time of trouble?

There are few people so alone as a pilot upstairs with an ailing airplane. Supervisors, engineers, instructors, designers and flying safety officers are all comfortably on the ground. Joe Pilot is up there wrestling alone with his emergency. Once he is on the spot there is little we can do to help, but if we thought about him when we designed the bird and planned his procedures, we can at least feel that we haven't made life unduly rough for him at this point.

You will note we say, "planned his *procedures*," not just his equipment.

By way of illustration of how equipment and procedures can be combined to keep a pilot as busy as a one-armed piano tuner with hives, consider the innocent, inoffensive little C-45H. About as simple an airplane as you can find, and reasonably honest. Okay, put it in the soup and go to work. First of all you are going to have a full time job just keeping the thing right side up, particularly if there's any turbulence. That we can't do much about. But here are two fine little dials in front of you to keep you informed about your course. The ADF indicator, tried and somewhat true, works the way it has for years. Turn right and the needle moves left. Turn back toward the needle and it comes back to meet you. Fine—this we have lived with for a long time, but what's with this other dial? The remote indicating compass is so rigged that it works the other way. Turn right and the needle moves right. Turn toward the needle and it moves farther off. A small point? Work with it and you'll get used to it? Maybe so, but why is this necessary? Try using these two instruments on a beacon letdown, stir in a little rough air, and you'll know what it's like to be mentally crosseyed.

On the ADF, turn right and needle moves left. Remote indicating compass works the other way. Use these instruments on beacon letdown and you'll know what it's like to be mentally crosseyed.

Next—this is a modern airplane, so it has UHF. A nice little black box with channels neatly marked from one to 18. So look in the Facility Chart to see what frequency you have to use to contact somebody. Does it tell you Channel 4? Of course not—it tells you 257.8 mc. Channel 15? No, it's 363.8 mc. This is too complicated so you try VHF — after all you have eight nice little red buttons lettered A through H. What does the chart tell you? Channel A? Of course not —now it says 135.9—135.OT. Well, after all, you can figure all this out —you have a little card posted somewhere, either on the ceiling or folded under the windshield, that lists all these frequencies for you. It's easy, just read them off. Of course the people who printed the card are apparently the same people who engrave the Lord's Prayer on the head of a pin, and anyway there's no light near the card so you can't see it at night unless you blind yourself with a flashlight. Flashlight? Heck, that rolled way under the seat eight bumps ago.

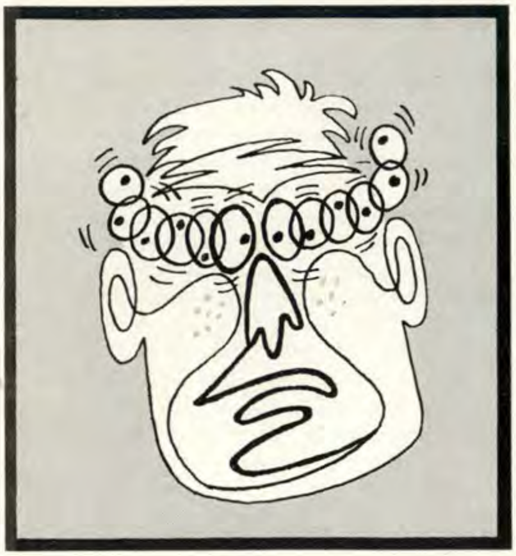
All right—you resign yourself to the problem and proceed — but of course you must make position reports. These involve estimated time at the next reporting point. So while flying precision instruments with this bouncing bird, you must check the clock, compute your speed since the last check point, apply that to the distance to the next, add it up on the clock — remembering to convert all figures from miles per hour to knots or vice versa, grab the mike and tell the man all about it. Of course, you probably won't be able to make yourself heard for some time because conversation on the radio is running pretty heavy and general. When you do make contact, chances are good that the man will come back and ask some ridiculous question like "Request your estimate over West Gate," which involves a frenzied search of the Facility Chart to find West Gate. This of course turns out to be merely an intersection, involving a good deal

Look at the Radio Facility Charts to find a frequency. Does it tell you Channel 15? Never.

S TO NAVIGATION				A/G VOICE		TOWER	
FREQUENCY GROUND	CLASS POWER	FAC. TO FLD MG. BRG.	NAUT MLS	CALL	FREQUENCY GROUND	CALL	FREQUENCY GROUND
212 117.2	SBMRLZ BVOR	358 006	1.5① 13.3 ①	Radio	255.4-*243.0* 135.9-135.0T 3023.5R		
344	BMH	At	FLD	RADIO	255.4-*243.0* 135.9-135.0T-*121.5* 3023.5R		
109.5		358	1.5①	Charlotte Apch Con	257.8-*243.0* 126.18-*121.5* 3023.5R-269T-212T	Charlotte Tower	257.8-*243.0* 126.18-*121.5* 3023.5R-269T
365	SBRAZ	250	1.2	Greens-	255.4	Greens-	257.8

more leg work around the cockpit. To complicate matters further, you then discover that West Gate is an intersection of a low frequency range leg and a VOR radial, and naturally you do not have Omni in the airplane. Right now it doesn't make much difference because (a) you have just gotten into precipitation and the ADF needle has gone haywire, and (b) you can't answer the man anyway because the man is having a long chat with somebody else about an ATC clearance. This is as good a time as any for a little carburetor ice to show up or better yet to have one of the tanks run dry, the fuel gage having been unnoticed during the confusion.

A few years ago a couple of London omnibuses and their crews toured



the United States as a good will gesture. In New York one of the British conductors was appalled to note the absence of conductors in the New York buses. He watched the driver making change, issuing transfers and incidentally driving, and concluded, "'Ow can 'e keep 'is mind on 'is job if 'e 'as to do sums in 'is 'ead?"

Are we asking Joe Pilot to do the impossible by requiring him to do too many "sums in 'is 'ead?" 'E 'as enough to do—pardon, he has enough to do just driving the machine and reading his instruments without overdoing the mathematical gymnastics.

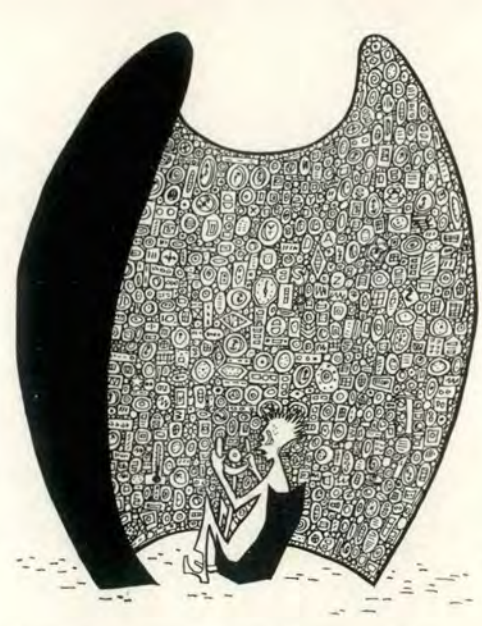
What route can we use to come to his rescue? Design—of both equipment and procedures.

Let's first consider the monstrous panel of instruments confronting the pilot. The obvious fault that hits us right away is the multiplicity of gages. Too many of them, can't they be simplified and consolidated? This of course can be done—not that it *is* being done, but it's obviously necessary. The bigger fault though lies deeper. We give the pilot all these gages, but are they really telling him what he has to know? If they are presenting the material he needs, are they presenting it in terms that he can use? Let's look and see.

The Whole Picture

• *Engine power*. This the pilot has to know, accurately. For years we have given him tachometers which only tell half the story, so we need manifold pressure gages to fill in the picture. Now, realizing that even the combination fails to get the whole message across, we give the pilot torque-meters. Of course we provide new alternatives of wet or dry power and add such variables as vapor pressure, so that now the pilot has three instruments per engine to tell him one thing, and still has to do sums in 'is 'ead to get the figures on which to base decisions.

• *Speed*. This simple but vital little quantity might just as well be presented to the pilot via a crystal ball. It's a rare condition of flight that allows Joe Pilot to read his actual speed on an indicator without going through some kind of numbers game. Technologically, our pitot-static airspeed indicator has progressed not one whit since the days of the Keystone bomber, and our present operating altitudes have made it a virtual

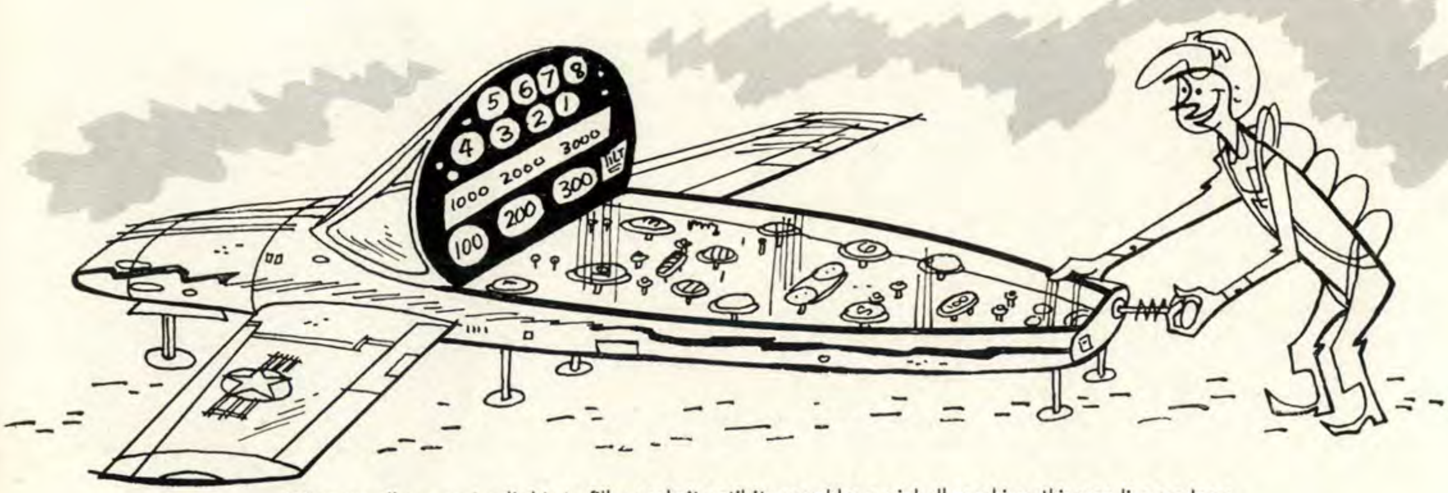


A monstrous panel of gages faces the pilot.

anachronism. To muddy the water even more, we converted our charts and measurements to nautical miles some time back, but have still not gotten around to converting the instruments in the bulk of our older aircraft. So to the conversions for altitude, temperature and instrument error must be added the mathematical ping-pong between knots and miles per hour. Finally, the most critical aspects of airspeed, those of takeoff and approach speeds in our larger airplanes, all involve computations of weight and other variables before the information on the dial really means anything.

• *Altitude*. Much has been said and written, and something has finally been done about the medieval presentation of the 10,000-foot scale on our altimeters. This at least is being rectified, but how about the basic inaccuracies of the barometric altimeter?

"Request your ETA over Wings." How long does it take you to find it? Is it an intersection?



When we allow warning lights to fill a cockpit until it resembles a pinball machine, this way lies madness.

Above 20,000 feet we know we can't guarantee sufficient instrument accuracy to insure adequate traffic separation. We know that the instrument lag in a high speed descent is totally inconsistent with the precision we require of a jet letdown. Plus the fact that what accuracy we do have depends on continual checking by radio with ground stations to get the altimeter setting and then calibrating for temperature and instrument error. Unless the pilot can check every 50 miles or so he can never really know his true altitude. And even when he does, he only knows his altitude above mean sea level. To know how high he is above the ground, 'e 'as to do sums in 'is 'ead again.

• *Fuel.* How vital can we get? This is one thing Joe Pilot must know with certainty at all times—how much fuel does he have? Admittedly, we have made some progress since the B-24, whose fuel gages were back in the radio compartment and could really only tell you if there was or was not fuel in the main tanks. Even so, look at the can of worms we have. In some of our airplanes the bouncing pointers show gallons—in all or in individual tanks. In others the pointers show tenths of capacity (more arithmetic?). In others we see pounds of fuel. In our jets the clicking counter shows our fuel being used up—*if* it was set right to start with. Fuel mismanagement—how we love to use that word—how much of it is traceable to fuel systems and indicators that just don't lend themselves to being managed properly?

• *Warning lights.* The pilot of a jet fighter has a lot of things to worry about and precious little time to waste worrying. The concept of a warning light instead of an instrument is generally sound. It's something you don't have to watch all the time, but it sure lets you know when something is wrong. It's a good enough idea as long as it isn't run into the ground. A few clearly identifiable and readily understandable warning lights serve a useful purpose, but when we allow a cockpit to be rigged like a pinball machine, this way lies madness. The right side of the panel in the F-84F sports a magnificent display of lights—each one tersely labeled, the bottom one being clearly identified as "Emergency." (Sic) Presumably when all light at once you have hit the jackpot and you may leave at will. Seriously, considering that each one of these lights involves emergency action in connection with one or other of the aircraft systems, and that a light coming on calls for immediate identification of the system involved, diagnosis of the trouble and proper corrective action, this type of presentation of data asks a lot of Joe Pilot. The point is—in evaluating the desirability of a warning light we must realize that it's a panicky kind of gadget, rather like a siren. It doesn't tell you what's wrong—it just hollers that something is wrong. It alerts a pilot—or panics him—but it doesn't give him a bit of information.

Now that we have made a big issue of all this, where do the working troops fit into the picture? Isn't this just a manufacturers' kettle of fish? I don't like to think so because all of us have to fly these airplanes, use this equipment, to do our job. If the equipment is poorly adapted to the job, are we entirely free of blame? We may each have a specifically assigned job, but we are not compartmentalized when it comes to our responsibility to the Air Force. In the procurement of aircraft and associated equipment a lot of factors have to be taken into account, and unless the pilot's beefs are documented they stand a good chance of being overlooked. Systems such as the UR program, the Product Improvement Program, are set up to register just such beefs. So if the user doesn't want to see shortcomings perpetuated, he would do well to get his head out of the bucket and let his voice be heard. A lot of lives could be saved if we wrote more URs and groused less.

The other very important aspect of this for the people on the line: Get really acquainted with the booby traps in your aircraft and procedures. Until they can be corrected or eliminated, you and your fellow pilots will have to live with them. Forewarned is forearmed. No one likes to be a patsy for a sucker play—so know the pitfalls and be prepared for them. Finally, if somebody does trip up, be alert to spot the real cause and let it be known. If it's fuel mismanagement, don't just leave it at that—trace why the system was mismanaged. Even if you conclude that the pilot was an idiot, don't drop the whole thing until you've given some thought to whether a system could not be made idiot-proof. After all, there'll be more idiots coming along. Consider the feasibility of incorporating what the Navy likes to call a "Dilbert factor" into our equipment and procedures. There'll be many a Dilbert flying our planes before the last trumpet sounds. How about giving Dilbert a break? ●

Well Done

First Lieutenant

Donald C. Hanto

91st F-B Sq, 81st F-B Wg.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

1ST LT. DONALD C. HANTO was headed home after having gear trouble on a practice bombing mission. Letting his F-84F down at about 320 knots, he called the tower for landing instructions.

While descending through 5000 feet, the engine flamed out. A quick check of the cockpit showed everything was "normal." Lt. Hanto informed the tower of his flameout and was cleared for a straight-in approach to runway 26. He tried a series of airstarts, without results, so he concentrated on the flameout pattern.

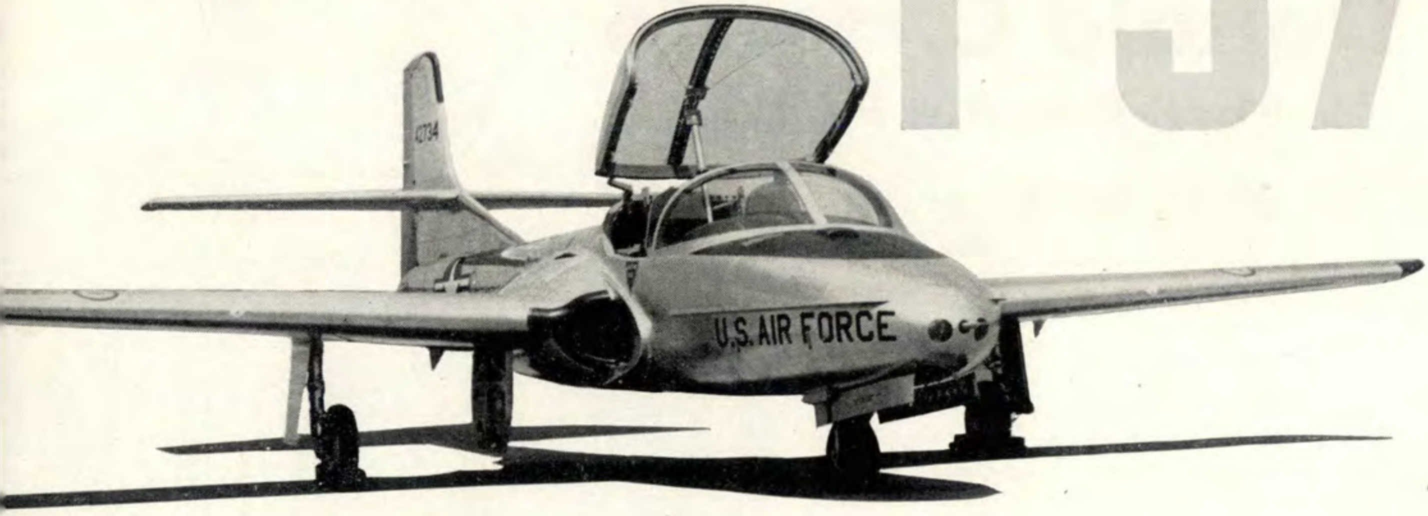
Realizing that he was too close for a straight-in approach to runway 26, Lt. Hanto pulled up immediately to 7000 feet and set up optimum glide speed. From this position he could establish a downwind leg for a landing on runway 08. The turn onto final approach was completed at 2000 feet, approximately one and a-half miles out at an airspeed of 260 knots.

He slowed to 230 knots and shoved the gear handle down. The main gear went down and locked, but the nose gear indicated unsafe. Speed brakes and flaps were extended and the approach continued. Lt. Hanto waited until he knew he had the runway made and then went to work on the emergency system. The nose gear snapped down and locked, and he crossed the end of the runway at 175 knots. During the roll, he used the brakes to the maximum while engine RPM was available to provide boosted brakes. The right tire blew but he maintained directional control and stopped short of the barrier.

Inspection showed that the flameout occurred when the throttle linkage became disconnected from the fuel control.

Lt. Hanto's cool reaction to an emergency situation and the professional skill he demonstrated qualifies him for a hearty "Well Done."

"Knee-high to a...." T-37



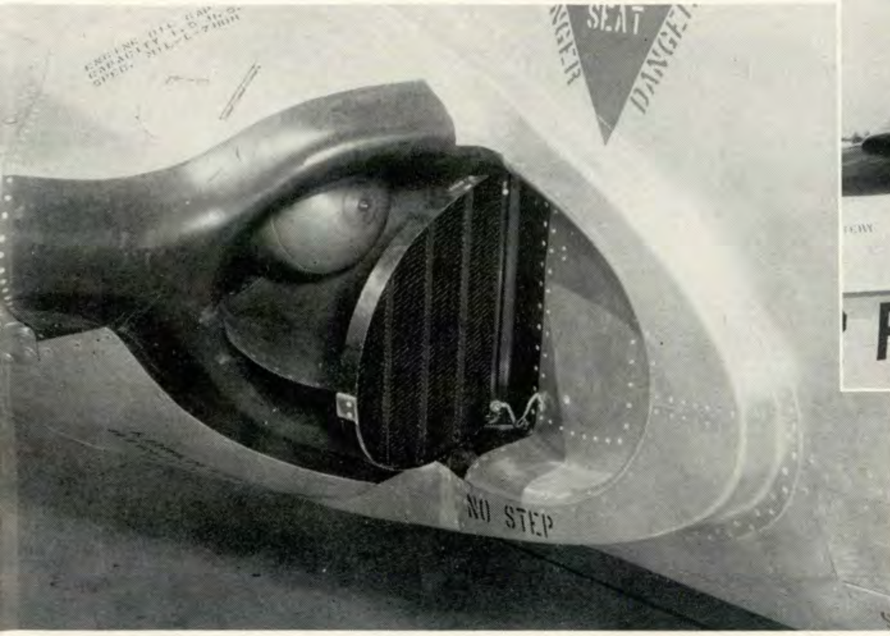
Bob Hagan, Cessna Aircraft Company

This article, prepared by a veteran test pilot, introduces the T-37. Only 29 feet long and with a wing span of about 34 feet, it is scheduled to appear on the air training scene.

FOR THOSE OF you who have not seen or heard too much about the T-37A, it is a twin-engine, side-by-side jet trainer. When you have your first look at a T-37A, the small, neat appearance will probably impress you greatly since the airplane is a friendly looking little rascal and is only about knee high to a "short" Texan.

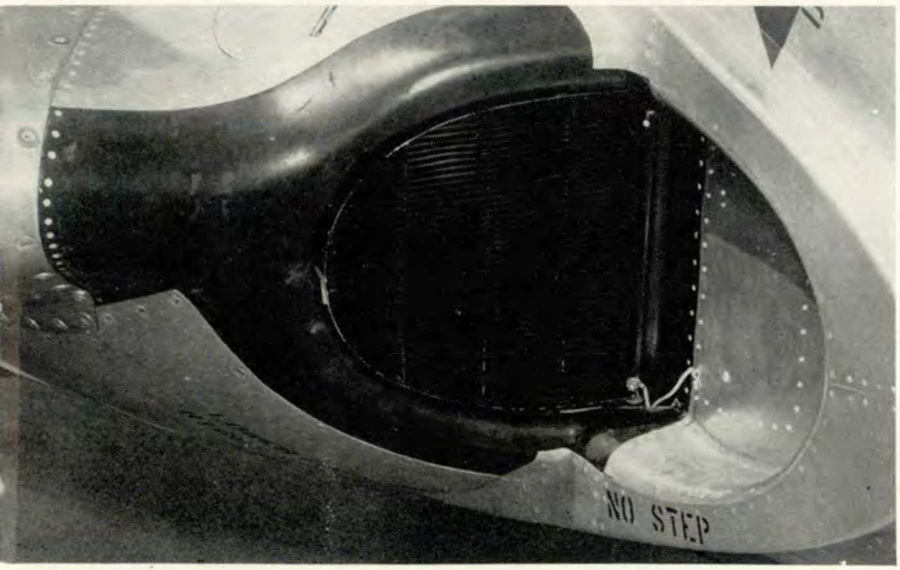
A fast look at the dimensional statistics shows the overall length at about 29 feet and the wing span approximately 34 feet. When you consider the distance from the ground to the top of the vertical stabilizer is only nine feet, you can see that this aircraft falls into the small bird category. Once you fly the T-37A, however, you will forget about its size because this airplane has everything its big brothers have in the way of

The "knee-high" T-37 has good flying qualities.



A stall spoiler generates natural stall warning.

Screens cover the intakes when the wheels are down. They retract automatically with "gear up."



flying qualities and maybe just a little bit more.

The airplane carries two centrifugal flow, Continental J-69-T-9 engines, rated at 920 pounds of thrust. The intakes are in the wing roots and they are covered by retractable screens to reduce foreign object damage. The screens are operated hydraulically and cover the intakes automatically when the gear is down.

As this article is being written, the only flight test item of any consequence that isn't completed is the structural integrity investigation. As a result, the "G" limit is plus 5.0 and minus 1.9G until the structural tests have been completed.

All of the other major flight test programs including the spins have been completed. After finishing one of the most comprehensive spin programs ever accomplished on an airplane we can safely say that any type of spin or spin entry is permissible in the T-37A. Also, any normal acrobatic maneuver is permissible.

Before we go fly, let's make a walk-around inspection and cockpit check. As we approach the airplane you will note that this is one bird that meets you on your own level. The walk-around covers nothing unusual. During the inspection, note that just one built-in step (per side) is used for ingress and egress. The step is just forward of the engine inlet boundary layer dam.

Since the T-37A has a side-by-side seating arrangement for the student and instructor, the cockpit layout is a little different than the average airplane. It has dual controls for all flight and power controls plus dual landing gear and flap controls. The instruments are arranged so that the student pilot (on the left side) has the standard instruments in front of him, plus the engine starting switches. The engine instruments and fuel shut off switches are in the center of the instrument panel so both the student and instructor can monitor them. On the instructor's side is the radio panel (both communications and OMNI) within reach of the student. Also cockpit heat, defrost and ventilation controls, circuit breaker panel and instructor's oxygen control panel are located here. So the instructor knows when to brace himself or close his eyes, an airspeed, altimeter and turn-and-bank instrument are installed on his side of the cockpit.

There are three safety pins for the student to pull before takeoff and one for the instructor. Two of the pins which the student pulls are for the canopy jettison, and one is for the ejection seat. The instructor's pin is for his ejection seat. All of the pins are stowed in a pocket on the left wall of the cockpit. The canopy and seat ejection are similar to the majority of the ejection systems in use and need no explanation here.

After adjusting the seat and rudder pedals (adjust fore and aft with a crank) let's begin the cockpit check. With the APU plugged in and running or the battery switch turned on, this check consists of checking the position of throttles, gear and flap handles, oxygen control panel, pertinent switches and the push to test lights on the student's side of the cockpit. On the instructor's side, all circuit breakers should be in, and the radio and heat control turned off. The cockpit check is so simple that a step-by-step run-down is unnecessary here.

About now we should be ready to start the engines. Since the T-37A starts just as well on the battery as it does with an APU, let's use the battery for starting. The procedure goes like this:

- Turn on battery, inverter and fuel pump.
- Open fuel shut-off valve for left engine (push left "T" handle above engine instruments).
- Push up on starter switch and hold.
- At five per cent rpm push up on ignition switch and hold.
- Bring throttle forward to idle.
- Release ignition switch at 16 per cent and starter switch at 22 per cent rpm. Engine will idle at 33 to 34 per cent.

To start right engine, run the left engine up to 45 to 50 per cent rpm to allow the generator to furnish the power and go through the same procedure as for the left engine.

The switch to close the canopy is just aft of and below the throttles on the instructor's quadrant. As a safety measure, be sure to lock the canopy any time it is fully closed for taxiing; the canopy light will go out when the canopy is properly locked. If taxi instructions have been received, "rev" up the engines a bit, push and hold the fourth finger button on the control stick for power steering and proceed to the active runway. Engine rpm for taxi is 45 to 50 per cent. Since there is a hot mike in the airplane, the instructor can be talking to you from "electrical power on" until the engines are shut down.

Prior to moving onto the *active*, take a look at your checklist to make sure nothing has been forgotten.

Takeoff may be made with or without nosewheel steering and with or without 50 per cent flaps. Takeoff in the T-37A is the same as in any other jet, with one major exception. After upping the rpm to 100 per cent on both engines and checking the instruments, release the brakes and go! The difference between the T-37A's takeoff and other jets is soon apparent. You are airborne about 1200 to 1500 feet down the runway at about 80 knots airspeed. After retracting the gear, pull the flaps up and climb on out. When the flaps are raised from takeoff setting (50 per cent), there is very little sink to the airplane, so there is no need to milk the flaps up after the takeoff.

During the climb, notice how light the controls are even though they are

The T-37 has dual flight and power controls and the student's side has the standard instruments.

The Author

Bob Hagan flew 91 combat missions in World War II in P-47s with the 9th Air Force. During the Korean conflict, he participated in the first hydrogen bomb test, flying F-84s for the Strategic Air Command. He joined Cessna in 1953 and flew the XT-37 on its first flight in October, 1954.

Note starting unit receptacle. The T-37 measures nine feet to top of stabilizer.

unboosted. The ailerons have a good, light feel to them from stall to about 250 knots. Above 250 knots the forces get heavier but the ailerons are still very effective.

In order to get the feel of the airplane, a few stalls in the different configurations and some acrobatics should help you get acquainted. With everything down, with or without power, the stall speed is 60 to 65 knots and is a normal, straight forward stall. Clean, the plane stalls out about 75 to 80 knots. Adequate stall warning is available in all configurations, and consists of buffet in the stick and airframe. With flaps down and 65 per cent or more rpm, take a look over your shoulder at the stall

Shown here is the '37 in flight. Notice the extended speed brake in above photograph.

spoiler on the engine nacelle. The spoiler generates natural stall warning when the flaps are down more than 60 per cent and the engine rpm is greater than 65 per cent. When the stall is completed, just release the back pressure on the stick and the recovery is made. You might notice that the ailerons are effective all the way through the actual stall.

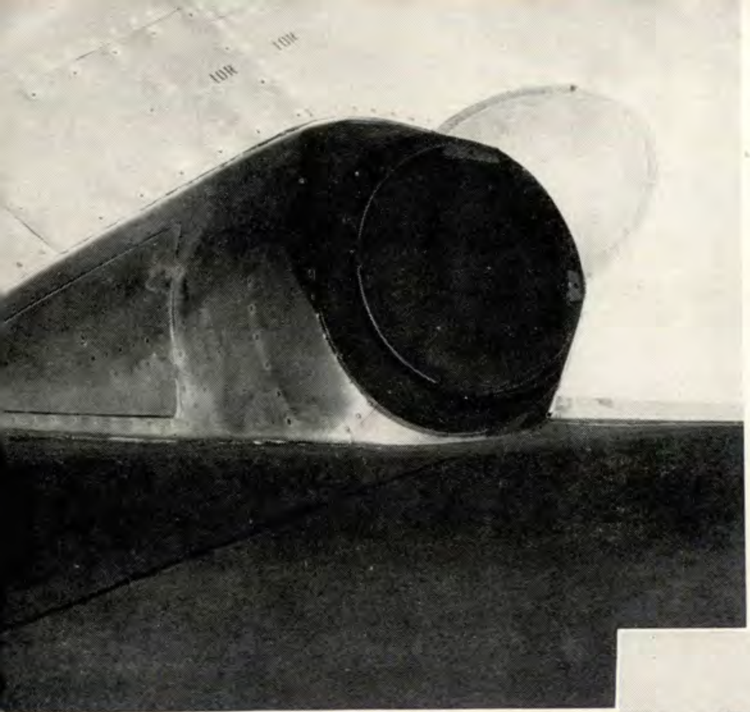
Rolls may be done over a wide range of airspeeds, 130 knots still will allow a good solid feeling roll at the low end and there is no restriction on the high speed end. For a trainer the roll rate is very fast, 120 degrees per second may be attained at cruise speed.

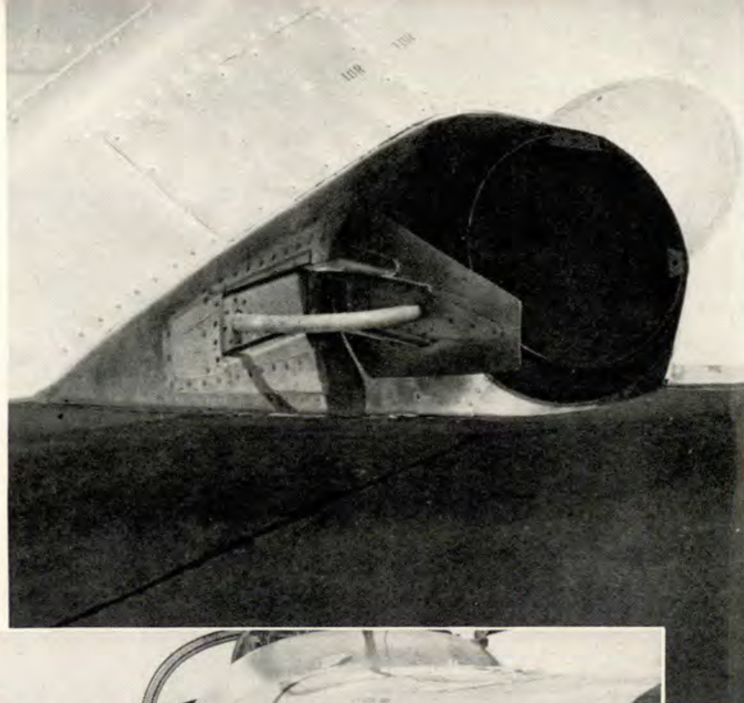
For loops, Immelmans and Cuban eights, 250 knots is a good entry speed for the first few; after a little practice the entry speed may be lowered. Any of the above maneuvers may be done without pulling more than 3G and within 2000 feet at practically any altitude. Loops have been done with an entry altitude of 25,000 feet. Since you are sitting off to one side of the airplane centerline you may need a little practice to be able to roll out straight at the completion of an Immelman, but that will come very quickly.

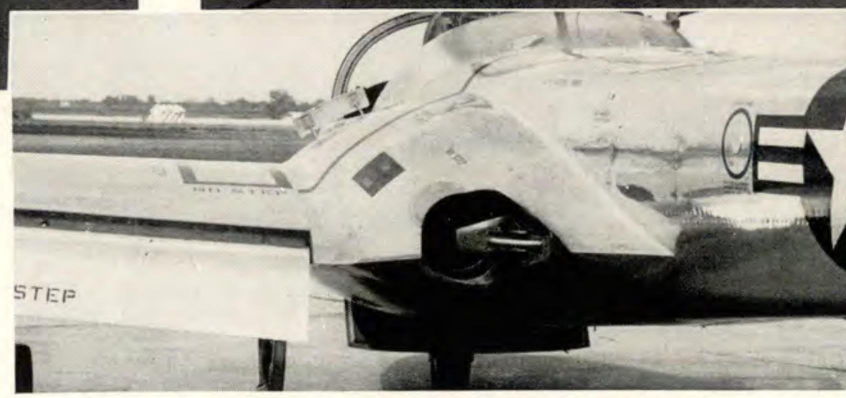
The spin program was mentioned earlier in the article, so a few words about the spin are in order. During the walk-around inspection you should have noticed what looks like the spray dampener used by boats and seaplanes on both sides of the airplane nose. Actually we call them "strakes" which is a Naval term. Instead of dampening spray, however, our "spin strakes" dampen the flow of air around the nose of the airplane in a spin and as a result we get a slower and steadier spin. From almost any type entry with idle power, the spin is steady in one-and-a-half to two turns with the time for each turn taking approximately three seconds. Recovery is made in the standard manner by applying opposite rudder and waiting one-half turn before popping the stick forward to about one-half down elevator. Recovery will be complete by one-and-a-quarter turns. The spins are covered in the flight handbook so not too much will be said about them here. However, I believe you will like the spins in the T-37A, if you happen to like spinning at all.

For high speed restrictions the critical Mach needle is set at .7 Mach. The airplane has no change in characteristics up to .7 Mach. However, if you happen to get your airspeed needle past the critical Mach indicator you will get a stick force reversal at .75 Mach accompanied by airframe buffet. When this occurs, pull the stick back to keep the same airplane attitude toward the ground, open the speed brake and reduce power to idle. The airplane will pull out by itself if you'll just hold up elevator to keep the nose in the dive attitude you had before reaching the .75 Mach area.

On the way back to the field for landing you may want to try a single engine flight. If so, just pull one of







Close-ups of the tailpipe area show how the thrust attenuators appear; extended and retracted.

the throttles back into the detent position. There is a rudder trim for occasions like this, but you will find that it is not really needed as one engine operation causes only a minor out of trim condition. However, if you do want to retrim the airplane, the rudder trim switch is on the student's quadrant just aft of and below the throttles. Stalls and turns into or away from the dead engine are easily accomplished. So single engine operation including landings is actually "no sweat" at all.

Before starting the engine again, be sure to drain the tailpipe and then if the windmilling rpm is eight per cent or more, depress the starter switch to the airstart position and hold for three seconds. Then, when a little action is shown on the EGT gage, bring the throttle up to idle. If the windmilling rpm is eight per cent or less, use the regular ground-start procedure. Either way the airstart is simple and fast.

Before we go in to land, a word on the endurance capabilities of the airplane may be in order. The total usable fuel load is 309 gallons of JP-4. This will give you a maximum endurance of approximately three hours, if you climb directly to 35,000 feet and stay there. For normal runs where the altitude varies between the ground and 20,000 feet, an hour and a half missions are well within the capabilities of the T-37A.

For landing, the checklist is short and sweet. It amounts to checking the instruments, the hydraulic pressure and making sure the fuel boost pump is "on" (it stays on all of the time, anyway). A good initial speed is 180 to 220 knots, speed brake down at the break, and engine rpm retarded to 50 to 60 per cent. Gear down at 150 knots, flaps full down at 135 knots, base leg should be made at 110 to 120 knots with about 105 to 110 knots for final. Over the fence at 95 to 100 knots and reduce power to idle when landing is assured.

After touchdown at 75 to 80 knots, the brakes may be applied as soon as you need them. Notice how easy it is to judge the flare and landing. I believe this is caused by the fact that your eye level on landing is approximately the same as it is if you were standing on the runway. The landing can be made in less than 1000 feet without too much strain.

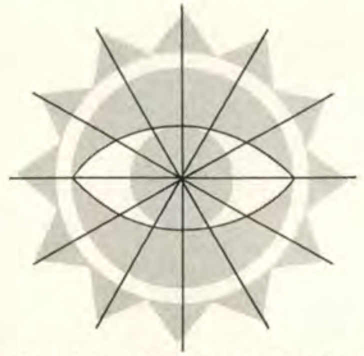
Pull the speed brake in as soon as the turn is made off the runway. This will retract the "thrust attenuators" (that's a fancy Cessna phrase meaning thrust destroyer).

Actually, the attenuators are metal paddles streamlined into the fairings aft of each engine nacelle. Their purpose is to cut down the engine thrust on final approach so that 50 to 60 per cent rpm may be maintained, for rapid engine acceleration if needed, and still allow a fairly steep approach angle. They extend only when the speedbrake is out and the engine rpm is below 65 per cent. In case of a go-around, they retract automatically when either the speed brake is retracted or the power is advanced beyond 65 per cent.

Crosswind landings and takeoffs present no problem. Believe me, I speak from experience since all of our test work has been done in Kansas where the wind always is blowing.

In this short article I have tried to give only a few basic tips on the T-37A. When you fly it you'll probably learn more about the airplane in one flight than you could from reading this article or talking to anyone.

I'm sure you will agree with me after you fly it that it is a simple airplane to master and the friendliest one you've ever been in. I hope that you enjoy flying it as much as I do. ●

LOOK  SHARP

Capt. John F. Welch, FSO, 77th Bomb. Sq, Ellsworth AFB.

IT WAS A hot day in Oklahoma, but a hot day is a good day to put up hay and so the two farmers, Hank and Pete, were hard at it.

Pete drove the tractor while Hank hooked the bales and dragged them on to the low trailer as it went by.

Hank held up his hand as a signal to stop.

"Shut 'er down, Pete, it's time for a shot of water," he said, mopping his brow.

With the tractor exhaust silenced, the low frequency throb of distant propellers could be heard.

"Sounds like one o' them B-36s," drawled Pete. "They're usually pretty high. Wonder if we'll be able to see 'em?" He tilted the water jug up for a mouthful, rinsed his mouth and spat, then took a long drink.

Hank was scanning the sky. "Yeah, there she is, comin' in from the southeast, Fort Worth, prob'ly."

Pete was looking now, while Hank had a drink.

"Hey!" he exclaimed. "There's another'n, comin' over from the west."

"I was readin' in the paper the other night that those things cost three an' a half to four million dollars apiece," mused Hank. "Look, they're gonna come pretty close to each other. Look about the same height, too."

"Yep," replied Pete, "They must be about five miles up. Wonder if those fellas wave at each other when they meet?"

"Man, they're gonna come awful close! Oh, Lord! They smacked inta each other head on!"

Hank and Pete stared unbelievingly at the flash of fire and smoke in the clear, blue sky above them. The tangled mass of wreckage began plummeting toward the earth, with some of the pieces floating off separately.

Pete ran for the tractor. "Hank, you watch for parachutes, and I'll run and call the Sheriff or the Highway Patrol or somebody."

As the tractor roared away, there came the sound of the distant explosion of the two meeting aircraft. Hank slowly shook his head. "Pete," he said to himself, "I don't think there'll be any parachutes."

The above incident hasn't really happened. But it has come closer than some B-36 crewmembers like to think about. And accidents like it *have* happened in other types of aircraft.

When you're tooling along in actual weather, you can depend on ARTC for separation on airways. But when the sky is clear, look out. The quadrantal altitude system is a big help, when it is followed. At least you sneak up on another airplane or get sneaked up on by one, a little more slowly, and there's more time to see or be seen.

Unfortunately, both for themselves and for people who are following the rules, too many aircrews tend to pick an altitude and maintain it throughout a flight, regardless of heading. This is partly because ARTC clears flights to cross airways at a particular thousand foot level. And it's partly because a change of altitude changes the navigator's and flight engineer's problems, causing them complications such as new problems to solve, and more log entries.

For some reason, aircrews seem to prefer nice, round numbers — like 5000, 10,000, 20,000 or 30,000. Ask any ARTC center or RBS site. You'd almost think that the altitudes in between are uninhabitable. With traffic piling up at the round number altitudes, they're becoming the uninhabitable ones.

Some Air Force pilots are probably unaware that altitudes above 20,000 are no longer the private preserve of the military. Transcontinental airline flights in DC-7s regularly use 23,000. As the airlines and some business planes change over to turboprops and to jets, they'll go right on up. From now on, you'll have to be looking out for them, too.

In any case, the little extra work saved by neglecting to change altitude once in a while isn't worth the risk. So, fly the proper altitude for your heading. Your chances of seeing another aircraft approaching from a quartering or head-on direction, even a lumbering C-124 or a B-36, are very small.

Two B-36s at 25,000 approaching each other head on would close at a rate requiring less than eight seconds per mile. Think what it is in jets! (See "Short Seconds," FLYING SAFETY, August 1954.)

The problems discussed here apply to VFR flight, when you have some hope of seeing another aircraft. Now here's something applicable to IFR that some Air Force pilots do not know about. When you are on a block altitude clearance, IFR, either in a bomber stream or on an individual clearance, ARTC is *not* responsible for your separation from other aircraft in the block. *You* are. The author once monitored such a mission from an ARTC Center. Two aircraft in the block clearance reported IFR over the same point at the same altitude, two minutes apart. That's not good. And they could not even be warned about how close they were, because immediately after reporting, both apparently changed frequencies.

Experience has shown that most collisions and near misses occur under good visibility conditions. The problem is most acute in congested terminal areas. When you approach your landing base or fly into or through an area containing one or more airfields, it is wise to monitor other traffic closely. Try to pick an altitude no one else is using. For VFR flight at night, the flashing beacons used by commercial aircraft (and now being installed on Air Force aircraft) are a big help. If possible, all crewmembers, including pilots, should always be on the lookout for other aircraft in congested areas at night and in the daytime, too.

Air Force, Navy, Army, the airlines, CAA and ICAO are all aware of the collision hazards induced by increasing traffic and a wide diversity of aircraft. The Air Coordinating Committee is working on revisions to flight rules that will reduce these hazards. Meanwhile, it's up to the aircrews to make it a point to look sharp (for other aircraft) and fly sharp (at proper altitudes). ●

The attitude of the "little woman" toward flying is very important to you, whether you admit it or not. So here is a reassuring . . . .

Word For Your *Bride*

DelVina Wheeldon

Important lectures on hypoxia were received.

The pressure chamber resembled an incubator.

HOW DOES IT feel to be the first woman passenger to go through the sonic barrier?

Ever since I went 830 mph in a dive from 48,000 down to 18,000 feet over the Great Lakes on May 12, 1956—the day before Mother's Day—people ask me this.

And it gives me the opportunity to tell them why I did it, which is a great deal more important than they have thought. It puts the whole thing in a new light.

Since I am a woman broadcaster, there naturally was some suspicion that this was done just as a publicity stunt. But neither my station nor I had any such idea when I wrote to the Continental Air Defense Command last March. My letter said in part:

"Not long ago, I heard some women talking about why they did not want their men to be in the Air Force. They said that jets were dangerous and did not want their sons or husbands flying them or near them. It seems to me with all the responsibilities the Air Force has for our national protection that it should not have to suffer unnecessarily 'mother antipathy' toward

Getting set for a fast ride, straight up.

Fitting of personal equipment had to be done before I was ready to climb into the F-94. I was briefed on all emergency procedures.

jet flying while meeting those bigger responsibilities."

My letter further told them that my conversations had shown that women know appallingly little about the Air Force, all of its safety factors in flying, what it's like to be in it, what its problems are and why it has to do what it does. For this reason, I stated my desire to do at least 13 and possibly 26 broadcasts interpreting airpower subjects in terms a woman could understand.

In this letter I threw in my best hope, asking if I could be given a jet ride and to approach or go through the sonic barrier. If this is done by a woman who is a housewife, I don't see how other women can fail to see their fears are groundless.

My purpose was to be able to talk woman-to-woman about it, and to do it with authority gained by actual experience.

If it is possible to find an over-the-back fence relationship between women and airpower, it seemed to me that the pass-word should be the air defense system. Air Defense units must not only live in close proximity to populated areas but must be prepared to scramble to altitudes and, if war comes, fight over the heads of all of our citizens.

There was a period of quiet which I, at first, charged to bureaucracy, but later found that the time was being used far differently. I was being listened to on the air, checked for sincerity and my program content, and only after I had passed the test did the gate swing open. It was then I found out that this Air Force is a very serious, demanding business—that it takes and leaves nothing to chance.

The first step was that I have a complete physical examination. My doctor's statement of my health's excellence, he said, "referred to the physical, not the mental." He had serious doubts about the latter. When over that hurdle, I was taken to Wright-Patterson Air Force Base, near Dayton, Ohio, "the birthplace of aviation." It was my thought that after they put me through the long lectures on atmosphere, air pressure, hypoxia, use of bailout bottles, ejection seats, and then finally into the pressure chamber, that I was going back into the incubator.

As Captain Thomas Mowry, the boss of the pressure chamber, took us up to 43,000 feet (in air density equivalent), I had my tape recorder spliced into the communications system to get his talk and my questions on record. To show me what hypoxia was like, and how to recognize it they took me off oxygen at the 30,000-foot level. I had to start putting pegs in a block which reminded me of an oversize cribbage board. There was a round peg and a square one to match the holes in the block. The object was to see how long I could do a real simple job correctly without a normal amount of oxygen. It took me a minute and ten seconds before my eyes went fuzzy, my hands and arms froze in place and a dizziness crept up on me.

After a quick whiff of oxygen, I came back real fast and started putting the pegs in the right holes without knowing that I had ever stopped. I made note on the tape of the hypoxia peculiarity which saves lives with oxygen restoration—the tendency of the individual to resume automatically what he was doing—a considerable reassurance in itself.

The rest of my days at Wright-Patterson were spent in talking to key Air Defense people, to our Air Force recruiters and to Air Force wives. I wanted to find out how it is to live and raise children in such a migratory existence. The answers were all informative, positive and constructive, and I was growing prouder by the minute of the Air Force and my association with it.

Then, the last day of my stay, 1st Lt. Robert Kline, a 26-year-old, F-94C pilot from Bunker Hill Air Force Base, Peru, Indiana, came sizzling in. He was the man to take me for my crowning experience: the jet ride and the assault on the sonic barrier.

He was originally from Indiana, Pennsylvania, he said, and reminded me that this was also Jimmy Stewart's hometown. "He makes movies," he said with a big boyish smile.

Although I was once a Powers model, the fashions I now found myself in were a far cry from the svelte materials and designs I once wore. Even for this, Kline had counsel. As I donned my bulky, flight gear, Lt. Kline remarked: "We don't make you pretty, but we try to keep you safe." He then explained the cockpit procedures several times and made me go through the rituals until I knew them by heart.

The Wright-Patterson tower had its bit of fun with me when Lt. Kline said he was going up with a lady aboard. The tower asked if he was flying or if I was the pilot.

In an air of authenticity, we went all the way through the Air Defense scramble procedure, from the squawker going off, the alert hangar doors swinging up, to the engine start and the scamper for the runway, and then the takeoff.

Almost before I knew it, I was hearing the pilot report us at 20,000 feet, still climbing, and with Lake Erie almost in sight. We were going far out over the lake where the sonic blast would not bother anyone.

"Leveling off at 48,000," Lt. Kline reported. "Ready?" Then he said, "Here we go." Despite all my thoughts at the time, I still remember that he settled me down with his quiet tone. It was as if he had said to a taxi driver that we would turn at the next block.

I watched the indicator as he had told me to do, saw the needle cross the line showing Mach 1 (the speed of sound), and I felt a shiver pass through the plane. That's all there was to it. Was I surprised.

Could this be the thing I had heard those women worrying about in the beauty shop? What was there about this, I asked myself, that should cause anyone to fear the experience?

The Air Force had put more than $70,000 worth of training into Lt. Kline before they had ever let him go it alone at those controls. Then I remembered the women I knew who had given way under pouts, pestering and other domestic persuasion to their kids, letting them slide behind the wheel of the family car with no experience whatever and thought them safe. It didn't make sense to me.

"We hit 830 miles per hour," Lt. Kline said later. Imagine 830 miles an hour! And I felt safer doing it than I ever felt driving on the highway or in my own neighborhood with all the kids out in hot rods.

My pilot's tone of voice had never changed (if you are a broadcaster you notice things like that). He loved flying—that I knew. He was in control of his own destiny—that he made me feel. And his job was to be ready to fight in order to keep the peace—which now dawned on me for the first time.

Some of this, I hope to get across to other women. When we landed, I was given a certificate of my accomplishment. A few days later, there was a wire from the Aircraft Industries Association which declared me to be "the first woman passenger to go faster than the speed of sound but only one of many who would have the experience in the future as supersonic flight becomes normal as aviation progress marches on."

But the thing which made me feel good inside that night was when I heard another broadcasting colleague on an opposition station telling of my thrilling experience.

"And our DelVina," he said, with his eye on the day after my feat, "provided the most unique Mother's Day present of all when she rode this Air Force jet faster than the speed of sound. Her Mother's Day present was one of reassurance." ●

Could this be the thing I had heard those women worrying about in the beauty shop last week.

Cool, Clear Water

If there is any one essential to staying alive, it's water. But leave a thin coating of it on the wings of an aircraft, take off in freezing temperatures, and the role of water, the life-saver, takes a one-eighty.

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