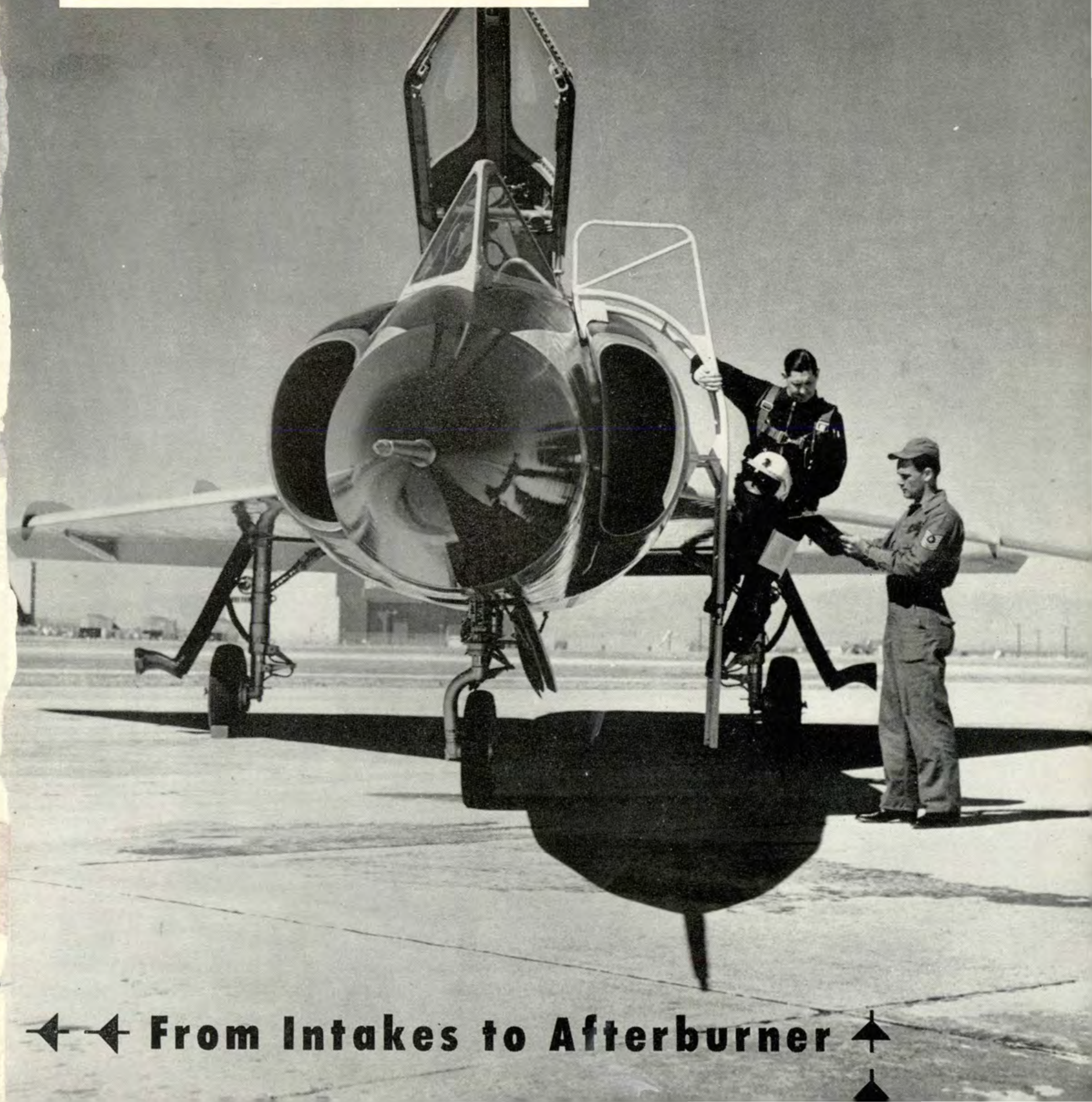
APRIL 1956

FLYING SAFETY

UNITED STATES AIR FORCE



From Intakes to Afterburner

FLYING SAFETY

VOL. TWELVE NO. FOUR

● Pilot error. What is it? Is there a magic cure-all for it? Read "To Err Is Human," page 2, for your answer.

● Wind-shear is a two-edged sword. See "Change Without Notice" for the complete treatment of this phenomena.

● To get exactly what we wanted for our front and back covers, it took about four hours of towing the F-102 into position, tugging and pushing at a 20-foot crew chief's stand and waiting on the sun. After about 15 different "takes," we came up with these. All in a day's work.

A real success story appears on page 25.

Major General Howard G. Bunker
Deputy Inspector General
The Inspector General USAF
Department of the Air Force

Brigadier General Joseph D. Caldara
Director of Flight Safety Research
Norton Air Force Base,
California

Colonel Daniel M. Lewis
Supervisor of Flight Safety
Publications

STAFF

Editor
Major Perry J. Dahl

Managing Editor
Major Jesse F. Townshend, Jr.

Art Editor
M/Sgt. Steven A. Hotch

Production

Major Ben H. Newby
T/Sgt. Chester D. K. McCubbin
T/Sgt. Carl E. Fallman
S/Sgt. Al Fortune
T/Sgt. G. J. Deen
Amelia S. Askew

CONTENTS

★ ★ ★

SUBSCRIPTIONS—FLYING SAFETY is available on subscription for $3.00 per year domestic; $4.25 foreign; 25c per copy, through the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Changes in subscription mailings should be sent to the above address. No back copies of the magazines can be furnished.

The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payment can be made for manuscripts submitted for publication in the *Flying Safety Magazine*. Contributions are welcome as are comments and criticism. Address all correspondence to Editor, *Flying Safety Magazine*, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Non-Air Force organizations must query the Editor before reprinting, indicating how the material will be used. The contents of this magazine are informational and should not be construed as regulations, Technical Orders or directives unless so stated.

USAF PERIODICAL 62-1

FLIGHT SAFETY AWARDS

In advancing the aims and objectives of a constant and integrated accident prevention program, the fourteen organizations listed below have been awarded engraved Flying Safety Plaques for the period 1 July-31 December 1955.

3599th C C Tng Sq (Ftr) Nellis AFB, Nev. (ATC)

•

Ardmore AFB, Oklahoma (TAC)

•

Hqs WADC, Wright-Patterson AFB, Ohio (ARDC)

•

64th Air Div (Def) Pepperrell AFB, N.F. (NEAC)

•

91st Strat Recon Wg (M) Lockbourne AFB, Ohio (SAC)

•

Carswell AFB, Texas (SAC)

•

56th Ftr Gp (Def) O'Hare Int'l Arpt, Chicago, Ill (ADC)

•

8th Air Div (AEW&C) McClellan AFB, California (ADC)

•

1607th Air Trans. Wg (H) Dover AFB, Del. (MATS)

•

317th TC Wg (M) Neubiberg A B, Germany (USAFE)

•

302d TC Wg (M) (2252 ARFC) Clinton Co. AFB, Ohio

•

435th TC Wg (M) (2585 ARFC) Miami Int'l Arpt, Fla.

•

133d Ftr Int Sq, Grenier AFB, N. H. (ANG)

•

155th Tac Recon Sq, Memphis Mnpl Arpt (ANG)

to err is HUMAN...

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

TO ERR IS HUMAN—to forgive, divine. This may well be accepted as a time-worn cliche, but how does it apply in a discussion of flying safety? First of all, the pilot is human; the aircraft is neither human nor divine. Ergo, it is not inclined to forgive, although the pilot is very much inclined to err. The result? All too frequently an unplanned termination of a flight, in short, an accident.

Through the years we have been attributing half of our aircraft accidents to a thing called "pilot error." The rest are distributed among materiel failure, maintenance or supervisory error and the like. For years we have treated pilot error as a clearly identifiable cause factor comparable to the other factors which we can see and measure. In other words we have said "the pilot goofed" in exactly the same sense in which we could say "a tire blew out" or "the prop shaft sheared." Whenever an accident happened, all too often, investigators have concentrated on looking for a specific error on the part of the pilot to which the accident could be attributed, rather than considering the whole picture.

It appears time to examine this concept of pilot error more closely, to analyze what we are really talking about in the tremendous number of costly accidents we are attributing to this cause factor.

What is pilot error, anyway? One simple way of stating it would be that it is human error committed while acting as pilot of an aircraft. From this view, pilot error is no different from any other kind of error, except in the environment and circumstances of its commission. So, before we dig into pilot error, we should look rather closely at human error itself.

From the time he wakes up in the morning until he retires at night, the human animal is prone to error. Even his most unimportant activities involve decisions. Frequently, these decisions involve conflict between his education, training or experience and his animal instincts. Challenges require responses, conflicts require resolution. If the decisions are the right ones the human animal proceeds on his course to the shower, to breakfast and to his day's work.

Wrong decisions or simple deficiencies in manipulation will result in what we call errors, large or small. One blue sock and one black sock, a cut while shaving, a misreading of the clock—all these are the little errors with which everyone is all too familiar. We don't worry too much about them because they are usually inconsequential, no disastrous results follow. Get that word "inconsequential." It means essentially "no consequences." We'll come back to that.

If we watch the human closely, we have to admit that he is making errors of some kind, constantly. For that reason we try to surround him with safeguards, guide lines and reminders to prevent the more serious errors or to minimize the consequences. Our lives are regulated by more safeguards of this sort than we care to admit. In our daily life, alarm clocks, mirrors, night lights, all are at least partially little crutches to help us on our way. Traffic lights, stop signs and traffic regulations themselves are designed to protect us from our own errors. Let's face it. What is the eraser on the end of a pencil for?

In the military environment, safeguard by regulation reaches a fantastic level. Every action is so prescribed by directive that one of the most common human errors is lack of familiarity with the safeguarding directives. Watch this now because a significant aspect of our problem begins to show up through the murk. A human can be given a task to do. In performing this task, he is prone to error. So we write out guidelines and directives to keep him on the straight and narrow. Fine, so far. But as the complexity of the task increases, the volume of the directives may increase as the square of the complexity.

The end result may well be that the human's struggle to keep abreast of the directives may tax his capacity *more* than the task itself. But, in a nasty, smug kind of way we can sit back and judge him because we now have an easy way to charge him with a specific mistake. We don't have to rack our brains so hard to figure out what he did wrong. Now we can say with authority, "He failed to comply with paragraph 12d (1), AFR XX-X, dated 1 September." So there is thought number one. Are we solving a problem by multiplying "Thou Shalt Nots," or are we just clouding the issue? This is not to say that directives are not necessary. They are. But if we are to study human error, its diagnosis and cure, we're not curing a thing by just saying that a man failed to comply with a certain directive or regulation.

Let's get back to this human who has finished breakfast and has gone to work. We must admit that his errors continue. His day is crowded with little mistakes, varying in importance with the degree of his responsibilities. Mis-spellings, misplaced correspondence, dialing wrong numbers on the telephone, miscounting change at lunch, forgetting to pick up cleaning, on and on.

The functions of command and management involve manifold and gross errors of judgment and evaluation every day by people of every level of rank and experience. Many of these errors cancel each other out. But the key point to these errors is that they are committed in a human, social environment, which is a forgiving one. Humans are prone to error but they are also resilient and adaptable. They can forgive, correct or allow for the errors of others. If it were not for this cushion, our daily lives would be a series of one disaster after another.

Now, put this human to work with a machine instead of with other humans. Put him at the wheel of an automobile, at the controls of a lathe or press or in the cockpit of an airplane. The soft cushion of human tolerance is gone now. The machine is governed all the way by the stern unwavering laws of physics, chemistry and mathematics. It doesn't give; it doesn't forgive. It may fail because of physical forces but it does not make mistakes. Action is followed by reaction; the laws of gravity, mass, inertia, temperature and pressure continue their implacable sway.

When a human sets these forces in motion he must obey their laws without question. That is, of course, why mistakes become costly when the unforgiving machine is involved. The magnitude of the consequences will now only depend on the potential of the machine to cause damage. A mistake with a hydraulic press has more disastrous potential than one with a Handy-Dandy can opener. And what machine can match the destructive potential of a 700 mph aircraft at low altitude, loaded with ammunition and highly volatile aviation gasoline? This is a controlled bomb, and mistakes it does not forgive. This is thought number two.

In our daily life, alarm clocks, mirrors, traffic lights and stop signs all serve as safeguards.

Now, an error is an error, no matter how thin you slice it. It is the consequences that give us cause for concern. Remember that word "inconsequential?" The error that results in nothing more serious than a soup spot on the vest and the error that results in a fatal crash are similarly alike in their basic nature.

The machinery of human error is the same. The error is simply an inadvertent deviation from a correct procedure or routine. The implication is obvious. Errors committed in an environment with disastrous potential such as an aircraft are errors we can ill afford, and they should be guarded against by every effective means at our disposal.

Is this being done? A few moments devoted to honest self-examination might be most beneficial to every pilot reading this article.

"Breathes there the pilot with soul
so dead
Who never to himself has said
'Whoo! I'm glad I got away with
that one!' "

From pre-takeoff planning to termination and "normal deplaning," a flight presents a constant series of challenges to a pilot. It is a rare flight that does not see an error of some kind committed at some time during its course. Self-examination is frequently very revealing. How many times have you *assumed* something was okay, without checking? Had trouble starting an engine because you forgot to turn on the switch, or the fuel? Failed to maintain an eagle-eye watch for other aircraft, especially at night? Taken off without checking controls for free movement? Forgotten to change fuel tanks? Sure, a checklist covers these items in most cases, but have you *always* used it? How often have you failed to contact a ground station because you were on the wrong channel? Or yelled yourself hoarse trying to talk to a CAA station

". . . the perfect pilot has all the virtues of Steve Canyon, Rex Riley and Davy Crockett."

that was clearly shown in the Facility Chart as having "no voice?" Or, pushed on into questionable weather under VFR to the tune of the old sad song: "Oh heck, it'll burn off by ten o'clock?" We could go on and on, but you get the idea.

How many errors does the average pilot make every day that by pure luck do not result in an accident? Nobody knows, but it's likely that the answer would scare a lot of people. When we say a pilot committed an unsafe act, are we really saying anything? When we charge an accident to pilot error, aren't we really saying "This was just one of many errors, only this one paid off in an accident?" Every hour of every day the sky is occupied by many, many aircraft whose pilots are constantly making errors. This very minute as you read this, a hundred errors are probably being made aloft by Air Force pilots. An alarming thought? Yes, it certainly is. Why aren't aircraft falling out of the sky like flies? Simply because in 99 out of these 100 cases, other circumstances have not combined to allow the error to bear fruit.

No one can question the fact that our aircraft are becoming more and more demanding on the pilot's capabilities. At the same time our flying safety performance has been improving. This proves that our pilots, by and large, are trying hard to meet the stiff requirements confronting them. Our analysis of accident cause factors, however, has not progressed so as to stay in step with our equipment. We are talking and thinking of pilot error in the F-100 in the same way as we did with the P-12. Not that we were right then, but our approach suited our purposes. Now that we are standing on the threshold of pilotless flight and our present day aircraft are calling for the absolute maximum in errorless performance from our pilots, a reappraisal is warranted.

We have been assessing pilot error by comparing our pilots with something that does not exist. It is a statue, a mythical being known as "the perfect pilot." This boy has all the virtues of Steve Canyon, Rex Riley and Davy Crockett, rolled into one. He is the guy who never forgets, whose technique is flawless, who never louses up a forced landing, and who never, never forgets to close out his flight plan. He is every "Well Done" personified in one handsome, broad-shouldered frame. He is a wonderful person and if he were real he should roast in hell.

By comparing our pilots with this paragon, we can easily slide into the concept that a successfully completed flight means the pilot was perfect. Especially if the pilot happens to be *me*. The corollary is that a pilot whose error precipitates an accident is therefore an inferior being. He has somehow failed to meet the standard. Standard? "Wonder boy" is the standard, therefore no pilot in the whole Air Force meets the standard.

When an airplane piles up at the end of a complicated chain of events, do we approach it with the attitude that "the pilot must have goofed somewhere," then find an error and blame the whole can of worms on that error? What guarantee do we have that the next pilot coming along, faced with the same circumstances, won't make the same error? That's our job—to head off the second error.

We know that no pilot is perfect. The only difference is that the "level of constant error" is higher in some pilots than in others, and those with high levels are therefore more vulnerable to accidents when the variables combine to clobber them. Training and supervision are tools that can help lower this level. It's a little like having enough antibodies in the blood to repel invasion by germs. We want to repel invasion by circumstances, weather, materiel malfunctions and all the other variables that can put a pilot on the spot. A low error level can help prevent these other factors from causing disaster.

So, if the pilot goofed, let's find out first if this was a goof that other people are likely to fall into. If so, let's do something about the cause. If it was an isolated case, peculiar to this one human, let's see why it had to pay off in an accident. Maybe this too could have been averted, could have resulted in nothing worse than a close call, one that would have scared the pilot enough to teach him a lesson, but not kill him. Was his accident indicative of a high error-level? If so, why was it high? And is there anything we can do about it?

What can we do? We have two tasks to accomplish. One is a goal, the other is a means to the goal. The goal is to reduce the frequency of pilot error accidents; in other words, to reduce the number of errors committed in flight. The other task is to make a more realistic evaluation of the errors committed so that we can get at the cause.

People don't make mistakes purposely. They are traceable to one or more of several areas. One, of course, is that of human inadequacy itself, which includes inability to maintain concentration, lapse of memory, fatigue and so on. Another area is built into the machine itself. Design frequently neglects human factors. Errors are made more likely and their consequences more serious by built-in "booby-traps" in the aircraft and its operating procedures. The third area includes the entire environment in which the pilot operates—his schedule, his training, his supervision, the weather and operating conditions; in short, any and all of his surrounding daily circumstances.

These influencing factors will be discussed in detail in subsequent articles. The main point to be understood right now is that these factors exist, and that pilot error cannot be considered by itself, in a vacuum, as it were.

Accidents, incidents, near accidents and operational hazards give us clues to the reasons behind errors. If, in investigating them, we button everything up by blaming them on the errors alone, we have not done even half the job. This is not accident prevention, because we have taken no action to prevent someone else from making the same errors in the future. Unless we understand the nature of the error and its causes, all we are doing is fixing blame, not applying a cure.

A determined attack on the causes of error will eventually result in attainment of the major objective, which is not elimination of error, but a lowering of the overall error-level of our pilots. If we can assure that the number of mistakes per flight are reduced, the accident exposure is going to be reduced, regardless of other circumstances. This is no magic cure-all. On the contrary, it involves a common-sense application of the age-old principles of caution, planning, alertness and technical proficiency, and a conscious desire on the part of the pilot to do the job *right*. Doing the job right means doing it with a minimum of errors. We ourselves destroy more of our aircraft than an enemy could ever hope to destroy. We are, in effect, our own worst enemy. Reduce all the errors committed and the disastrous ones will decline, too. The result can be the biggest payoff in effective accomplishment of the Air Force mission that has yet been seen. ●

LETTERS TO THE EDITOR

Airways Flying

The staff of FLYING SAFETY has in the past compiled information on airway flying in a pamphlet entitled "Flying Safety on the Airways." The publication was of great value in that it assembled all information from various regulations and flying publications pertinent to flight planning and airways flying. The publication at present is outdated.

How about a new one?

Capt. Billie J. Wetzel
FSO Kelly AFB, Texas

The one and only subject pamphlet was actually a reprint of an article from Flying Safety Magazine. It has been re-worked and will be republished as soon as it is coordinated with all interested agencies.

★ ★ ★

In the Dark

In your December 1955 issue you had an article entitled "Send A Letter," which to me sounded like an excellent idea. Since reading this article I have tried to use this letter system but to my surprise I have yet to find a base operations that knows what I am talking about. On three or four occasions, I have put an appropriate letter in the remarks section and circled it, only to get the following question thrown back at me: "What does this mean?" Can not something be done about this to circulate the letter system so that all base ops know about it? How about printing the letters in the remarks section on the 175s when they are first printed?

1st Lt Wilmarth B. Walker, Jr.
4756th Air Def Sq (Wpns)
Moody Air Force Base, Ga.

Try this treatment: Open up the Radio Facility Chart to Special Notices section, and make believers out of them. It's in the book. Many base operations stamp the letters in the "Remarks" section for the convenience of pilots.

★ ★ ★

B-26 Exits

As Air Force Adviser to the 106th Bombardment Wing (T), New York National Guard, which is equipped with B-26 type aircraft, an item of flying safety concerning this aircraft has been brought to my attention. Considering its importance to all personnel flying B-26s, I am forwarding this information to your publication.

In accordance with the current T. O. 1B-26F-1, revised 22 July 1953, emergency exits from the rear compartment of B-26 aircraft are designated in the following sequence:

a. Primary — through bomb bay doors.

b. Secondary—through side door.

c. Tertiary—through top hatch.

In order to effect an exit through the bomb bay, it is first necessary to open the bomb bay doors which are directly dependent on the proper operation of two systems, electrical and hydraulic. A malfunction of either system would prevent the use of the bomb bay as an exit. These would be doubly vulnerable in combat.

I believe the directive which required the installation of the side door was aimed at providing a positive and safe exit irrespective of bomb bay door operation. This feature relieves the gunner of any dependence on electrical or hydraulic systems. It is believed that this side door exit was meant to be designated as the primary exit from the rear compartment of the B-26.

In addition, NACA tests on exiting from this section of B-26 aircraft revealed that the side hatch was just as safe as the bomb bay. At no time did a body strike the tail section of the plane.

Col. Edison C. Weatherly
Air Force Adviser
106th Bomb. Wg (T) NYANG

Thanks for the latest information on the B-26. Here's hoping nobody has to use it, but if a hasty exit is required, it's nice to know what door to use and why.

★ ★ ★

Marker Authority

I have just finished reading the article titled "Runway Warpaint" in the December 1955 issue of FLYING SAFETY. With reference to the runway distance markers, I should like to have the authority and criteria for establishing these markers on the runway. This information is requested because I have run into some difficulty in obtaining authority for such markings, and I feel that they are needed and will be of great benefit to the pilots on this base and to all transient crews.

Maj. Cody U. Watson
Base Ops Officer
Donaldson AFB, S.C.

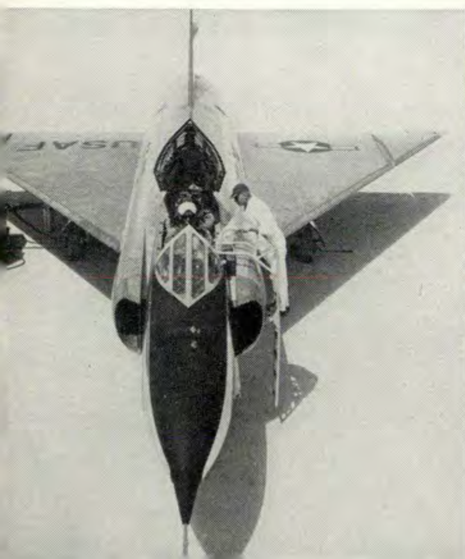
The following three sources will help you to make your marks: AFR 91-17, ATM 6003 and ATL 5035.

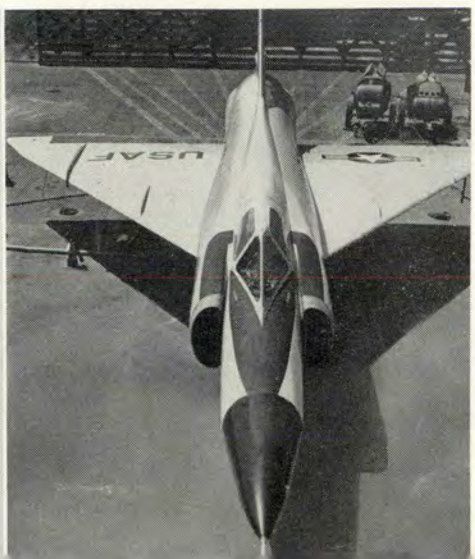
Parade of the

In this issue of FLYING SAFETY, the F-102 is featured. Radical in design, it is the second Century series airplane to become operational. Here is an article that you will find mighty interesting.

Richard L. "Dick" Johnson
Chief Engineering Test Pilot, CONVAIR

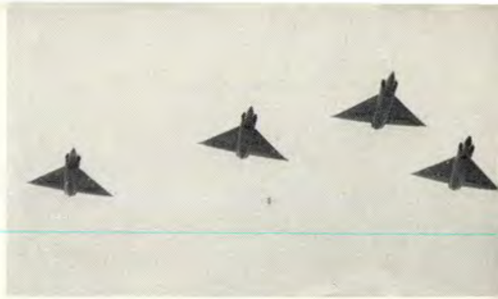
Before and after. Left, note straight fuselage on YF-102. Right is F-102A with nipped-in waist.

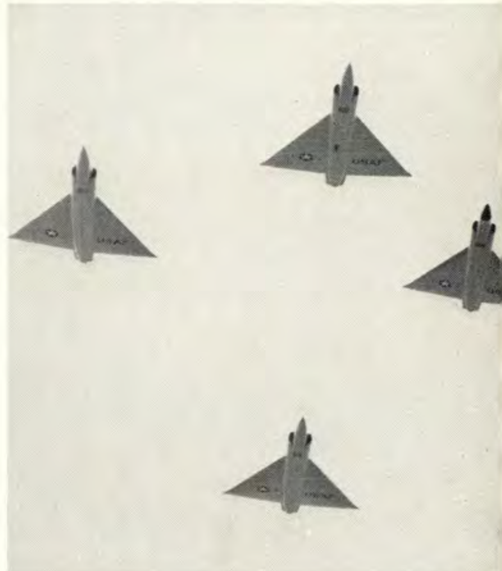




DURING ITS RELATIVELY short life the F-102 has had, like any new airplane, many names. Some were honest efforts at picking a good name and some just plain good humor. I'll mention one and I'm sure it will insult no one. You know what you say when the bump in the road jars every joint of your pride and joy, or when you first and suddenly see an airplane that's twice as everything as you expected. Or, perhaps when you're going umpteen hundred knots and you hit the roughest air you've ever encountered, the same thing was said by all but the chaplains when they had their first look at the F-102—so we sometimes call it the "Saviour." We also could take a line from the roadside ads that say. "One hundred and one were tried."

If you're still with me, I would like to explain that there are a few flight test items that are as yet undone. The spin program isn't complete, and the structural integrity investigation has reached approximately 80 per cent completion. Some of the investigations mentioned, and maybe all, will be finished when you get your F-102s. As of now, don't spin, don't





F-102 Centuries

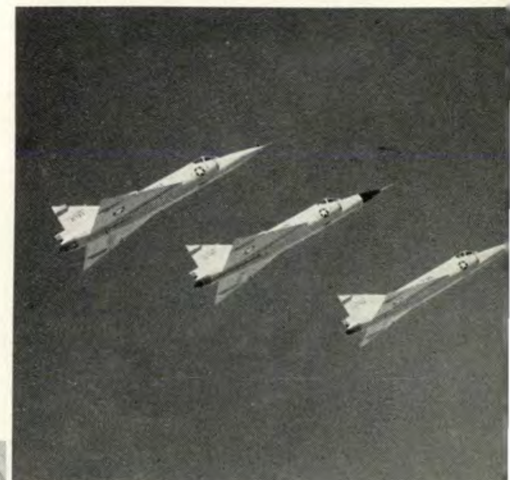
exceed 5.6G and don't fly with external tanks until the Dash One gives you the okay.

Now let's have a look and then go fly. The F-102 is unusual; it has more sweep back than anything except a California teenager's sideburns. It has no horizontal tail and its wings have a low aspect ratio (short, stubby wings). Its nose-radome is more pointed than any other Century series aircraft; the engine air intake ducts are dual and have their open end adjacent to the cockpit. As a matter of fact the entry and egress ladder is hung on the left duct. The pictures used to illustrate this article adequately explain the rest of the exterior description.

One Safety Pin

In the cockpit, following a proper walk-around check which includes all of the usual but nothing unusual, one finds a neat comfortable ejection seat with one safety pin in the right armrest. (The pin has the usual banner attached but has a convenient stow-clip on the right wall of the cockpit. The end of the banner is attached to the cockpit wall so that it can't be "stolen" or forgotten in place.)

The stick is double-headed; the right handle is for flight control and the left is the radar-fire control system. The handles are about six inches apart. The left one can be locked

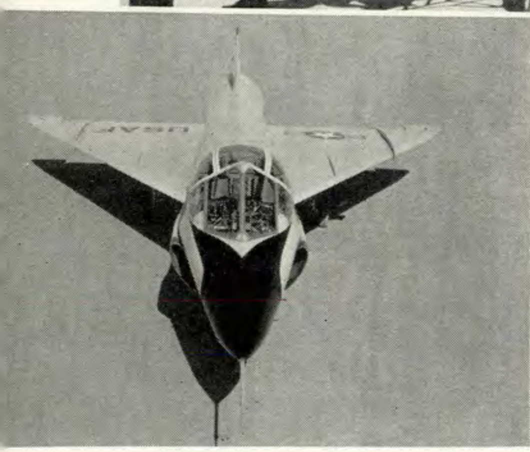


From takeoff to altitude, these four F-102s show their distinctive delta-wing design, which spans 38 feet. Powered by a J-57 engine, the F-102 is 68 feet long. It is an all-weather interceptor.

Author Dick Johnson prepares for a flight.

Taxiing out, this side view shows sharp nose-radome of F-102. IDLE power is sufficient.

Below, is the TF-102A. This trainer version seats pilots side-by-side. Note wider cockpit.



Left, the TF-102A combat proficiency trainer can be used as an all-weather interceptor.

In the TF-102A, all phases of flight are closely supervised by instructor pilot.

for left-handed flying whenever the radar control is not in use. There is a curtain that extends from the top of the scope to the apex of the windshield. It completely prevents undesired reflections in the flat sharp "V" windshield. The canopy is closed easily by hand and manually locked with a push-pull control on the lower right side of the instrument panel. The seat-height control is a toggle switch on the forward part of the right armrest. Every detail of a cockpit check makes a lot of writin' 'n readin', so let's hit the high spots from left to right and then start the P&W J-57-P-23 type engine.

Number one type items on left console are the following controls: "G" suit, pressure suit helmet face-piece-de-fog, ARC-34, fuel shut-off and on boost pumps, R.A.T. (Ram Air Turbine power for emergency hydraulic control) throttle which includes air and ground start (identical), afterburner control and stop-cock, and oxygen regulator. Now to left sub instrument panel: cabin pressure, landing gear and emergency landing gear control. The instrument panel contains all of the essential instruments which include landing gear position, fire and overheat warning, hydraulic systems condition light, canopy unlocked light and in the amber category, the master warning light.

Armament Controls

The bottom part of the panel contains the armament controls and the center lower panel contains the stability augmentation controls, engine anti-ice control and cockpit and instrument light switches plus a crank to move the rudder pedals fore and aft. The right sub panel contains the master warning panel and test and reset switch. The right console contains electrical controls, navigation radio and identification equipment.

To start the engine with the fuel system properly set up, we push outboard on the throttle in the OFF position and hold there to at least 12 per cent N_2 RPM, then push and hold the ignition button located on top of the throttle and move the throttle to the IDLE position while continuing to hold the ignition button down until 40 per cent RPM is indicated. The engine takes over now. If the start was normal, the tailpipe temperature went to about 230°C.

Taxiing is like almost any other jet bird with nosewheel steering. If there is nothing expensive behind you, rev up the "motah" a bit and move out. If you don't own or can't pay

From outside, high angle of attack attitude is shocking. To pilot, no sweat.

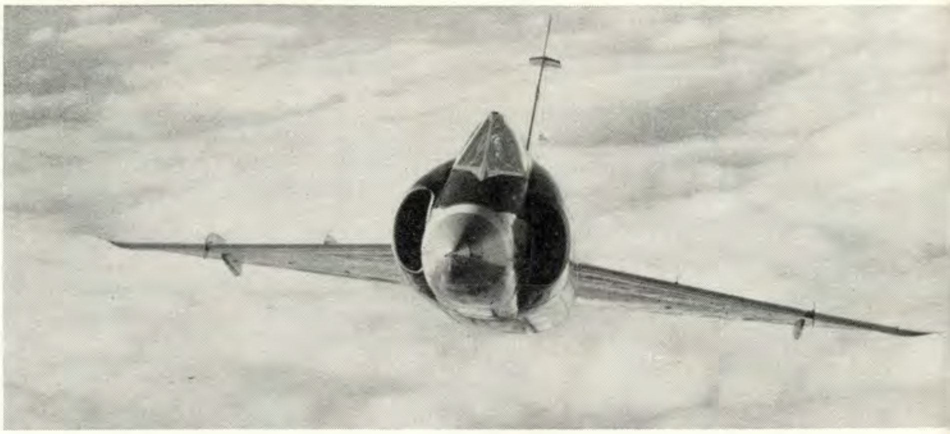
Control on climbout is excellent, but requires a light hand.

for what's behind you, move out with patience and IDLE power. The nose-wheel steering button is right beside the trim switch on the control stick. All of the taxiing required can be done at IDLE power except against more wind than any chamber of commerce would allow.

Just prior to reaching takeoff position, have a look at the fold-away checklist above the forward portion of the right console. If you have completed what is indicated there under "takeoff" and everything checks out according to the book, line up, release the brakes and go.

From outside, the steep or high angle of attack attitude during takeoff and landing is pretty shocking at first, but not even noticeable when you're flying the F-102. You can see straight over the nose up to 15 degrees angle of attack.

One of—if not the last checks made prior to takeoff is to see what the ratiometer says. (It's a new instrument that is a "go" or "no-go" indicator for dual compressor mills—that's California for engine.) The proper ratiometer reading will vary with temperature. You will have a simple chart to tell you what it should be for any temperature you will encounter. The chart indicates an allowable band and if we have a number



Most outstanding flight characteristic is probably good maneuverability at high altitude.

Below. Touch down at 130 knots and deploy drag chute. Brakes good, pedal force medium.

in the band, we go. Something like 15 seconds from brake release we are airborne and the gear is on the way up. The climbout is steep, which is necessary to keep from exceeding gear limits. About half the time it takes you to get any other scope toter to 40,000, you're there. During the climb if you hurry, you have time to check to see that your dampers and turn coordinator are on. You are climbing almost straight up. Visibility is good but restricted forward because of the extremely steep attitude. Control is excellent but requires a light hand, particularly in lateral maneuvers.

If you fly an early F-102 you may have a roll restriction that puts the kibosh on high grade airshow antics but only affects the mission slightly. It will have a "black box" that makes high rate rolls for emergency situations okay but holds one to something like 120°/sec. roll rate for 180's and over while positive quadrant bank angle changes will be unrestricted. With later airplanes if you want to roll or need to, have at it. You'll find the results exactly as you planned them to be.


A handy gadget. The ram air turbine (R.A.T.) provides power for emergency hydraulic control.

Good Maneuverability

The most outstanding flight characteristic is probably the good maneuverability at high altitude. With it you stand a good chance to out-maneuver any competition. Within its limitations which allow speeds over 1000 mph and as low as 110 mph you'll find a straight forward, pleasant and easy-to-handle machine. Anything that applies to any "conventional" jet airplane applies to this one with regard to ordinary good accepted flight techniques.

Before landing fire up the afterburner a time or two, including once at say 10,000 feet while indicating 400 knots or better. The result is like lighting a string of firecrackers to a scared rabbit.

The pre-landing checklist doesn't have much to say. It is basically all boost pumps on (they should stay on all of the time—check anyway) and gear down.

If I had the words of wisdom that Tony LeVier or Rusty Roth have to offer on the subject of landing jet aircraft, I could now copy them and substitute F-102 as the need indicated, and have said exactly how to land an F-102. As in all other aircraft, you will find each landing different. While striving for the perfect pattern and landing each time that we "come in," we have discovered that it is (by accepted WW II fighter standards) a very conservative landing pattern.

Partial Power Compromise

It has a downwind leg and is, as LeVier and Roth have said, a partial power compromise between a power-off landing and a high power drag in. In the F-102, you can fly the pattern something like this: Gear down at something between 200-240 knots following the break, bleed off to about 180 knots IAS for the base and then to about 160-170 knots for final with RPM near 80 per cent.

★

The author flew 180 missions in WW II in P-47s, with the 12th Air Force. He is, in his own words, credited with "one ME-109, jillions of locomotives, trucks and holes in the ground." His decorations include one Silver Star, four DFCs and 13 Air Medals. He received the Henry DeLaveau Medal for the world's speed record in an F-86A on 18 September 1948 — 670.981 mph. It was good for 4 years.

As an Air Force test pilot, he helped to deliver the first set of 50 "hard, leading edge" F-86s to Korea, checked the pilots out, and flew a few missions there. He left the Air Force as a Lt. Colonel in September 1953, and went to work for CONVAIR.

He has flown all of the U. S. fighters except the F-101 and F-104; has also flown the X-1 and X-4. Foreign types include all British fighters except the Folland Gnat and the P-1; all current French fighters, including Mystere I, II, III and IV, and two Russian fighters.

Dick Johnson has not confined his flying to the fighter types. He has flown many more cargo and bomber planes than can rightfully be called a fighter pilot's "share."

Dimpling of the entire surface of a new type of titanium shroud insulates engine from fuselage.

Over the fence with slightly less power and partial flare at 150 knots. Touch down at 130 knots and hold what you have (nose approximately on horizon) and deploy drag chute by pulling the drag chute handle out. Then ease forward slightly on the stick to start a gradual descent of the nose. Brakes are good, pedal force is medium. Use as required. To jettison the drag chute, push the handle back in. You may use speed brakes for landing as required. Deployment of drag chute opens speed brakes and it probably will be SOP to utilize speed brakes on all landings.

Landings are pretty important so I'll say some more on the subject. If your engine has had it, but is still turning (windmilling) freely at 200-220 knots IAS you will find the RPM at approximately 25 per cent. This is plenty for good control but extend the ram air turbine for emergency system power at the high key which can be 9000 feet, plus or minus 1000. Your low key should be about 4000 feet and base about 2000 feet. You'll find control is excellent and when and if it's positive there's more altitude than you can use, side slip as required, but with due consideration for wing loading. (Wing loading is light for a fighter.) Touch down at 130 knots IAS as for a normal landing. If your engine is dead so that there is no possibility of going around, deploy the drag chute up to 180 knots IAS and 20 feet above the deck. That's nice to know but it's the only time to do it.

Below. Can you identify this airplane? It's the XF-92A. Compare it with F-102A in lower photo.

Below is the production model F-102A. Painted all-gray, it is now going to active units.

Crosswinds No Sweat

Crosswinds are only slight nuisances up to so much as 30 knots at 90 degrees. Keep the nose high, following landings on slippery surfaces. Let it fall when it gets heavy to take best advantage of the high angle of attack for braking. The tailpipe can be dragged on landing but it takes muscle in the head, as well as in the arm to do it.

An airstart can be accomplished under extremely different conditions of airspeed and altitude. However, about 220 knots IAS and the accompanying 25 per cent is recommended. If you know your normal fuel control is okay, handle the throttle as during a ground start. If the normal system is inoperative, switch the emergency system ON by pushing the red guarded toggle switch forward. Then go through a ground start but "play" the throttle to get the fuel flow and starting temperature desired.

I haven't gone into a long dissertation as to how the F-102 should or should not be flown in all types of configurations. You'll learn these rudimentary items when your F-102s are delivered.

In conclusion, I'll say this: The F-102 is a "Going Jesse." It's loaded with sting power; it's stable and it's supersonic. I'm convinced you'll agree with me, it's a "real gone" machine. ●

It's in the

Capt. Westley H. Hamilton
Bomber Branch, D/FSR

AT FIRST GLANCE, the B-47 accident rates look very encouraging. Based on the number of major aircraft accidents per 100,000 flying hours, the rate in 1955 decreased to a low of 3.2 per cent of the 1951-52 figure. A comparison of accident cause factors shows that the number of accidents caused by materiel failure has decreased from 29 per cent of the total in 1951-52 to 13 per cent in 1954. The same comparison of maintenance error accidents indicates a downward trend from 12 per cent to 10 per cent; not so startling, but still on the credit side of the ledger.

But what of the pilot error type of things? Now that's a horse in a different garage. From a not-very low of 33 per cent of major accidents during 1951-52, pilot error as a cause factor rocketed to 57 per cent of all major accidents in 1954. Think about it. Nearly 60 per cent of the B-47 major accidents during 1954 were due to a pilot's miscalculation, poor judgment or improper technique. No matter how you look at it, the pilot just plain goofed. The resultant loss of life, the destruction of and damage to aircraft, and the impact upon Air Force capability are staggering.

When we break the figures down a little more we can find the area of operation where the trouble occurs. Seventy-six per cent of the total pilot error accidents occurred during the approach and landing phase of flight. So? So why did they? Because pilots didn't maintain proper airspeed on the final approach; didn't use proper flight control technique; didn't know actual stopping distance; didn't know minimum stopping distance procedures. Does the "Bible" tell them what, when and how? Sure it does!

Reference: Tech Order 1B-47E-1

Check your handbook for takeoff calculations. Then apply them to the existing conditions.

Book!

Is reading your Pilot's Handbook enough? This article has a couple of other ideas on how to use it properly.

(the "Bible"), dated 30 June 1955, revised 30 September 1955.

- Approach and landing, pages 161-169, inclusive.
- Go-around, pages 169-170.
- Landing emergencies, pages 197-202A, inclusive.
- Refused takeoff, page 196B.
- Approach and landing, pages 545-554, inclusive.

There's nearly enough information on those pages to teach your wife how to land the airplane.

Yes, it's in the good book, and the chances are you've read it. But reading it isn't enough. You must analyze it and apply it to the existing conditions. When landing at a strange field, or at a familiar one under wet or icy conditions, or under nearly any other-than-normal situation, pause and consider a few things. Check your stopping distances for your gross weight —you might find the last part of your skid is on green grass. The stopping distance charts are good, when used properly. But just for kicks take a look at the "Conditions" down in the lower right corner (good book, pages 552-553). You don't normally chop the outboard four at touchdown, nor do you have the brake chute fully opened at touchdown, so figure on rolling a little farther. And although there's no wet concrete reference line on the normal stopping distance chart, check the other charts and you'll find you're good for another 1000-2500 feet of landing roll on wet concrete. Of course, if you're landing on wet macadam, or well oiled and rubbered concrete, better add another few feet for the wife and kids. Should your landing be on packed snow or ice, you're not braking—you're skiing!

A few other items worthy of your attention prior to landing are wind conditions, terrain features beneath the traffic pattern, runway approaches and overruns and lighting systems. Crosswinds, gustiness and vertical drafts caused by terrain features have all caught B-47 pilots unaware and resulted in accidents. There's really no need for hitting a power line or trees on the final approach, but it has been done and can be again by pilots who don't know the things exist. Crosswinds require corrective technique and gustiness necessitates an allowance when computing final approach speeds, yet neither are extreme hazards when pilots are aware of such conditions. And if you're familiar with obstructions, approach and runway lighting systems peculiar (and some really are!) to the field, then confusion is less likely. Give yourself a break by checking those items early rather than having them surprise you as you encounter them in the pattern.

After you've completed the recommended reconnaissance, it boils down to this:

- Adhere to checklist procedures and compute the appropriate best flare speed accurately.
- Allow for gustiness and turbulence; ask the tower for existing winds if not given to you.
- Fly the airplane smoothly and monitor closely the airspeed and power settings. Have your copilot help you check speed and power.
- Maintain best flare speed until crossing the approach end of the runway; make your flare slow and smooth as possible.
- On the ground, deploy the brake chute; if it malfunctions, immediately initiate go-around or brakes — only stopping procedures.
- Use wheel brakes judiciously. Learn the feel and sound of anti-skid cycling. It's important.

Simple, isn't it? You may be thinking, "Why print this simple story? Everyone knows that." The troops that broke the airplanes didn't know it or use it. But I do. How do I know? The "Bible" tells me so! ●

Stopping distance charts are good when used correctly. Don't forget runway gradient!

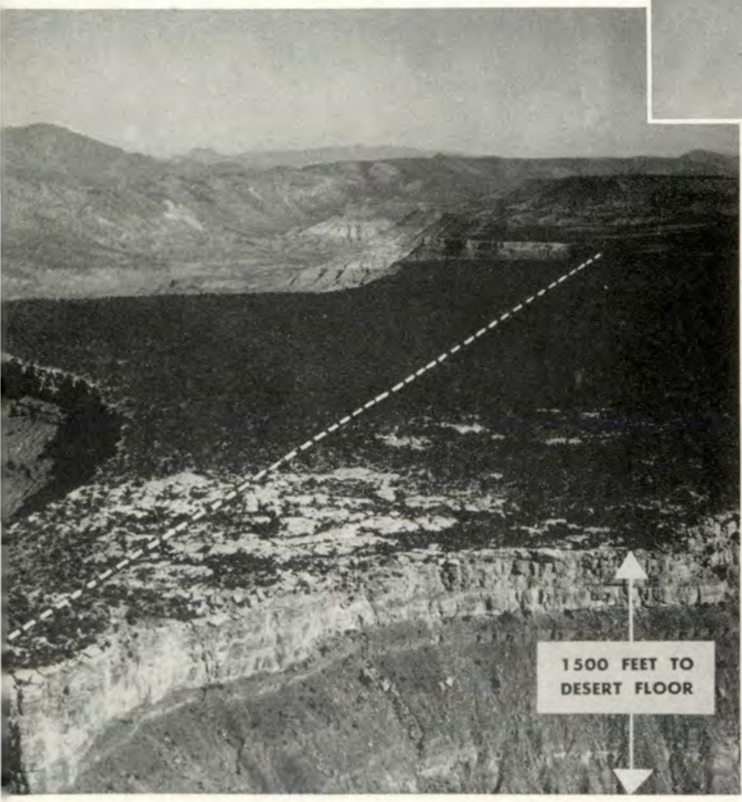
Gusty wind conditions require corrective techniques in computing final approach speeds.

Keep Current

NEWS AND VIEWS

Note nacelles, above and right, on Convair YC-131C turboprop transport. It uses T-56 Allison engines.

Below, path "SMART" takes on Hurricane Mesa, Utah. (See next page.) It was built to test ejection seats.



Flying Submarine—Still only in the thinking stage of development, the flying submarine does not differ markedly in appearance from a standard swept-wing jet fighter. However, it utilizes two power plants. A jet engine with air intakes on the upper part of the fuselage for air operation and a marine engine driving a small propeller at the rear of the craft for underwater propulsion. In flight, the marine propeller is designed to be retracted within the fuselage.

A hydro-lift landing gear or water skis can be retracted in flight. This type of gear already has been tested on several types of conventional aircraft.

In the two media operation, the pilot of the flying submarine would start the marine engine just before landing. The craft would aqua-plane until it slowed down and came to rest on its hull. Then the jet engine would be stopped, the air intakes and exhaust sealed and the cabin pressurization turned on. The craft would then take in water in ballast tanks and submerge, driven by its marine propeller and maneuvered by its airplane control surfaces.

There are many technical problems that must be overcome, but the only difference between flying in air and "flying in water" is just a question of density. ●

★ ★ ★

S-M-A-R-T—Successful, rocket test-sled runs on the new USAF supersonic test sled track at Hurricane Mesa, near Zion National Park, Utah, have shown that accurate observations can be made on the problem of bailout at supersonic speeds on both personnel and equipment.

Called SMART (Supersonic Military Air Research Track), this rocket-propelled test-track facility duplicates, on the ground, actual supersonic flight conditions under controlled instances the testing of aircraft seat ejection equipment, various types of parachutes and the effects on pilots of bailout at high speeds.

Unlike other existing test-track facilities, the SMART project was designed to provide free flight for test equipment and its recovery for further use. This is accomplished by catapulting the test equipment over a 1500-foot cliff and lowering it by parachute to the desert floor where it is recoverable. ●

★ ★ ★

Hands Off—Rotary-wing aircraft enter a new stage of stability through use of a newly developed flight control system by Sperry Gyroscope Company. The system gives the pilot full freedom for manual maneuvering, yet provides automatic stability at all speeds including cruise, hovering and engine-out auto-rotation. In manual-automatic operation, the gyros stabilize the aircraft on its existing flight path. While the pilot relaxes "hands-off," special controls hold the desired altitude, speed or climb positions. To change flight path, the pilot applies pressure to the control just as if in manual flight. ●

Above, new helicopter control system permits "hands off" flight. Below, pilot is freed for navigation duties. Light pattern on cyclic stick reveals movements required in 15 seconds of operation.

Unveiled recently is the Snark, intercontinental guided missile.

...Change Without Notice !

Maj. Lewis J. Neyland, Operations Analysis Division, Headquarters Air Weather Service

Here is an article prepared by an experienced pilot who has also served as a weather officer since 1943. Everybody is cognizant of the landing undershoot bug. Here may be the answer to at least some of these accidents. FLYING SAFETY *feels that it is important to read this article carefully and when the wind doth blow, watch out for wind shear.*

• • •

THE OTHER NIGHT I was courageously doing a little hangar flying with some of the boys. The ensuing hairy stories had us pretty well convinced that most of the hazards of the good old days are long gone. No more tearing up the sod with the tailskid when we taxi. Haven't had to check the safety wire on the rigging turnbuckles for a long time. You have to work at it to groundloop the modern bird. Nowadays, landing at a strange field is seldom complicated by a freshly dug badger hole or a stray herd of startled bovines.

Our airfields have gradually evolved into luxurious landing areas, and in spite of the best efforts of us fiery stones, the Fly Safe people have made it pretty difficult to get into trouble on a normal landing.

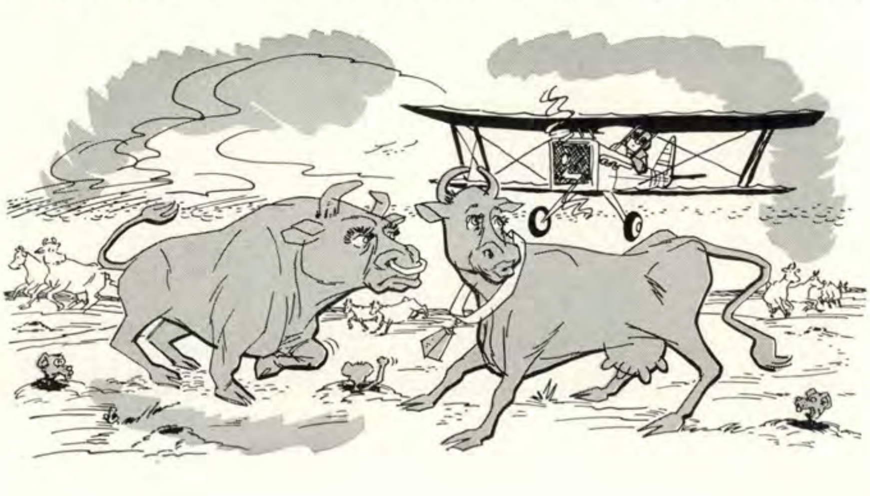
If you remember the long difficult process of evolution leading up to our present long, wide airstrips, you'll remember that they'd hardly gotten the rhinoceroses off the old 4500-foot macadam strips when someone thought up the jet. Right off the bat Uncle's bill for barbed wire fence and corn fields off the far end of the runway elicited screams of rage from the economy-wise comptroller.

It didn't take long to decide we'd better do our touching down near the front end of the strip, but a few months of this operation and the man came around with the suggestion that since we were now ruining the farmers corn on both ends of the field, he would buy us some more acres so we could stretch that 4500 feet of macadam to 10,000.

"One hundred per cent spare runway ought to take care of anybody," my P-80 colleagues commented.

Alas! By the time we got our new runway, some joker came along with a bigger, hotter machine that gobbles up the runway faster than the visiting brother-in-law sops up your rare old Scotch. So, here we are again, paying for more fences and corn fields.

Landings today are seldom complicated by a freshly dug badger hole or a stray herd of cows.



What Makes a Landing

Down at the far end, the barrier looks like a good answer, but how about these carom shots off the rocks short of this end of the field?

Whether we admit it or not when we're flying a tight formation at the local pasture, you and I both know we make occasional landings we'd rather not talk about; those landings where nothing quite clicks and you're jockeying for position all the way to touchdown, for instance. I find these harder to remember when talk turns to flying than the ones where the whole pattern feels good and you know you've got it made all the way through the landing act.

But, once in a while, when you're sliding down the groove and that warm, "this is one of those good ones," feeling comes over you, suddenly the bottom falls out and you're scrambling around the cockpit looking for a lot of RPM in a hurry. Or, almost as bad, you had it made for a perfect touchdown on the numbers, only the bird has other ideas and flies clear past the first intersection before it gives up!

"What gives? Have I lost the old touch?" I mutter as the smoke billows up from the tortured tires.

I speak with the voice of experience when I say that circumstance is a shattering experience, and I don't like to be shattered. The feeling is something like trying to pass a bogus "5 sixes" to a suspicious neighbor in a liar's dice game—even if you get away with it this time you know it's Lady Luck and not skill that deserves the credit. Maybe this explains the interest that was born sometime ago when during an investigation of a C-124 accident out west for possible weather factors, it turned out that very possibly a wind shift (or shear) was largely responsible. A few questions around the command disclosed quite a few people who had given the matter of wind shifts or wind shear and the landing and takeoff problem quite a lot of thought. As a matter of fact we were sent a very good article on wind shear and landing fighters that had appeared in the ADC monthly flying safety publication, "Archie Newsflash."

The more I looked into the problem the more convinced I became that the best answer to 100 per cent safe landings might be to extend the runways to 10,000 feet both ways from the touchdown point. However, I must admit that this suggestion was received with considerable coolness by everyone including my seven-year-old who pointed out with some scorn that this couldn't be done since our house was in the way.

Wind Makes the Difference

Having tried to solve the problem with amazing lack of success, it seems that the next step is to read you all in on it so you won't get caught short.

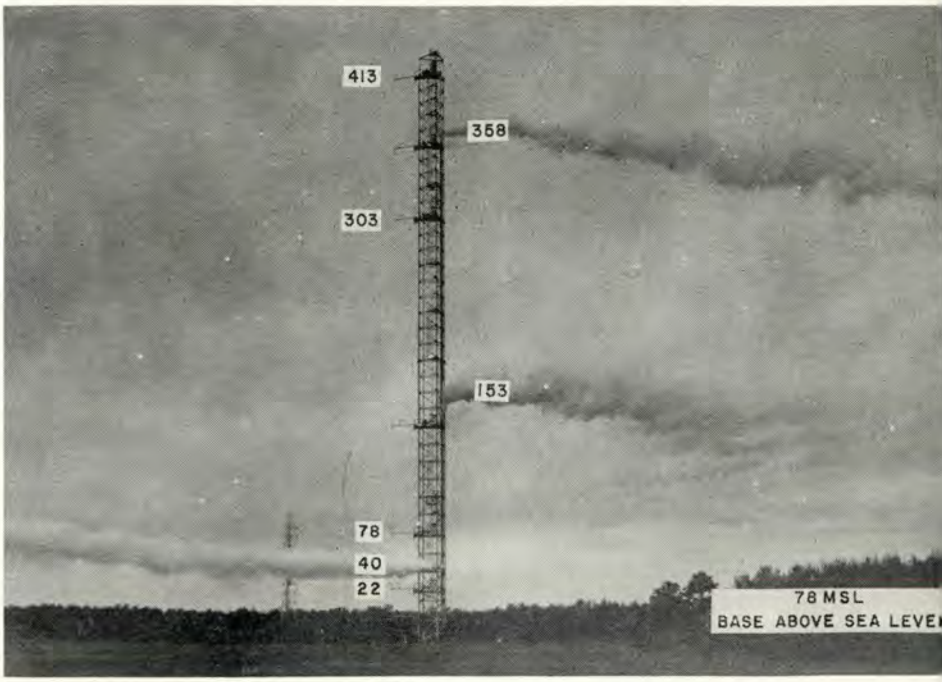
If the air were always calm, you could shoot a few landings in your favorite bird, learn how things look from "high key," "low key" and final, and go on from that day forth making every one right on the numbers. However, weather and wind being what they are, every approach is a little different. (In this discussion I'm only concerned with VFR approaches and landings.) Most of us, I believe, use about the same power setting and airspeed every time we come down the final. The hotter the plane and the shorter the runway the closer the final approach speed has to be to the stall speed in order to get it on the ground and stopped short of the far end of the field.

In order to use our standard approach, airspeed, rate of descent and power setting, we generally compensate for wind by moving the base leg in closer to the field. The stronger the wind, the closer the base leg (within reason). I can imagine a situation at a place like Thule where the windspeed might equal the final approach airspeed of a particular plane. That would be the "limiting case" as the mathematicians say, where, if we insisted in using our standard approach speed, rate of descent and power settings, we would have to roll out onto final directly above the touchdown point. Since our approach speed and the windspeed would be equal, our groundspeed would be zero and we would come down vertically at our normal rate of descent. As a matter of fact, I've seen a version of this sort of thing and I'm sure you have, too, around the local civil airport when occasionally the Cubs and such can be seen hovering or actually flying backwards when there is a stiff wind blowing.

Let's just suppose that one day we have a chance to try this vertical landing operation. We know the wind is strong enough to do it from the amount of flying it took to get into position in the pattern. There we are at 1000 feet over touchdown point, indicating about 120 knots, flying into a 120-knot headwind (zero groundspeed), final approach power set and our normal rate of descent established. As we let down through say 500 feet, we pass through an inversion and discover to our horror that below the inversion there is NO wind blowing. With zero groundspeed and now no headwind to give us flying speed, it feels like someone has cut the string and the rest of the flight resembles that of a manhole cover tossed out of a 10th floor window.

The culprit in the case is wind shear. Fortunately, such extreme shear probably doesn't exist outside of a tornado (which I'm not personally going near enough to investigate).

The fickle wind. Experimental smoke trails off in three directions. Height of the tower is 428 ft.



If such shear were common, you undoubtedly could not give away real estate in the approach zone of an airport. However, it's a rare day indeed when there isn't a little wind shear kicking around.

What Is Wind Shear

If you have the wind blowing one speed and direction here and another speed or direction a short distance away, you have wind shear. You can dress up the definition a little and call the surface where the two winds going in different directions or speeds rub against each other, the zone of shear or the shear surface or shear line, but it all means the same thing. A cold or warm front is a good example of wind shear with the warm air above moving in one direction and the cold air below going in another direction.

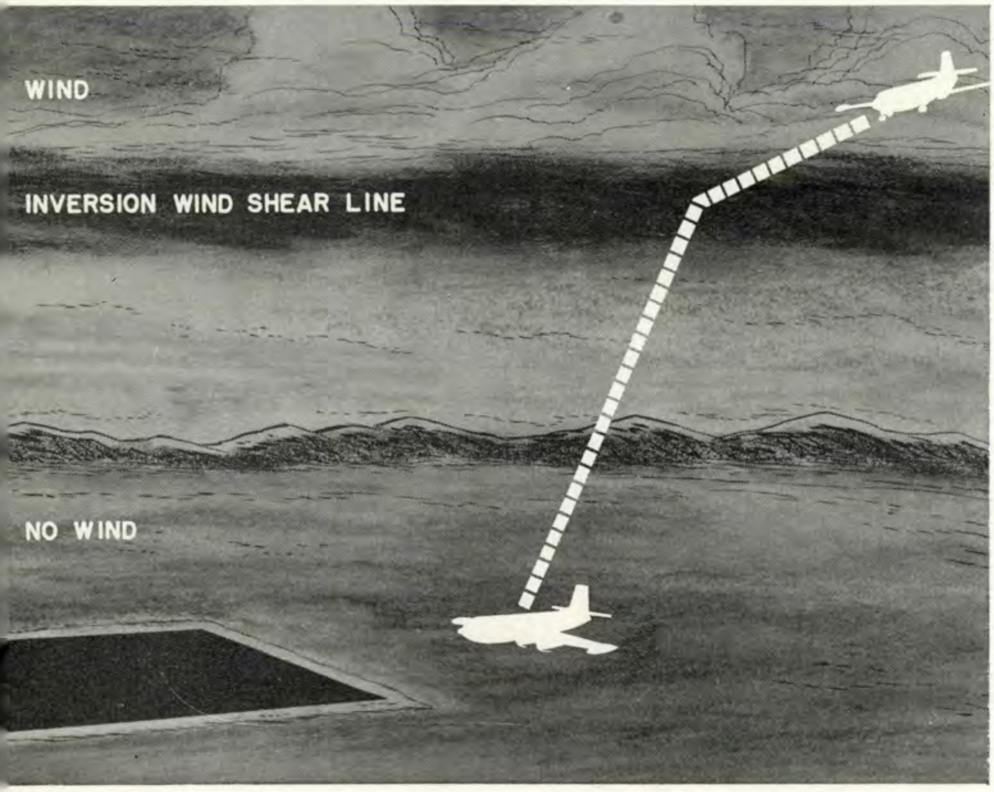
Another good example of wind shear is the strong wind that suddenly springs up just before the afternoon thunderstorm reaches the weatherman's picnic. At one instant it is almost calm, the next it is blowing and raining like mad. The dividing line between the calm air and the wind is a wind shear line.

First, let me explain further why we should keep our eyes peeled for wind shear and then I'll give you a few hints on how and where to search it out.

Even though the extreme example of shear we dreamed up a few paragraphs back wouldn't occur, wind shear between the ground and traffic pattern altitude of 15 to 20 knots is common and a shear of 30 to 40 knots is not at all uncommon in some parts of the world.

In modern high wing loading planes, this situation can cause trouble. If we come down the final approach at 15 knots above stalling speed, and pass through a shear line, where our effective head wind decreases by 15 knots we are immediately at stalling speed. The only way we can prevent a stall is to sacrifice altitude for airspeed or increase airspeed by adding power. In actual practice we simultaneously drop the nose and hit the throttle and if we have enough altitude we drag it on into the field and make a landing. Should our altitude run out before the power takes hold, we land short. The more sudden and severe the decrease in head wind component and the closer to the ground it happens the more chance there is that we will stall in short of the runway.

"... rest of the flight resembles that of a manhole cover tossed out of a 10th floor window."

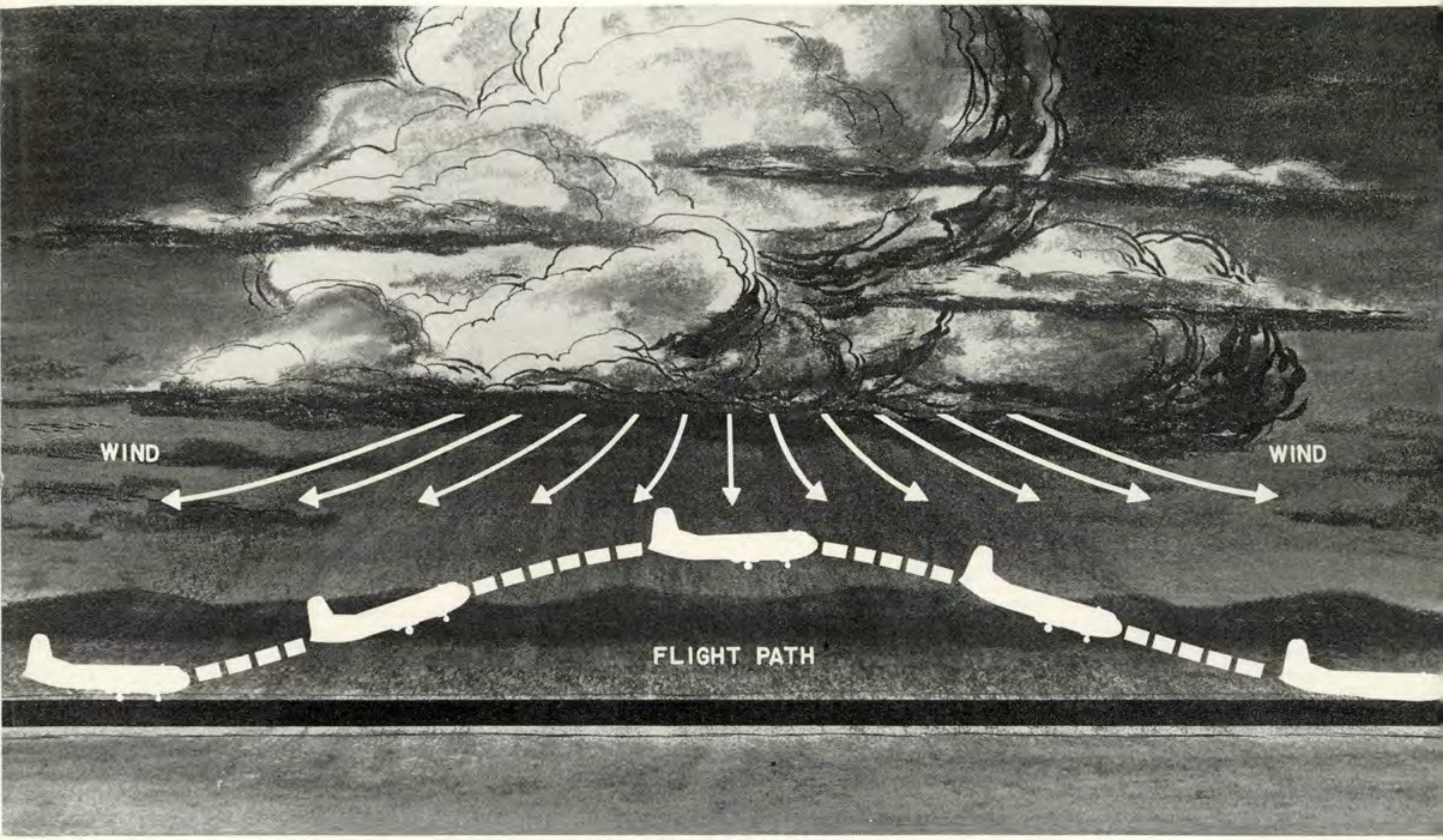


The Two-Edged Sword

This wind shear is a two-edged sword. It can put a good man down in the rocks at the far end of the field too if he's too proud to go around. Suppose our particular bird stalls at 100 knots so we've decided to fly our final approach at 115 knots. On this particular day there is no wind at traffic pattern altitude so we set up our turn onto final accordingly for the usual touchdown on the numbers. Since there is no wind at altitude, our speed over the ground and our airspeed are the same or 115 knots in this case. Just as we get down to the last 100 feet, we pass through a shear line and on the other side of it we find a 15-knot wind blowing right on the nose. Since for several seconds at least the bird keeps blundering along at the same old groundspeed of 115 knots, the 15 knots of wind on the nose adds to it and you find yourself with 130 knots of airspeed. This is pure bonus to the modern low drag airplane and it continues to fly way, way down the field before it gives up and touches down. A T-bird driver friend told me that an extra five knots airspeed over the boundary lights meant an extra 1000 feet of runway on a calm day. This may be a slight exaggeration, but in the absence of any conflicting story I'm inclined to believe him.

The situation begins to get even more binding when you consider the case of the bigger and hotter birds. With the bent wing 84s, 86s, B-47s and B-52s, and the planes to come, we are operating out of many fields where the runways are long enough but don't have a big margin for error. As a result, we are refining our landing techniques, slowing our approach speeds and shooting for a touchdown closer to the approach end of the runway. This leaves us wide open for the wind shear type of undershoot landing, although it's good medicine for the overshoot type.

This wind shear problem can cause a lot of consternation on takeoff too and that is where it is most apt to affect prop types as well as jets. Take for example a heavily loaded transport. Even with maximum takeoff power, it takes several seconds for the airspeed to build up to say, 25 knots above stalling. If you run through a shear line that decreases



"Don't take off or land into the teeth of an approaching thunderstorm if you have any choice."

your airspeed by 20 knots just as your wheels start up, you stand a good chance of settling back with a dull thud. The same thing can happen of course to any type of plane but the faster it accelerates through the critical speeds near stalling the less chance you have of getting in trouble with wind shear on takeoff. That's why the fighter types should have less worry on this score than the heavy transport and bomber jockeys, if you don't pull the fighter off before it's ready to fly.

Where to Find It

If you are convinced that wind shear can put you in an uncomfortable spot, here are some pointers on where and when to look for it.

In the first place, wherever there is a temperature inversion you nearly always have some shear. Since inversions form almost every clear night, near the ground it stands to reason that the late night and early morning hours are a good time to be extra wary. These nighttime inversions can develop within a short time, and a wind shear of 10 to 20 knots within 100-200 feet of the ground can be expected. Semi-permanent inversions stick around places like the southern California coast, Spain and northwest Africa caused by the California and Azores high pressure areas, respectively. Those inversions are generally higher than normal traffic pattern altitude though and so don't often cause a shear problem.

The inversion caused by the Great Plains high is sometimes low enough to cause a traffic pattern wind shear problem anywhere from the Appalachians to the Rockies. However, it is along its western edge where it pushes up to the foot of the Rockies that you can find one of the most startling and perhaps dangerous displays of wind shear.

In a 50 to 150-mile wide belt in the flatlands east of the Rocky Mountains extending all the way from Ladd AFB, Alaska, to El Paso, Texas, blows the famed Chinook wind. Shear-wise, the Chinook causes its trouble when it is trying to move in, and the effect is most pronounced when there is a cold high pressure cell spread out over the plains and pushing up against the foot of the Rockies. What happens is this. The warm, dry Chinook wind comes booming down over the Continental Divide from the west toward Ladd or Malmstrom or Amarillo, where a layer of cold air is covering the area like a tent. The Chinook, being warm, naturally slides over the top of the cold air and right there you have a very respectable shear surface established. As it continues to blow, gradually pushing the cold air back, the inversion (shear line) works its way down toward the surface. Eventually at pattern altitudes and lower you find a westerly wind of as much as 40 knots, while at the surface the wind is nearly calm.

If you happen to make a landing about the time the inversion has worked itself down to within a hundred feet or so of the ground, you can see that you might well be in for some excitement.

Another wind shear situation exists when there is a strong surface wind blowing. Moving rapidly over trees, rocks and buildings, the wind closest to the ground is slowed down so that from 25 to 50 feet above the surface and on up the wind is blowing faster than it is at the surface. This friction induced wind shear *always* tends to make you land short. However, its effect is usually small and since it is only present with fairly strong surface winds when you can afford to shoot for a spot 1000 feet or so down the runway, it is not a serious hazard, provided you remember that it does occur, and you should make allowance for it.

The one other major wind shear producer is the thunderstorm. Flying cross-country on a summer afternoon you've seen a cloud of dust marching along just ahead of the storm. When you are sitting on the ground you know how deathly calm it gets before a thunderstorm, then all at once the wind and rain hit. That's the thunderstorm's most severe shear line. About the only useful advice I can offer is "Don't take off or land into the teeth of an approaching thunderstorm if you have any choice." It's better to wait until the storm center passes over the field.

That's the general picture on what sort of situations produce wind shear lines and some of the reasons why this is becoming more of a problem than it has been before. Since it is a problem, it is important to be able to recognize a wind shear situation when you see one. (See Figure 1.)

How to Spot a Wind Shear Situation

1. Look for an inversion below traffic pattern altitude. Smoke rising in one direction for a few hundred feet, then suddenly turning and taking off in another direction above that, is a sure sign. Smoke from high stacks going in a different direction than that from short ones. (This is common in the case of the big stack near Malmstrom AFB.) A flat topped haze or smoke layer also indicates an inversion. This is usually the best way to spot one of the nighttime wind shear inversions.

2. When the wind at pattern altitude is obviously stronger than that reported by the tower, you have shear . . . so be on your guard.

3. When the tower reports strong surface winds, say over 30 knots, you are apt to have a significant amount of friction-induced shear in the lower 25 to 50 feet . . . so be prepared.

4. When you see a thunderstorm approaching the field, watch out for wind shear. It's certain to be there.

FIG. 1

How to Counteract Wind Shear

1. Landing:

• Make your final approach longer and flatter. (Be reasonable of course, don't drag it in for miles.) This enables you to carry more RPM, making full thrust available to you more quickly, should you need it, and just as important, with the lower rate of descent, you pass through the shear line slower. You then have more time to adjust your speed to compensate for the changed windspeed in the lower air mass, whether it is causing an over or undershoot.

• When the tower reports strong surface winds, in addition to your longer and flatter approach, plan to land a little long. With the strong wind, you will be able to stop in plenty of time even if you touch down a few hundred feet from the approach end.

• When the surface wind is strong and gusty, allow yourself a little extra margin of airspeed on the final.

2. Takeoff:

• Get plenty of airspeed before you pull up the gear. Accelerate to climb speed as rapidly as possible.

FIG. 2

What's Being Done About It?

Frankly, at the present time there is no practical way to measure wind shear above an airfield. Since we cannot measure it, it follows that the tower is unable to warn you of its existence when you call in for landing instructions. A wind shear situation can change almost as rapidly as ceiling and visibility. It follows that to be of much practical value, wind shear conditions would have to be measured at reasonable frequent intervals. Once an hour might be frequent enough but no technique we have available at the present seems to be practical for measurements that often. Various kite or captive balloon combinations have been considered but there are those among us, including myself, who would rather fly through a wind shear than a string of kites and balloons. There are undoubtedly other ways to measure the phenomena and perhaps one of you, the pilots who will have to become more and more concerned about the problem, has an idea that will work. If you do, let us hear from you.

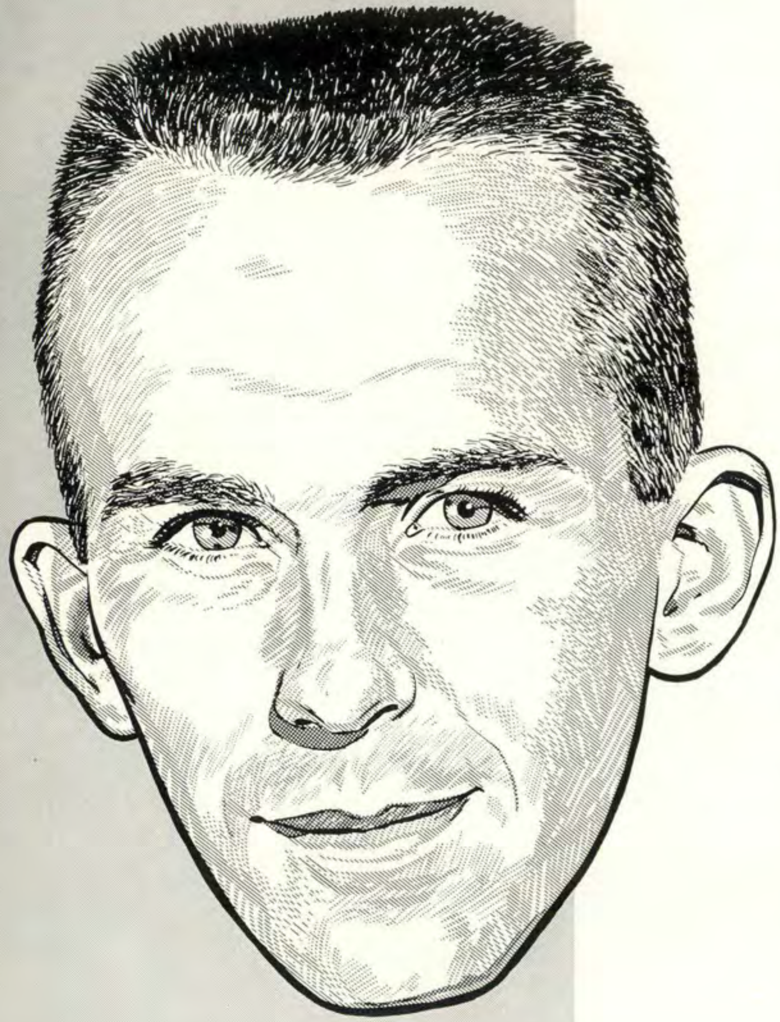
What Can You Do?

Meanwhile, now that you know how to recognize wind shear in its native habitat, you'll find that it can be handled in a fairly straight-forward manner if you spot it before it gets you in a spot.

By following the few simple rules (See Figure 2), you will practically eliminate the chance of your landing too short or too long, or goofing a takeoff because of wind shear. ●

Well Done

KNOWLEDGE TRAINING



CRUISING AT 23,000 feet on a local radar training mission, a muffled explosion rocked the F-86D. Severe vibrations followed and the aft fire warning light came on. Lt. Chester Payne took emergency measures immediately. However, the fire warning light remained illuminated and the aircraft continued to vibrate excessively. Lt. Payne stop-cocked the throttle and established a glide for Perrin AFB, Texas.

In the vicinity of Gainesville, it became evident that Lt. Payne would be unable to make Perrin, so a flameout pattern was set up for the Gainesville Municipal Airport. The longest runway available measured 4700 feet.

Setting up his pattern for this runway, Lt. Payne made a successful landing and the drag chute was deployed to minimize the landing roll.

Inspection of the aircraft revealed the turbine wheel had failed, releasing three blades, which were thrown through the aft section.

Lt. Payne displayed excellent judgment and superior skill, especially for a relatively inexperienced pilot, in safely landing the aircraft under such hazardous conditions. His decision to land the aircraft at an auxiliary airfield on such a short runway and his proper deployment of the drag chute prevented the loss of an aircraft. Well Done!

1st LIEUTENANT

Chester J. Payne

3558th Combat Crew Training Squadron
Perrin AFB, Texas

Obese, stout, portly, fleshy, chubby, bulky, well-fed, well-rounded, large-size, corpulent, heavy and husky. Still they say . . .

Everyone Loves

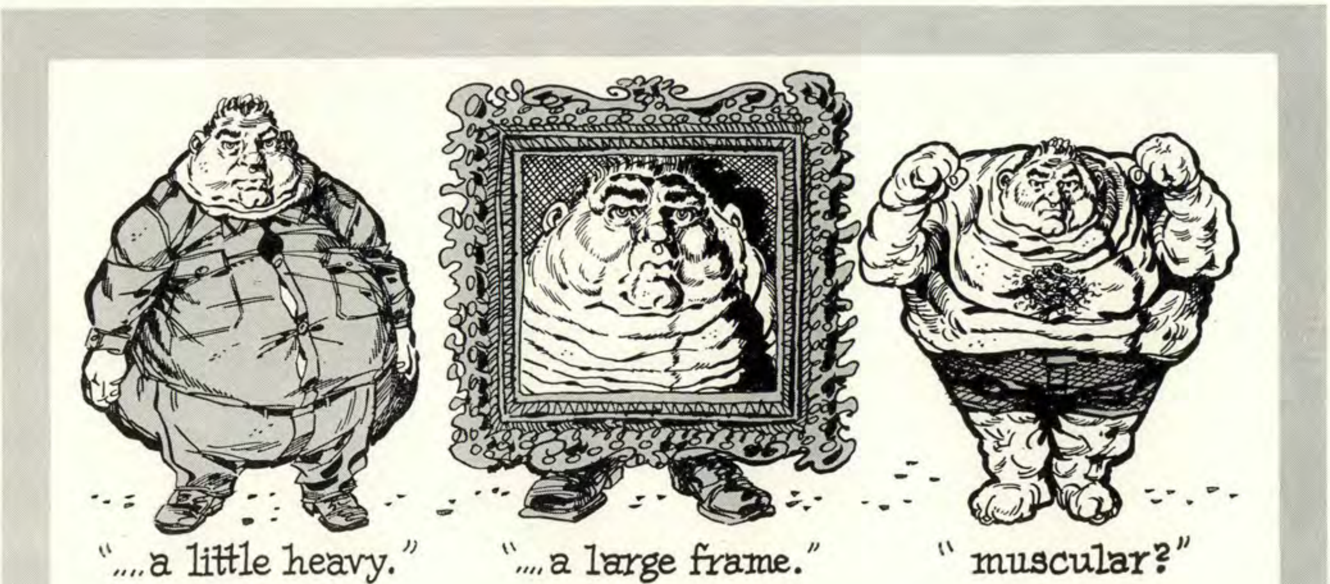
Lt. Col. Harold V. Ellingson (MC)
Deputy Surgeon, Alaskan Air Command

IT'S HARD TO GET a man to admit that he's really fat. Generally, he prefers to think of himself as a little heavy, large framed or muscular. To admit being fat is to admit failure, to acknowledge that you're on the decline—on a highway marked by declining vigor, declining resistance to disease, declining appeal (and declining usefulness) to the female and declining longevity. Many of the ills laid at the door of advancing age actually should be blamed on obesity. Being fat, moreover, has some special hazards for flying personnel in the Air Force.

It is true that good nutrition is essential to good health. And, unfortunately, the public has come to consider a little plumpness as an indication of health. But actually, overweight, even a little, is a health hazard. The more you're overweight, the greater the hazard.

What are the special dangers of overweight for flyers? Fatty tissue is notoriously capable of dissolving nitrogen from the blood, and it is likely to release the nitrogen at high altitude in the wrong way. At best, gas released at altitude can cause bends. At worst, at high altitudes, and especially in case of sudden decompression, the freed bubbles of gas can push little particles of fat into the blood stream, where they can be car-

It's hard to get a man to admit that he's really fat. No matter what you call it, though, it's still fat.



a Fat Man?

ried to the heart or the brain and cause death.

Two cases of death following explosive decompression at 30,000 feet have been reported recently. Both of these individuals were obese. They were riding in Air Force jets as passengers for special, emergency reasons, without clearance from a flight surgeon. Both went into shock when the airplanes lost their pressurization at altitude. They were unconscious when the aircraft returned to the ground and both died within a few hours after being removed to hospitals. Though these individuals were passengers, the same hazards exist for pilots and other crewmembers who allow their weight to creep upward.

Aside from the special dangers to flyers, overweight carries many additional hazards to everyone, whether he flies or not. Obesity is one of the great and growing health problems of the United States. True enough, cancer is more in the limelight of the public press and has recently achieved the number two standing in the causes of death among our fellow citizens. But obesity does its dirty work under other names, by making other diseases more dangerous or more highly fatal. Let's look at some of the other diseases on the team of killers and see how they are aided by fatness.

Take heart disease, the number one cause of death in the United States. A man's prospects of being struck down by a heart attack are enormously increased by obesity. Even if you're only 10 per cent over the ideal weight, your chances of having a fatal heart attack are 50 per cent greater than if your weight is normal.

Take brain hemorrhage or stroke, which is the number three cause of death in the United States. A man is 57 per cent more vulnerable to a stroke if he's overweight than if he is at his normal weight.

Take kidney disease, which is also high on the list of causes of death. Overweight brings a 72 per cent increase in vulnerability.

Take diabetes. Here, obesity causes

The old treadmill can't match this intake.

a 156 per cent increase in mortality!

Even suicide, farther down the list, shows a similar effect of obesity. The fat man is 29 per cent more likely to take his own life than is one of normal weight.

What do these statistics mean to you, in practical, personal facts? Just this: If you allow yourself to become overweight, you are voluntarily cutting from 5 to 20 years off your life expectancy. You are advancing the day when your widow must take care of the children on the proceeds of a couple of insurance policies that looked generous at the time you took them out, but on account of inflation have become pitifully small. Or, maybe she'll be able to marry a leaner, more vigorous man.

These are some reasons behind the Air Force policy on obesity, as outlined in paragraph 19e, AFM 160-1, (revised 15 December 1953). To quote from this publication: "In flying personnel, weight in excess of the maximum may be considered cause for suspension from flying duty until corrected." By barring flying status or preventing promotion, overweight can really hit us where it hurts the most—in the pocketbook.

What can be done about overweight? The best thing of all is adequate prevention.

A few lucky souls can eat like horses all their lives and remain trim. For the rest of us, there comes an age, between 24 and 40 years, when it suddenly becomes very easy to put on excess weight. You can usually detect this yourself, with occasional weighings, and *then* is the time to cut down on your intake. Eliminate between-meal snacks and foods rich in calories. Beware especially of cocktail parties! At a cocktail buffet, one can easily stow away enough calories to cover his needs for two or three days. A serious and determined drinker can do even worse, for alcohol is an especially rich source of calories.

Once prevention has failed and you've become attached to your fat, removal is a long and painful process. The usefulness of exercise in control of weight is greatly over-rated. The only practical way to eliminate fat is to reduce the intake of food. Once down to a proper weight, you must watch your diet indefinitely, or you will regain the weight.

An "informal" diet, simple avoidance of over-eating, will often suffice to reduce your weight. If not, you should get a definite and well-planned diet from your flight surgeon. He may, if it is desirable in your case, be able to give medications which will help in the initial phases of the diet. But the most important qualities for a successful diet are self-discipline and self-denial. Once you've been fat, you must exercise self-control in eating and drinking for the rest of your life. If you allow yourself to remain obese, you are endangering your health, your career and your very life! ●

Overweight can really hit us where it hurts the most—in the pocketbook.

Low Blow

Captain Joseph P. Davies, Jr.
Aero Medical Safety Div., D/FSR

HOW LOW CAN I eject and still make it? At 500, 800, 1000, 3000 feet? Of course, there's no pat answer to that question. It depends too much on variables such as aircraft attitude and speed, whether your lap belt and parachute are fully automatic and connected and, of course, on you, yourself. By this we mean how sharp are you on low altitude ejection procedures, and, if you don't have fully automatic equipment, how long does it take you to get into action after the initial ejection jolt?

The records show that with only manual equipment, and when your aircraft is in a straight and level or climbing attitude, it is best to have at least 2000 feet. On the other hand, with fully automatic equipment you should expect a successful ejection escape in these attitudes at 500 feet; but, of course, in a high-speed dive you should have several thousand feet between you and the ground, regardless of the type of egress equipment you have.

Once in a while though, an individual will complete a successful ejection escape at a very low altitude even without an automatic lap belt and parachute. Without fail these men have been as sharp as a tack on their low altitude procedures and able to get their bodies into action immediately after the initial ejection jolt.

Such was the recent case with 1st Lt. Ed Mastay, near Naha, Okinawa. There he was—not at 30,000 feet, flat on his back, but riding a flameout at 600 feet in a heavy rainstorm at 110 knots IAS. And his emergency procedures had just failed to get a relight. The time he spent debating whether to eject couldn't be measured on the finest chronometer. In fact within four or five seconds he had completed his ejection procedures and his parachute was in the process of opening! And open it did—with room to spare at an estimated altitude of 200 to 300 feet. He landed in the ocean with half of his Mae West already inflated. Subsequently, he completed his water survival procedures and was picked up by a local fishing vessel. Only minor injuries were received in the nature of neck burns from the parachute shroud lines.

Why was Lt. Mastay able to make a successful ejection escape at this altitude? Of course, his plane was under control and in level flight. But the list of unsuccessful ejections under just as favorable conditions and at altitudes no lower is too long. . . . "He had pulled the ripcord but was still strapped to the seat." . . . "The ripcord had been pulled, but he was just beginning to separate from the seat."

The key to Lt. Mastay's success was practice; the procedures were repeated until they became second nature and could be automatically set in motion by just such an emergency as he experienced. In fact, his ejection report ended with the following statements: "My ejection procedures were exactly the way I had practiced them in the event of a low-level bailout. I think that was the primary reason for the bailout being successful." He stated too that the F-86D simulator was used extensively for this ejection practice.

Well, let's take a look at Lt. Mastay's procedures. Here's what he did:

- Jettisoned the canopy.
- Disconnected his oxygen hose and *manual type* lap belt.
- Put his left hand over the parachute D ring.
- Positioned himself in the seat and ejected.
- Pulled the D ring with *both* hands.
- Inflated half of his Mae West on the way down.
- Went through further water survival procedures after landing in the ocean.

Of course, this procedure could be made shorter (for instance by leaving the oxygen hose connected). However, if position in the seat can be maintained, unfastening the *manual* type lap belt prior to ejection is an absolute must at low altitudes. This is the most important part of the low altitude procedure with manual equipment and one that had been discussed thoroughly in this pilot's organization by everybody.

So, it is possible to win at Low Ball even without automatic equipment. And practice may well spell the difference between the best and second best hands.

However, this article is not by any means meant to suggest departure from present recommended minimum ejection altitudes. It is intended to show the value of knowledge and lots of practice.

Here are the procedures:

Recommended minimum ejection altitudes from aircraft in level or climbing attitudes:

- With manually operated lap belt and parachute—2000 feet.
- With automatic opening lap belt or manual type lap belt unfastened prior to ejection and manual parachute—1000 feet.
- With automatic opening lap belt and automatic opening parachute properly connected—500 feet.

From aircraft in high-speed dives, ejections should be initiated from several thousand feet and if possible, before descending below indicated 10,000 feet above the ground.

If position in the seat can be maintained, the manual type lap belt should be unfastened prior to ejections below:

- 2000 feet if aircraft is level or climbing.
- 5000 feet or more if aircraft is in a steep dive.

Even though you have fully automatic equipment, at low altitudes the parachute D ring (*not the timer knob*) should be pulled as quickly as is humanly possible.

If at all possible, get your aircraft in a climb or level attitude. At very low altitudes your chances are considerably better in level flight and infinitely better in a climb as compared to a dive. ●

taking the IF out of LIFT

EVERY AIR-MINDED schoolboy knows what *lift* is—the mysterious force that keeps a plane in the air. Aeronautical engineers also know lift; it's no mystery to them. They design a calculated amount of it into every aircraft they build.

Now the fly-boy who is expected to get that plane from here to there and back also knows that "calculated amount of lift." He does, that is, if he has a slide rule mind—puts in the flight manual numbers, corrects for angle of attack, determines gross load, power effects, G forces, gusts and gets a safe airspeed — under emergency conditions. It looks like the fly-boy must be a wonder boy.

Haven't we gotten awfully close to the woods? You bet we have. Let us consider for a moment: Over 50 years ago the Wright Brothers accomplished sustained flight for 12 seconds. Ever since then we have been straining to fly faster, farther, higher—and with greater ease. Of course, it's easier! Look at the instruments we give the pilot, a cockpit full of them. Look again. Do you see any fundamentally new instruments? Of course you don't. To really help the pilot we must think and design in terms of new measurements, new intelligence. And this doesn't mean a reshuffling or regrouping of the six flight instruments now classified as "basic."

Experience and logic dictate that we are long overdue for "lift instrumentation." Let's give the pilot an indication of the very force that keeps him airborne. Why not show him at a glance, without computation, without lag, the speed he must fly to obtain the desired performance from his wing. Let's take the "if" out of "lift."

Beginning ten years ago the aerodynamicists and engineers of the Safe Flight Instrument Corporation, White Plains, New York, initiated a research program to do just that—to take the "if" out of "lift." The result is an instrument named Speed Control, installations of which have been flight tested in all types of aircraft. Experienced airmen are amazed at the stable, precise, slow-speed performance of their aircraft when flying this instrument. One such experience is related in the May 1955 issue of FLYING SAFETY in a flight report entitled "Rugged But Right," on the new C-123B. This aircraft was equipped with Speed Control, the instrument referred to in the article as the Landing Speed Indicator.

Single Pointer

The system behind Speed Control sets up some new parameters for lift, and in a very simple manner resolves a complex set of variables. The indication is easy to fly; a single, center-reading, pointer type of instrument is all that appears in the cockpit. And a note to the weight and balance boys: Typical installations weigh only two to six pounds!

Why is this instrument so important? For the first time a pilot can tell directly what his wing is doing for him during approaches, landings, takeoffs and holding procedures. Mental gymnastics are passé. The pilot simply flys the pointer at center, and at the desired angle of attack. If the aircraft is being flown too slowly, the needle moves to SLOW; if too fast, the needle moves to FAST. It's as simple as that. Speed Control presents this information instantaneously and continuously.

This new, fundamental instrument has specific uses, particularly when the pilot needs help the most. For instance: *Routine Approaches* — Every routine landing approach can be a precision maneuver. On the final approach, fly the Speed Control to keep the pointer centered. Every factor affecting the wing is being measured, every configuration taken into account: flap position, power condition, gross weight, angle of bank, longitudinal accelerations and density altitude conditions.

Flight path descent is steady and sure, permitting the pilot to "boresight" a spot on the runway and more accurately predict his touchdown point. Flying throughout the approach at a controlled approach speed means that the over-the-fence speed will be correct and uniform, every time. The result will be standardized approach techniques for all types of aircraft and all skill-levels of pilots.

The transitioning pilot will benefit particularly from Speed Control measurement. Even for the student pilot, undershoots and overshoots should become obsolete.

Instrument Approaches — The importance of correct speed during the final stages of the instrument approach is obvious. Flying the Speed Control pointer to center assures safe lift at lower speeds, permitting more accurate centerline and glide path bracketing. The precision flying required to follow the ground operator's instructions, especially the final controller, is more easily and confidently attained by its use.

Landings—Landing on Speed Control brings the airplane over-the-fence at a fixed glide angle every time and eliminates excessive touchdown speeds. In the case of flameouts in jet aircraft, the very narrow range of

Left, shows how easy the indicator is to read. Above, if the aircraft is being flown too slowly, the needle moves to SLOW; if too fast, the needle moves to FAST. Below, throughout engine emergency procedure, the pointer instantly moves toward the SLOW side, showing loss of lift.

acceptable approach speeds for this condition can be continuously indicated by Speed Control, providing invaluable information throughout the entire approach.

Emergency Engine-out Condition—Every pilot knows the necessity for split second timing when an engine-out emergency occurs, particularly during takeoff. At that point you've only one instrument of paramount importance and that's the airspeed indicator. When one mill goes, you firewall everything and hope for single-engine or engine-out speed, depending on the type of aircraft.

There's a goodly number of accidents on record that could have been prevented, had the pilot been able to refer to an accurate indication of airspeed or change in airspeed. Such an indication would have guided the pilot through the continuous and smooth elevator control required for transition to the best engine-out climb speed for safe flight.

Unfortunately, the airspeed indicator responds to airplane attitude with considerable lag. This is not the case when flying Speed Control.

Power Loss Indicated

Immediately upon *any form of power loss* the pointer instantly moves toward the SLOW side, showing a loss of thrust and warning that the attitude must be adjusted immediately. However, now instead of guessing, the pilot can lower the nose to instantly keep the pointer centered throughout the transition.

Simply, it boils down to this: After losing an engine, the pilot can change the pitch attitude of the aircraft enough to center the Speed Control needle. Throughout the emergency, he will be assured that the desired angle of attack is being produced for the available power.

In the beginning, Safe Flight Instrument Corporation engineers reasoned like this: On the leading edge of an airfoil in motion is a definite stagnation point where the air divides to flow over the top and bottom surfaces of the wing. The position of this stagnation point shifts with changing angles of attack. Therefore, the relative position of this stagnation point as it moves along the outside contour of the airfoil should be an indication of the pressure pattern on the surfaces of the airfoil for that particular angle of attack. Calculations and tests proved this to be true, and that, aerodynamically, this pressure pattern is a function of the wing angle of attack to provide lift.

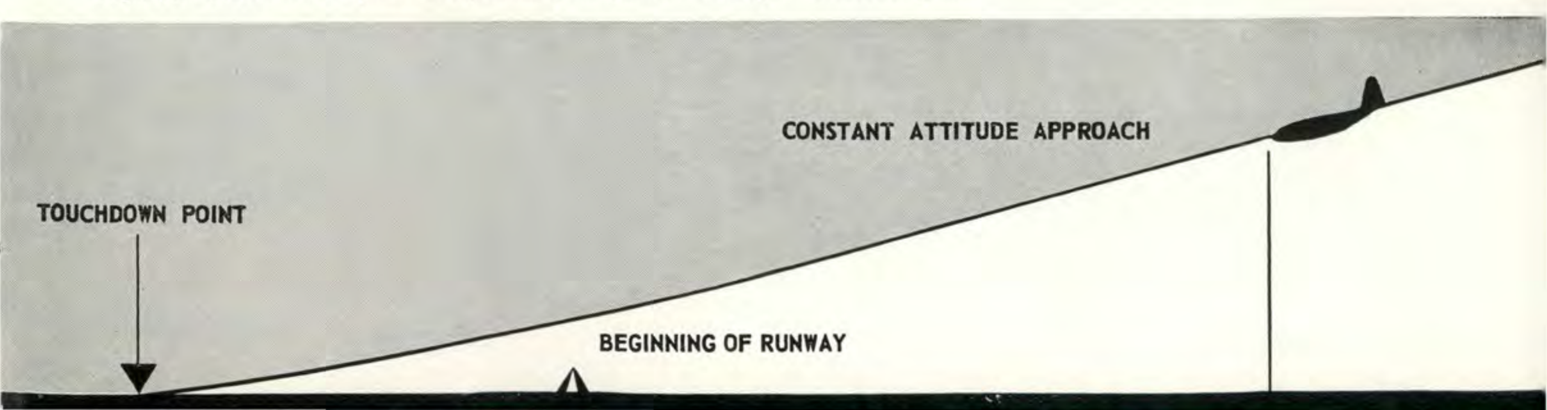
Then came the years of developing the instrumentation to produce stall warning devices. And out of this developed the complete Speed Control system embodying sensing, computation and indication.

Four Components

The system in operation is composed basically of four components: A lift transducer, a flap potentiometer, a lift computer and a Speed Control indicator. The control column shaker is optional. It can be installed to produce movement of the column, simulating control buffeting at or near stall speeds, thus serving as a stall warning for aircraft which do not normally exhibit this aerodynamic flight characteristic.

The type of measurement made by

Flight path descent is steady and sure, permitting the pilot to "boresight" touchdown point.



SPEED CONTROL MEANS SAFE CONTROL

Type of Incident	Cause	CORRECTION WITH SPEED CONTROL
Undershoot	1. Loss of lift. 2. Too far on back side of horsepower required curve. (See Page 26, "Flying Safety," October, 1955.)	1. Provides indication of all factors effecting lift in addition to airspeed. 2. Will prevent getting into this area by showing trend—and without momentum lag.
Overshoot	1. Excessive speed. 2. Touchdown too deep.	1. Provides a demand type reading that shows only one right way. 2. Indication of uniform lift makes prediction of touchdown point possible.
Final Approach Stall	1. Bank at too slow speed. 2. Gross weight error. 3. Difficulty in deciding rate and trend information from airspeed indicator. 4. Power off too soon. 5. Excessive G.	Senses all factors contributing to stall, including improper attitude. (Warning to overcome inattention can be provided by control column shaker.)
Takeoff Stall	1. Insufficient takeoff climb. 2. Loss of control or altitude after engine failure.	1. Speed control keeps speed at proper value for best takeoff climb. 2. Warns immediately of any power loss and that attitude must be adjusted.

this system has no precedent. It is therefore easily misinterpreted and misunderstood. The fact that it is so simple and yet accounts for so many variables in the lift equation, leads to further apprehension, until its functioning is fully comprehended. Simply stated, although there is much more for digestion by the aerodynamicist, the system functions something like this:

The lift transducer is mounted in the underside of the leading edge of the wing. The small vane of the transducer protrudes through the skin of the wing where it can be displaced by the changing wing pressure patterns. Displacement of the vane originates an electrical signal which is applied to the lift computer, comprising a circuit which is entirely electrical in design, with no electronic complications.

In the computer, the original transducer signal is corrected in accordance with the position of the flap potentiometer shaft which is mechanically actuated by the wing flap system. A longitudinal accelerometer signal, directly related to the resultant of the power-drag condition of the airplane, is added to the corrected signal. The integrated signal, representing the various factors affecting lift, is simply presented on the single pointer of the Speed Control indicator in the cockpit.

Flying the Speed Control pointer means flying a fixed lift ratio. The indication is lag free, sending immediately transient lift factors that are instantaneous in nature. In brief, Speed Control actually measures the angle of attack and fore and aft acceleration forces acting on an aircraft.

Flying critical-performance aircraft at slow speeds is assumed to be routine for the military pilot. And yet, approximately 45 per cent of all USAF accidents in 1955 occurred during landing approaches and 10 per cent during takeoffs — during times when the pilot is forced to rely on the airspeed indicator as an index to minimum safe lift. We're reading something into airspeed that this indicator can not show, directly, that is. For instance:

Many Factors Involved

As a lift index, airspeed is helpful only when used in formulas with known factors such as exact gross weight, flap effects and power effects. And even then the answer may be very nebulous.

And another thing: Pilots often talk about the "lag" of the airspeed indicator. Actually, the instrument is not so bad in this respect. It must be remembered that the ASI is measuring a rate (velocity) in miles per hour or knots. That is all it is intended to indicate. However, during transient flight conditions requiring change of attitude or configuration, the pilot instinctively looks to the airspeed because he has no other indication of rate of change. This intelligence the airspeed indicator can not supply. It is not an acceleration instrument. Therefore, during critical flight conditions when the pilot scrutinizes the airspeed for trend information and doesn't get it, or it seems delayed in coming, he blames the lag.

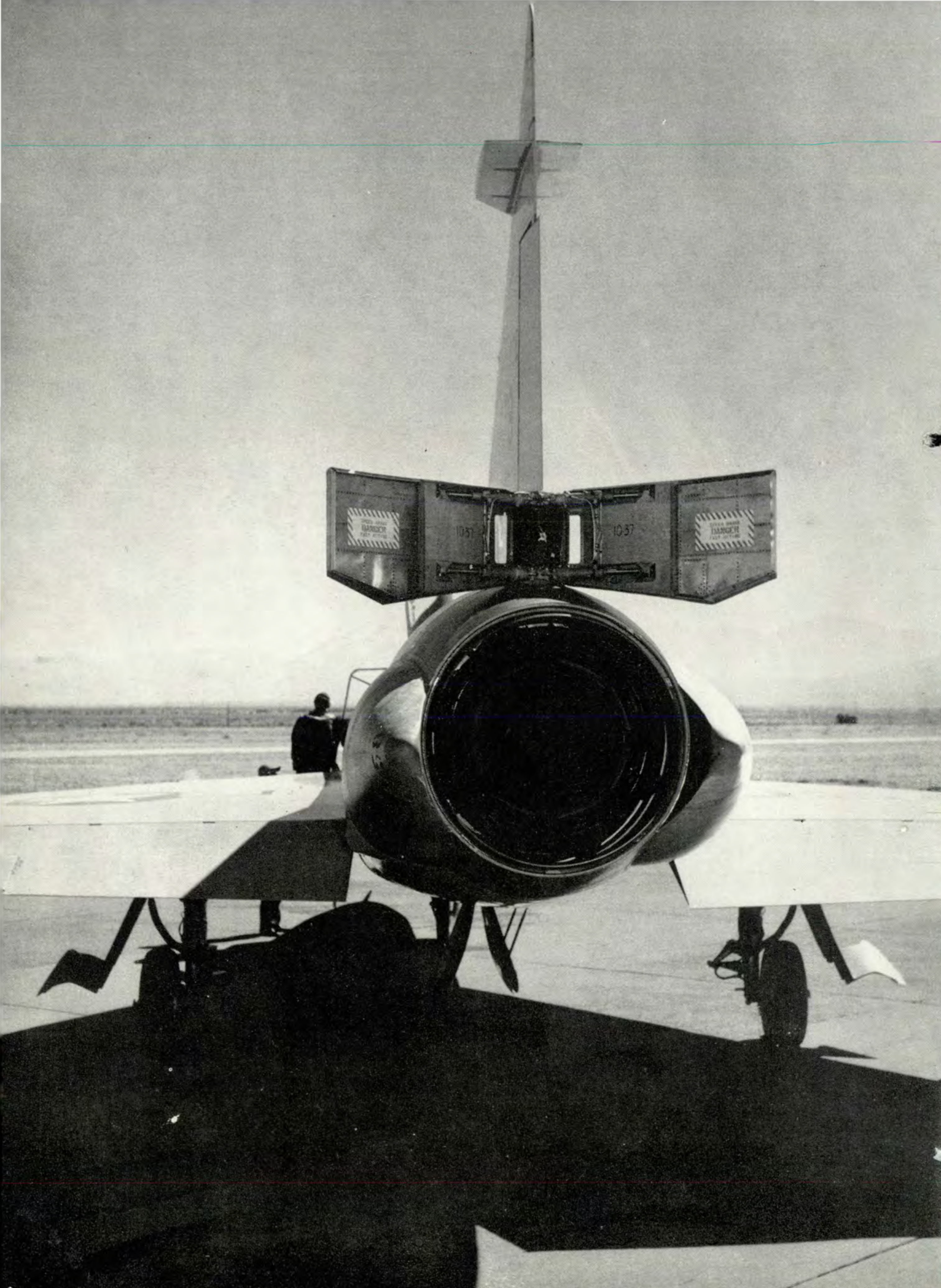
The assault transport pilot who is about to execute a maximum performance landing, or any pilot for that matter, shouldn't have to formulate variables, look for rates that aren't there, or worry about lag.

Analyze the chart titled "Speed Control Means Safe Control." Here is an instrument that provides a positive, non-lagging, speed indication, assuring angles of attack which are below the stall. ●

One more won't hurt

•

For this impish moppet, maybe yes, maybe no. For the rest of us, there comes an age, between 24 and 40 years, when it suddenly becomes very easy to put on excess weight. "Everyone Loves a Fat Man?" on page 22 treats this problem of overweight in a light yet serious manner.



*U. S. GOVERNMENT PRINTING OFFICE . . . 362333