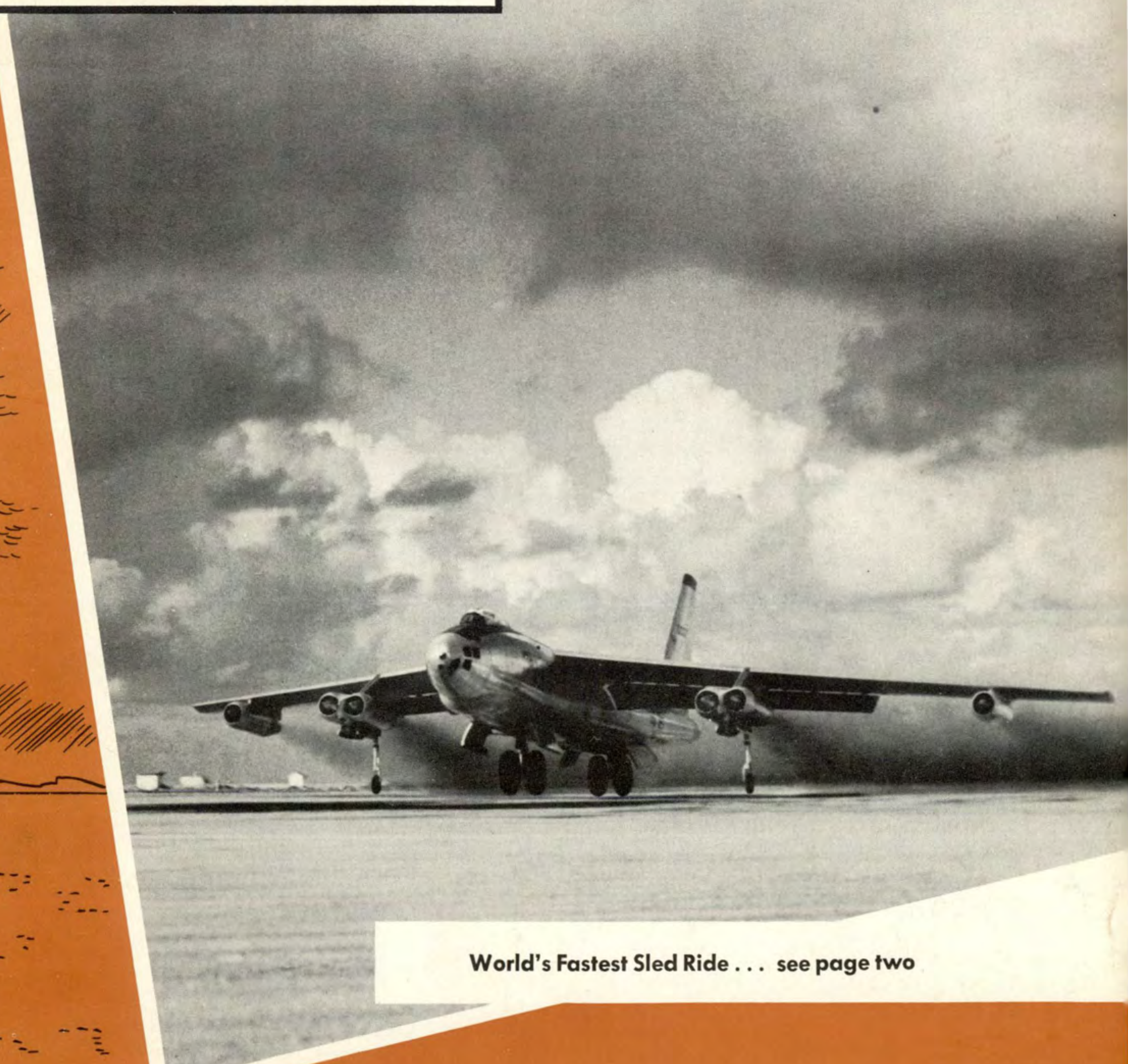
JUNE 1954

FLYING SAFETY

UNITED STATES AIR FORCE



World's Fastest Sled Ride . . . see page two

FLYING SAFETY

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SUBSCRIPTIONS

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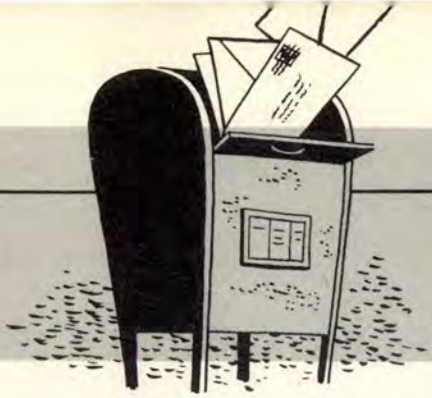


CROSS FEED

LETTERS TO THE EDITOR

Fitting Your Chute

The article "If the Chute Fits" appearing in the March 1954 issue of FLYING SAFETY has been reviewed by this Center. Following are quotations from the article with applicable comments:

• "Put the harness on. Fasten the chest and leg straps. Tighten the leg straps in back." (Step "C" in fitting your Class III harness.)

NOTE: The sentence "Tighten the leg straps in back" confuses the reader since there are no leg straps in back. Assuming this to be an error in proof reading, the omission of the words "in back" would make the sentence appropriate to the recommended procedure. However, omission of the word "leg" would lead the reader to a highly undesirable procedure.

• "Reset index number and re-tighten back strap." (Last sentence in Step "D" in fitting harness.)

NOTE: Here the reader is led to tightening the back straps prior to Step "F" which tightens the leg straps. This results in malpositioning of the mainsling.

• It is recommended that the "Steps in Fitting Your Class III Harness" read as follows:

Prefit your harness to your sling length by setting to proper number. Set the index number by turning the quick-fit adapter on the sling 90 degrees to the webbing and pull until your number shows.

Height	*Index Number*
Up to 5′ 6″	7
5′ 6″ to 6′ 0″	6
Over 6′ 0″	5

• Tuck excess webbing into elastic keepers. Loosen back straps to insure that you will be able to get sling under buttocks.

• Put the harness on. Fasten the chest and leg straps.

• Slide chest strap up or down the sling to the proper distance below your chin. (12″ below chin.)

• Tighten leg straps by pulling down on loose ends.

• Adjust and tighten chest straps.

• Tighten back straps.

After fitting, loosen leg and chest straps by merely turning the quick-fit hardware 90 degrees and pulling gently, making yourself comfortable. Tightening again requires only a few seconds.

The Class III harness will fit men 5′ 2″ and 110 pounds, to men 6′ 4″ and 240 pounds, wearing heavy Arctic clothing.

Canopy release should be below collarbone. If it is any place else, your harness is not adjusted properly. Loosen back strap again. Reset index number and re-tighten back strap.

Parachute Branch, Equipment Lab
Wright Air Development Center

Thanks for your letter of explanation. Such clarity is appreciated. FLYING SAFETY trusts the revised T.O. will be as clear.

★ ★ ★

Letter to Steve

For some time now I have admired your work in FLYING SAFETY.

Congratulations on doing a superior job!

Cordially,
Milton Caniff
New City, Rockland Co
New York

P.S. Why don't you sign your full name — Steve Hotch — and more readably?

★ ★ ★

More On Foamite

"Captain E. J. Slown of the 61st Fighter Interceptor Squadron, APO 864, was on a local flight in a T-33 type aircraft, when on takeoff the nose gear selsyn indicator showed an unsafe condition. A low approach was made past the tower and the pilot was advised that the nose gear doors were open. Lt. Col. Max Wolfson, Commander of the 61st, upon returning from a mission accomplished a fly by and verified this information.

It was also determined at this time that the nose gear was cocked at approximately a 10-degree angle. An emergency was declared and the pilot elected to make a landing. Coordination was effected with Base Operations and the Crash Fire Department. Foamite was spread approximately six feet wide on the landing runway. A long final was flown aligning the aircraft with the foamite on the runway in order that the nosewheel would touch down upon the slick surface. Touchdown was made and the nosewheel held off until aircraft was over the foamite. Brakes were used to maintain directional control. The aircraft was brought to a complete stop, without damage. The pilot was commended by his Squadron Commander for his skill and ability."

Capt. Raymond G. Summy
FSO Base Ops Div
Ernest Harmon AFB, NEAC

★ ★ ★

LINK Speaks

I have just read the articles in the March issue of FLYING SAFETY, one showing our B-47 Simulator and the other an article entitled, "Old Link, New Look," by Sgts. Wood and Hickman of Edwards AFB, Calif. Needless to say, they are of interest to us and appear to be very well done.

I wonder if it would be possible for us to receive an additional copy or two from your organization. I note that back copies are not available from the Government Printing Office.

Lloyd L. Kelly, Gen. Sales Mgr.
LINK Av'n, Inc., Binghamton, N.Y.

Sgts. Wood and Hickman rate the kudos; mags are on the way.

Final adjustments to safety harness are made prior to record run.

WHOOOOOSSH!

YOU don't have much time to think. Never thought it would happen to you. Doesn't seem real, even now. Hurry, hurry! Hey, take it easy, boy. Let's see. Oh yeah, get that mike and oxygen line off. Okay, everything is ready. Squeeze it!

There's a rushing, roaring sound. You can almost see the noise as a million fingers pluck at your body. Dammit. You forgot the visor. Better step it up, lad. Come on get with it. Then you clamp down on the right trigger. Your tailbone slaps the cushion. Ka-whoom! You can't see 'em but you can feel your legs driven down and then up! All of a sudden you're a projectile. Up, up, up and over, and away.

The next couple seconds are still hazy. Who knows up from down? This is funny though. You can feel the tumbling gyrations and then all the forces are gone and you are floating. Now it's almost quiet. Aw, this whole thing is screwy. There's the ground over your head. Or, it was anyway. What is this, a game? Hey! The belt. Get it off. Open it, open it. Come on, kick away from that seat, do it right now!

You squirm and elbow away. Hurry, hurry, hurry. The ground is coming. Grab the ring. There it is—now, pull! There's another neck-snapping jolt. Your body does a 180 in a split second and the right riser whaps your helmet. You wonder how it stayed on anyway. The second jolt is worse. It hurts this time. Quick, slashing pain that tears your guts. Okay, smarty, now you know why they say, "keep those leg straps tight." Well, it's too late for this round but if you ever get a second chance, that harness is *really* going to fit.

It's routine now. You watch some trees jumping toward you and then there's that one last whapp! and you're down. No future in this racket, you think. Maybe it's okay but why play it like a sucker? Who-e-e-e! You let your breath out and stretch out flat. That was just too close.

Maybe that won't be your impression of a high-speed bailout. Possibly you will have figured all of the angles in advance. Maybe it will be worse than that. After all, when the old Mach meter is sitting on the plus side, *anything* can happen. After all, who knows?

Well, there's one small group of individuals within the Air Force who know pretty well what will happen during a high-speed ejection. It's true that all of the answers are not completely firm, yet, but soon they will be.

Col. Stapp starts on the fastest ride that man has ever taken while still on the ground, propelled by six rockets generating 27,000 pounds of thrust.

A small group of scientists at Holloman AFB are using a rocket sled to determine tolerances to deceleration, windblast and tumbling, following a high speed ejection.

Ever since the advent of jet aircraft, men have wondered about their batting average during a high-speed bailout. Three hundred, four hundred, five hundred miles an hour. Speeds have increased and proportionately so have survival problems. The ejection seat was the first answer and later, capsules and allied double-whammy cases to contain the hapless individual were designed by our scientific thinkers. In the final analysis, however, the jet pilot has often wondered (and sweated a bit) if his body could stand the shock of sudden ejection, the tumbling and at the same time, the rapid deceleration that accompanies a hot-seat ride sans jet airplane.

The Air Research and Development Command scientists engaged in human factors experiments also have been dubious as to whether a human with no protective equipment could survive a high-speed (Mach 1.0 or greater) bailout. Now, recent events have resolved some of these doubts.

The individual who has done most to explore these unknowns is an average-size, quiet, studious-appearing man who closely resembles the popular conception of a college professor, which he was. Lt. Colonel John P. Stapp, the 44-year-old ex-college professor, has a Ph.D. degree in Biophysics, Bacteriology and Physics and an M.D. degree from the University of Minnesota.

However, Lt. Col. Stapp is one scientist who combines action with his scientific theories. As Chief of the Aero Medical Field Laboratory, Holloman AFB, he selected himself as a guinea pig to make the first human run on the world's fastest land vehicle—the new supersonic rocket sled. This sled has many functions. At present it is being used in a series of experiments to determine tolerance to deceleration, windblast and tumbling which are incurred simultaneously during escape from very high speed aircraft at high altitudes.

A speed of 421 mph was reached on the run.

After the initial tests using dummies proved successful, Stapp made his record breaking trip down the 3500-foot rails—attaining a top speed of 421 mph, faster than man had ever traveled on the surface of the earth before. The truly amazing part of his feat is that he knew just about what to expect when he rode the sled as he had taken 26 previous trips down the tracks on a slower sled while stationed at Edwards AFB, California.

Planning for a human test run starts three months before the actual firing. Col. Stapp and his small coterie of working scientists, both military and civilian, write a complete outline of the test, designating the individual responsible for each step of preparation. At X minus three days, a prefiring conference is held to firm up the details and over-all plan and to be sure that each section and individual understands the designated responsibilities.

Special equipment includes sled mounted cameras, ground cameras for still and motion picture coverage, sled-mounted and ground telemetering units, SLERAN installations (speed measuring units), recorders and special electronic devices used to record the test results on graphs and curve charts.

Actually, the rocket propelled device consists of two sleds—the test vehicle and the propulsion vehicle. Speed is determined by the number of rockets fired at the start of the run. Col. Stapp used six rockets to attain his top speed of 421 mph but eventually expects to ride the sled propelled by 12 rockets, each providing 4500 pounds of thrust.

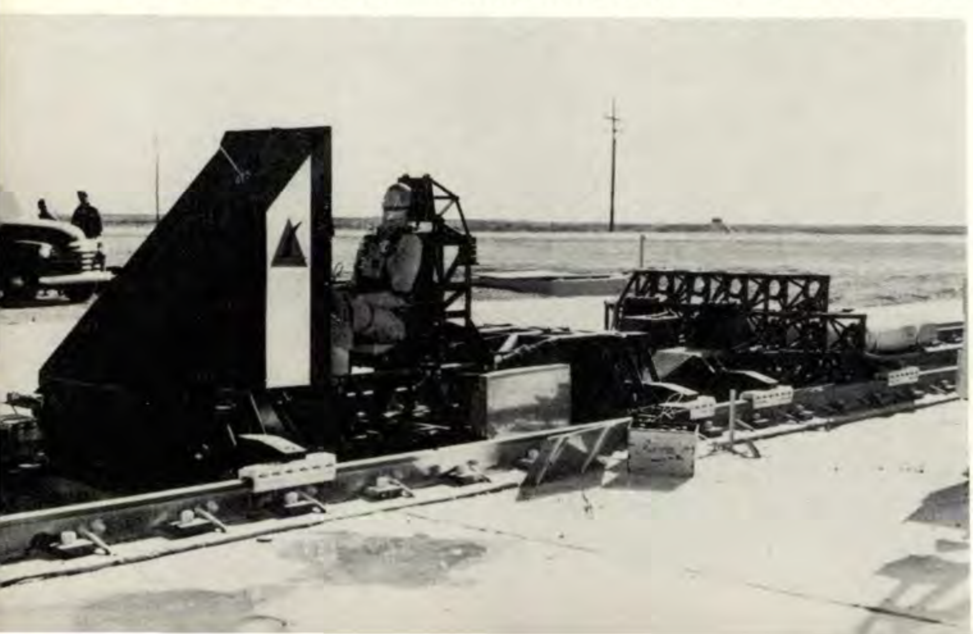
The 12 rockets will push the sled at 750 mph or approximately Mach 1.0 at the Holloman elevation of 4092 feet above sea level. Since these tests will be conducted in the relatively dense air encountered at this altitude they will simulate a bailout from an open seat at 40,000 feet at 1800 mph.

The propulsion vehicle, when fully loaded with rockets, weighs approximately 3500 pounds and is 84 inches wide and 90 inches long.The test sled which carries the human cargo, weighs about 2000 pounds, is 84 inches wide and 150 inches long and is designed to withstand up to 100G with a 50 per cent safety factor.

The braking system is unique in that it uses water to stop the sled instead of the mechanical brakes on the earlier models. A trough or ditch five feet wide and 18 inches deep extends the full length of the track. At any desired braking point, small masonite dams are inserted to inclose the water for the desired braking distance. Metal scoops extend beneath the propulsion vehicle and the test sled to scoop up water for the braking action. The scoops beneath the propulsion vehicle are deeper than those on the sled, hence it slows faster and permits the sled to separate from it and to travel ahead and stop individually. Forces generated by scooping up the water at high speeds provide a predictable and highly effective braking action and allow the desired G forces to be predetermined.

Following is the account of his record run, written by a man who in the not-too-distant future hopes to be tumbling head over heels at 750 mph while exposed to full windblast, Lt. Col. John P. Stapp, a guy with real guts.

After the initial tests using dummies proved successful, Stapp made his record-breaking run.



Small plastic dams hold the desired water level for braking action of high speed sled.

By Lt. Col. John P. Stapp

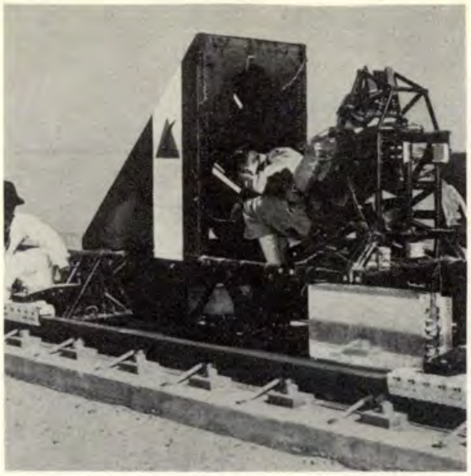
THE aircraft company ads picture needle-nosed ram jet jobs with wings like sweptback ears. They headline them as the "Fastest, Highest Flying Contribution of the Look-Mom-no-wings Aircraft Company to America's Air Supremacy." But, even the superlatives hardly do justice to their products. They are stuck with the simple truth because it would be too much work to think up anything more fantastic, and besides if an aircraft engineer tried to tell a whopper he might be breaking security on a rival company's latest model.

If you don't believe it, look at the progress of aviation in just 50 years —exponential, no less. Where will it end? Very likely with some chief test pilot going into outer space propelled by light beams and grumbling because the universe affords no faster source of power.

The design engineers save their real gripes, however, for one stubbornly unchanging item peeping forlornly from among the titanium rivets —Man, M-1, the same, yesterday, today and forever, fallible, vulnerable, incurably addicted to errors, and above all pathetically mortal.

Some time ago I was project engineer for a series of tests completed at Edwards Air Force Base, California. There it was experimentally demonstrated that the properly suspended human body can survive, uninjured, exposure to crash forces well beyond the material strength that can be built into an aircraft which can still get off the ground. It looked like a good place to rest the case but now it appears to have been only the beginning. I submit a paraphrase of the kind of talk that we are getting from

Technicians prepare the six rocket propulsion unit. Soon, 12 rockets will push sled 750 mph.



"Special equipment and devices are used to record test results on graphs, curve charts."

these insatiable design engineers: "Doc, we are working on a few of the bugs of our model—you probably know all about it, the super Rocket Zilch 1313.

"It goes to Thermal 2—we call it 1313 because any time you go through the Thermal Barrier twice, you've had it two times over. What Mach number? That's for squares still fooling with jets; we're already doing preliminary test on Thermal 3. Confidentially, doc, we've got problems.

"In going up to Thermal 2 or in coming back through it, we have accelerations for durations and magnitudes that you Aero Med people don't have any figures on yet. If we stay at Thermal 2 for very long, we expose the crew to temperatures that look like the thermometer on my wife's electric stove.

"You medics don't have any suits to keep them cool in that range. Doc, how about making up some kind of an asbestos suit and moving the seat on your rocket sled to a position just behind the rockets where you'll be sitting in the flames. I know you can't push a sled up to Thermal 2, but if you can decelerate at 50G for about 10 seconds I think that will simulate most of the factors."

That's no time to smile—you'll find yourself sitting in the back seat of Rocket Zilch 1313 without a canopy, and look who's laughing. Tell him it is impossible? Not on your life, or you'll be forever haunted with the specter of a dewey-eyed eager beaver taking off in the first RZ 1313, waving farewell as he shoots from view—without the asbestos suit.

I guess we'd better put in a long distance call to Johns-Manville and ask them if they have any 8-Ply asbestos cloth, ready for delivery by return air express. "And one more problem, doc. How is he going to bail out? Can we still use the open ejection seat or do we have to go to the ejection capsule?"

About that time I start thinking about the last resort—Titanium Halo M-1, to be adjusted during the last slow roll as the pilot passes through the pearly gates. Oh well, in my business you don't worry about your hat, you just try to hold onto your head.

Perhaps the foregoing is a slight exaggeration but the mission of the present program of research in Biodynamics (effects of mechanical force on living tissues) at Holloman Aero Medical Field Laboratory is directed to find the limits of human tolerance to decelerations, windblast and tumbling such as may be encountered in escape from very high performance aircraft.

These experiments are performed on a rocket sled which, in the maximum velocity configuration, operates at the equivalent of pushing a 2000-pound vehicle with 54,000 pounds of thrust.

The subject, strapped in a seat, can be exposed to linear decelerative forces equivalent to that experienced after abrupt exit from an aircraft flying at 1800 mph and at 40,000 feet. By abruptly opening large doors in the sled windshield, the loss of a canopy at maximum speed can be simulated and a bungee actuated seat, mounted on gimbals, can tumble the subject head over heels at 180 rpm or less during the application of deceleration and windblast.

The equipment has been delivered to Holloman ADC, and to date nine proof tests have been accomplished,

Right, a film strip sequence of Col. Stapp during his record-breaking trip down the tracks.

X plus one second

Start of acceleration

Peak of acceleration

Hitting the brakes

Near max deceleration

22G!

After 26 previous runs at speeds up to 150 mph, Stapp knew what to expect. He hopes to make a test run tumbling in the seat head over heels, exposed to full wind blasts at about Mach 1.

including two tests of the quick-opening windshield doors. We have not personally worked out on the tumbling seat, as yet.

The seventh proof test was a conservative trial to determine suitability of the equipment for human experiments. Project engineers always come first on such occasions, purely to improve the morale of the other subjects. This test was also to serve as a control on windblast tests by exposing the subject to all factors of the acceleration and deceleration that would be experienced except those of windblast.

Anyway, on the morning of the 19th of March at 0615, I had a cup of coffee and an orange and then drove from my house in Alamogordo, where I live alone and lump it. I carefully obeyed all traffic rules en route to my office at the Aero Med Field Lab at Holloman AFB. After signing a few papers and looking over the morning mail, I went to the lab room where Major Dave Simons, USAF (MC) is second in command at our shop. He's a Flight Surgeon whose Space Biology research is concerned with vertical rather than horizontal rockets. We went through all the steps required in the pre-run physical.

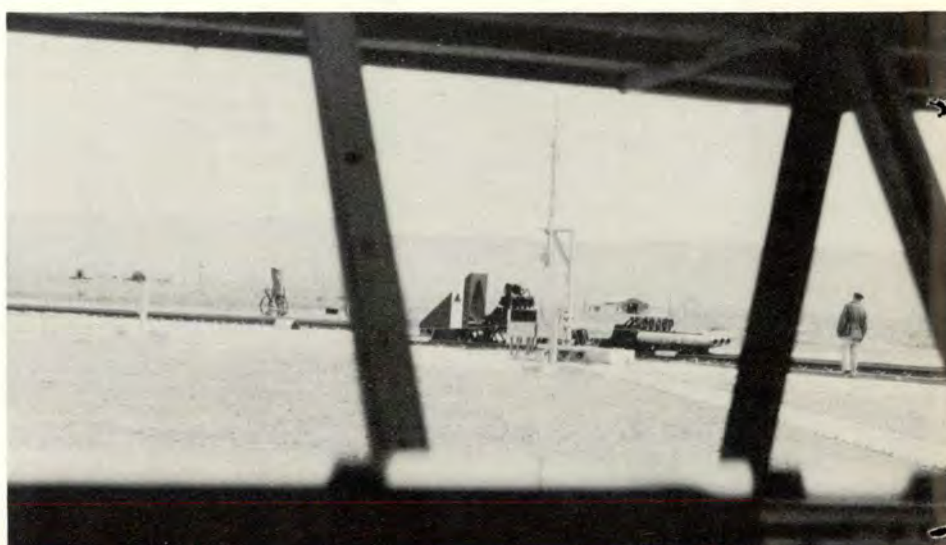
The electrocardiograph showed a fast pulse, my blood pressure was up just a little, and I was perspiring some, although the room temperature was not high.

When we were through I put on a sweatshirt and a standard wool blue flying coveralls. I picked up the black gum rubber mouthpiece made to a cast of my dental arches by the base dental lab. Major Jackson, Dental Surgeon, called it a "bite block." I jumped in the car and let Major Simons drive us to Baker 3, where the 3500-foot track is located.

We arrived at 0830 for last minute arrangements. The run was scheduled for firing at 1000 hours. Jake Superata, Northrop lead mechanic, and his crew were checking out the last details of pre-run preparations. Lt. Leonard and Lt. Hack, officers in charge of the Track Unit, were calling back and forth over the intercom from the blockhouse getting all set for that 10 seconds of supreme coordination when cameras, telemetering transmitters, Sleran time-distance recorders and a host of other devices would click in the right sequence to make the precious records of all the intelligence, the analysis of which provides the end product of the run. Six channels on the sled would broadcast to a truck at a relay point, which would re-transmit the signals to Tula Peak, 12 miles away, for recording.

I climbed into the sled, remarking quite honestly that I didn't look forward to this run. The shoulder straps, the lap belt and inverted-V leg strap were positioned and clamped in place. I put the mouthpiece in my mouth. My hands were tied between my knees with webbing. A string to start one of the two cameras mounted at my feet and pointing at my face was handed to me and I was told to pull it at the count of five on the firing sequence.

Almost everybody walked off and left me at the count-down of X-5 minutes, except one instrumentation man doing last calibrations. He was switching over from external to sled-borne power on the transmitters, and two airmen were checking the rocket firing circuits. They soon left. X-3 minutes. I was no longer nervous or worried. Just pull that string at X-5 seconds. X-1 minute—two red flares and a siren signalled from the blockhouse. X-45 seconds. I gripped the bite block, swallowed, moved my head forward and shifted my knees together. X-30. My heart rate was picking up. X-15—here it comes—in a few seconds all hell will break loose but don't forget to pull that string at



Top, track coordinator makes final check. Below, view through bunker periscope of blast-off.

John P. Stapp, Ph.D., M.D.
Lt. Col., USAF (MC).

Lt. Col. John P. Stapp was born July, 1910, in Brazil of missionary parents. He came to the United States in 1922 for his education, attending Baylor University, the Universities of Texas and Minnesota, among other schools.

Col. Stapp was called to active duty in October of 1944 and served in various medical assignments as well as attending several schools of aviation medicine.

He was assigned to the Aero Medical Lab of Wright Field in 1946 and was on detached service at Edwards AFB for four years serving as project officer in Human Deceleration. From 1951 to 1953, Col. Stapp was Chief of the Special Projects Section, Biophysics Branch of the Aero Medical Lab at WADC. Since that time he has been at Holloman as Chief of the Aero Med Field Lab, specializing in two subjects—Space Biology and Biodynamics.

Col. Stapp has many research achievements, including high altitude unpressurized flight tests of a liquid breathing system; studies on the effect of windblast, including a flight in an F-89 with the canopy removed at 570 mph; and human deceleration studies. The last took in 73 human experiments on a rocket powered sled which was decelerated from speeds of 150 mph by mechanical brakes. He was a volunteer for 26 of these tests, culminating in an exposure to forces of 46.2G during a quarter of a second.

During these experiments he sustained numerous injuries, including several broken bones, but succeeded in exploring human tolerance to crash-type forces, establishing human limits considerably in excess of aircraft strength specifications.

Col. Stapp received the National Air Council Award for outstanding research contribution by an Air Force officer during 1951, the Legion of Merit for his research in human tolerance to abrupt deceleration and the John Jeffries Award of the Institute of Aeronautical Sciences for outstanding contribution to aeronautics through medical research during 1952. He was elected a Fellow in Aviation Medicine by the Aero Medical Association in 1952.

★ ★ ★

X-5. Then the count-down. 10, 9, 8, 7, 6, 5—I pulled the string and heard the camera whir—4, 3, 2, 1 FIRE! A brief blasting noise, like an engine blowing off steam, as six rockets, totalling 27,000 pounds thrust, came on simultaneously and the sled seat rammed against my back with an explosive surge.

My head sank into the five-inch thick cushion of rubberized boar's hair. One, two, three, four, five. The sled screamed forward with the most terrific sustained pick-up I've ever experienced. The 26 rides I took in previous years at Edwards AFB on the 2000-foot track had nothing to compare to this. For a fraction of a second, the speed was 421 mph. Then at burn out, the force was suddenly reversed.

For about a second, the rail friction on the sled slippers and the wind drag slowed the sled down with a force equal but opposite to the pick-up of the first five seconds. I was slewed forward in perfect position for the water-brake deceleration which was to follow. Unknown to me, the headrest cushion flew off at this time and gave one horrified spectator the impression that my head had come off. Then the water brakes . . . A smooth, abrupt loading of pressure against the shoulders and hips as I was pushed into the harness, held for noticeably longer than any deceleration I had previously experienced.

The initial surge of deceleration was 22G with a build-up of 500G per second. The subsequent maintained level of force felt perfectly smooth to me, but the records show that in .59 seconds I oscillated 17 times in a sine wave of amplitude diminishing from 10 to about 5G, a pressure change against the harness of about 1700 pounds dwindling to 750 pounds at 30 cycles per second. But I didn't know it and could only take the recording oscillograph's word for it afterwards. During this time the sled slowed down from 313 mph to 156 mph in 200 feet. Less abruptly, the pressure eased off the harness, and after a few seconds, there was a brief impact as the sled hit the emergency water brake and came to a halt.

The water scoops under the sled had knocked out masonite dams and scooped up the water between them, throwing it up 50 feet in the air throughout the deceleration, but I wasn't even wet.

I pulled my right hand out of the webbing and waved an okay. Jake Superata and Major Simons came running up and looked me over anxiously. I took out the mouthpiece and grinned. About that time, my poor confused circulatory system, doing its best to keep the right pressures at the right places through the rapid changes of the last eight seconds, lost its way just a little and I felt a bit woozy, but no different than after many a ride on the centrifuge.

Major Simons says that I was just a little bit pale for about half a minute, but immediately snapped out of it and sat through the picture taking. About that time Colonel Haney, acting CO of the Center, and his staff came up, there was much talking and picture taking. I was happy about the whole thing. I call it survival euphoria and try not to be too ridiculous about it. Finally we got in the car and went back to the lab for the post-run physical. Everything checked out all right. The electrocardiograph was slowed down to normal rate; my blood pressure was back down to 130 over 86, and later to 124 over 80. I wrote up the subjective report, answered some phone calls and started wondering when we would go to lunch. It couldn't come too soon.

The 64-dollar question is, of course, why do it? Why not just use dummies? My answer is that aircraft are still flown by people and if a slightly plump 44-year-old flight surgeon can take it, why can't you? ●

This is the second of two articles on design problems of swept-wing aircraft, by Engineers of Boeing Airplane Company and Lockheed Aircraft Corporation.

YAW LAW

by R. J. White and A. T. Curren, *Boeing Airplane Co.*

THE introduction of high speed swept-wing aircraft into widespread military operation has resulted in many questions from flight personnel concerning the basic design differences between the conventional straight-wing and the swept-wing. This article will explain some of the stability and control characteristics of aircraft with wing sweep in the order of 35 degrees.

We will review several of the main airplane characteristics affected by sweeping the airplane wing and will compare these characteristics with those of an unswept-wing airplane, where such a comparison can be made.

In general, the flight characteristics may be discussed by considering stalling, pitching and lateral and directional control. These will be discussed separately in detail.

Stalling Characteristics

Basic differences in the stalling characteristics of swept-wing and straight-wing aircraft are clearly illustrated in Figure 1. These plots do not represent any particular aircraft.

Note that with flaps up, the lift curves are similar, and stall warning margins are good in both cases—10 to 20 knots. Maximum lift and minimum speed occur at a greater angle of attack or steeper attitude in the swept-wing airplane. (Attitude or angle of attack may be considered as interchangeable in this discussion.)

In a flaps down configuration, the straight-wing demonstrates a smaller spread between initial stall warning attitude and the full stall attitude.

With flaps down, the swept-wing has a gradual rounding of the lift curve similar to that for flaps up. Figure 1 shows the top of the lift curve to be quite flat. Here the stall warning is definite but a substantial increase in angle of attack or airplane attitude is necessary to complete the stall. As the angle of attack increases, the drag also increases very rapidly, so that a large rate of sink may develop prior to the full stall. In fact, at low engine thrust the stall break may not be apparent to the pilot due to high sink rates. The full stall is usually accompanied, however, by strong buffeting which is termed "vertical bounce" by most pilots.

Flaps Down Approach

The flaps down approach characteristics are important because the pilot is operating close to the ground and near the initial stall buffet speed during the approach for a landing.

There are both straight-wing and swept-wing jet aircraft which have low drag in the approach configuration due to aerodynamic cleanliness. Some of these aircraft are also equipped with jet engines with poor acceleration capabilities. On these planes the low drag requires a fairly flat approach at low engine thrust to avoid building up excess approach speed which can result in a long floating distance before the aircraft settles down on the runway. Because of the relatively long time (6-10 seconds) required to accelerate from idle rpm to moderate thrust values,

pilots must be alert for the following.

With the aircraft on final approach, flying approximately 10 knots above the initial buffet speed, the pilot may attempt to maintain the desired flight path by raising the nose of the airplane slightly and accepting the loss of a few knots in airspeed. Only a small increase of lift coefficient is required to balance the speed decrease. However, due to the shape of the lift-drag curve (C_L versus C_D curve), a large per cent increase in drag occurs. This is illustrated by point A to B in Figure 2. Unless thrust is immediately increased, a further speed decrease occurs because of the additional drag and the cycle repeats itself until the first stall warning occurs. Figure 2 shows a plot of rate of climb or rate of sink versus airspeed at low engine thrust.

From this it can be seen that if the airplane is flown at an approach speed too near the first stall warning, high rates-of-sink very easily may be encountered. These rates of sink can only be checked by nosing down to re-establish speed or by applying power. A loss of altitude will occur by nosing down to pick up airspeed. This will occur also should the jet engines require too great a time to accelerate up to thrust speed from idle power.

The only way to avoid this situation is to plan ahead. Allow the necessary time to accelerate the engines up to the required power, or have sufficient extra drag in the approach configuration so that a larger per cent of power can be used during the approach. This latter will permit the engines to accelerate faster and will permit the pilot to effectively adjust his glidepath by engines only.

Pitching Characteristics

Unlike the airplane lift characteristics, there can be no direct comparison between the pitching moments of swept-wing and straight-wing airplanes. The reason for this is that undesirable pitching moments may occur for either type airplane and, in each case these must be modified during the airplane design to give satisfactory pitching moments.

The swept-wing at low speeds first showed that pitch-up (unstable pitching moment slope) can occur at the higher lift coefficients. This pitch-up is due to the stalling of the tip areas which are behind the center of gravity. This causes the inboard lift ahead of the airplane center of gravity to rotate the airplane in a stalling direction. The low speed pitch-up tendency can be cured completely through proper wing, tail and nacelle design. This is essential for a good flying airplane.

As airplane design approached sonic speed, the effect of Mach number produced a high speed pitch-up tendency for many airplanes, both swept and straight-wing. In addition, variations in the pitching moments occurred with increasing Mach number, giving rise to an additional flight effect referred to as tuck-under.

There are, therefore, three pitching moment problems which must be controlled or reduced to a minimum in the design of any high speed airplane. These pitching moment problems are:

- *Low Speed Pitch-Up*

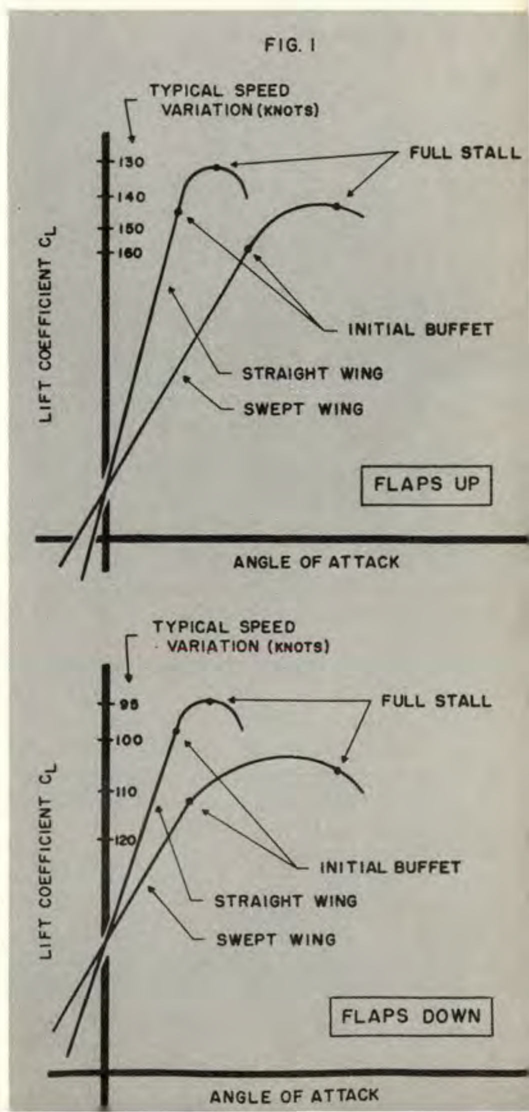
Low speed pitch-up may occur during a low speed stall. Here the nose of the airplane may gently come up as the stall is approached, after which a pitch-down will occur. If this effect is mild, the airplane may still be satisfactory. A severe pitch-up tendency without a following pitch-down cannot be tolerated.

- *High Speed Pitch-Up*

The high speed pitch-up may occur during an accelerated pull-up. Here more G is suddenly realized than can be momentarily controlled by the pilot. This effect is, of course, undesirable, but can be tolerated if the tendency occurs well above the normal operating conditions of the airplane, and if the pitch-up does not result in exceeding the allowable load factors.

- *High Speed Tuck-Under*

The third pitching moment effect is tuck-under. This condition is associated with a change in airspeed and trim during level, unaccelerated (1G) flight. Here, at a certain high trim speed, the airplane may have a tendency to increase airspeed gradually and nose down, requiring the pilot to retrim. If this condition is mild and does not occur in the normal operating conditions, the airplane is satisfactory providing the pilot has sufficient elevator and trim control to bring the airplane back to the desired trim speed.



The lateral control for the swept-wing airplane must be increased over that used on the straight-wing airplane. The reason for this is that the airplane rolling moments developed when the airplane is yawed are greater for a swept-wing than for a straight-wing during low speed flight. Here it is necessary to provide sufficient lateral control to hold the wings level when flying at yaw angles up to the maximum yaw that can be supplied by the rudder.

The rolling tendency produced by yaw is the same as that which would result with a straight-wing having a large dihedral angle. When an airplane with dihedral is yawed, each wing experiences a change in angle of attack which results in a rolling moment. A 35 degree swept-wing with no dihedral has the same rolling tendency at low speeds as a straight-wing having 15 to 20 degrees of dihedral. The effect of excessive dihedral requires the pilot, during steady sideslip maneuvers, to use more lateral control than would be required on a straight-wing airplane. By providing sufficient lateral control with low control forces, desirable flying qualities can be obtained.

It should be noted that the large dihedral effect is in the stable direction. In airplanes with insufficient dihedral, the advancing wing drops when the rudder is applied in a sideslip, thus producing undesirable flying characteristics.

It should be noted that many airplanes are limited in the yaw that can be produced by the rudder at the higher airspeeds. This yaw restriction is purely a structural limitation to save weight in the vertical tail and associated body side bending material. The general way of limiting the high speed yaw angles is to increase rudder pedal forces proportionate to airspeed.

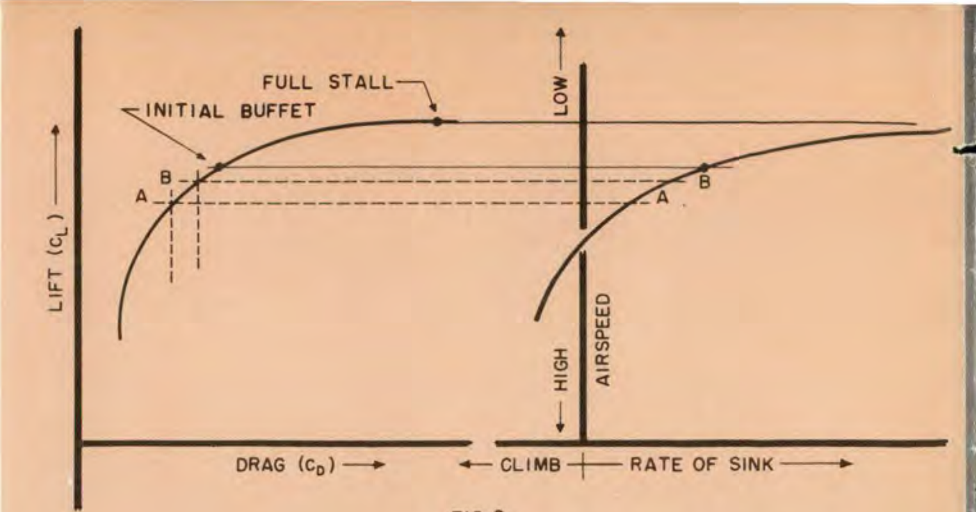


FIG. 2

In regard to the dynamic effects, stability theory indicates that excessive dihedral will produce an airplane lateral instability referred to as "dutch roll." In many present day aircraft, due to high wing loadings and undesirable inertia characteristics, this instability results even for straight-wing airplanes. This has led to the development of the yaw damper which is used to improve the "dutch roll" characteristics.

Engine-Out Flight

A yawed flight condition can occur when an engine fails on a multi-engine airplane. In a propeller driven airplane, loss of an engine reduces the slipstream over the wing resulting in a loss of lift and an increase in rolling moment, in addition to the expected yawing moment. In the case of a jet airplane, only the yawing moment and the roll induced by yaw will be present. This relieves the amount of lateral control required for a jet airplane for the engine-out condition. Any airplane, whether swept or having a straight wing, must have sufficient rudder and aileron control to handle the engine-out condition.

Crosswind Landing

During the approach on a crosswind landing, there should be more rudder and aileron control available than that necessary to hold an airplane in its yawed condition. By having an additional amount of control, proper corrections may be made for any upsetting gusts. The additional rudder control can be used to momentarily increase the yaw just prior to touchdown if it is necessary to reduce any existing crab angle. In the case of a swept-wing airplane, the rudder may be used effectively to obtain an additional rolling moment if such is necessary during the landing. Lateral control is, of course, necessary to lift the wing should it drop while near the ground. Both swept and straight-wing airplanes should have sufficient control to meet the crosswind requirements for which they are designed.

Conclusions

Some of the fundamental differences between swept and straight wing airplanes have been discussed. Here it may be concluded that the low speed handling characteristics are the major differences between swept and straight-wing airplanes. Other problems are common to both types and must be solved through proper design of the airplane.

The difference in the stalling characteristics of these airplanes must be considered carefully by the designer and should be understood fully by the pilots. ●

by Philip Colman, Chief Preliminary Design Engineer
Lockheed Aircraft Corp.

IN CONSIDERING the flight characteristics of straight-wing and swept-wing fighters, several variables have to be considered. The primary mission of a particular aircraft will have considerable bearing on the final design.

Where speed requirements are high enough, swept planforms have no basic aerodynamic advantage. Every effort should be made to obtain an "all purpose" airplane for both operational and economy viewpoints, but obviously this has limitations. Optimum wing planform helps in approaching realization of this desire.

There are some inherent differences between the swept-wing and straight-wing airplane that must be taken into account by the designer. Certain tendencies manifest themselves in swept-wing aircraft that require mechanical aids to offset undesirable flight reactions. Wing fences, slats, synthetic stability damping and control feel are prime examples of these aids.

All aircraft will fly reasonably well at low angles of attack corresponding to normal flight conditions if properly designed. At high angles of attack, however, such variables as directional stability and roll damping (resistance to roll) tend to decrease and become reversed. Although these characteristics can be present in both planforms under discussion they can be avoided by correct design with straight-wing airplanes and are more severe in swept-wing aircraft.

High outer wing loading, increasing with angle of attack, is a basic characteristic of swept-wing designs. Thus, the outer wing sections stall well ahead of the inner sections, which induces tip stall. Airflow at the tips tends to separate from the upper surface of the wing near the tips and induces a stall in that region while the root or apex portion continues to develop effective lift. The immediate reaction, due to this characteristic of swept-wings, is a pitch-up moment. The degree of this adverse condition is dependent on wing planform, amount of sweep, taper and aspect ratio.

Loss of directional stability and roll damping will occur at the same time. This will occur in normal stalls and equally important, in accelerated maneuvers. Therefore, as noted, mechanical aids must be provided to assist the pilot in overcoming these characteristics and in obtaining a satisfactory airplane from the safety standpoint.

As we have noted, flow separation starts at the wingtips of the swept-back airplane. This leads to another problem. With ailerons located in a conventional position, aileron control effectiveness will become progressively less and disappear as a stalling angle is approached.

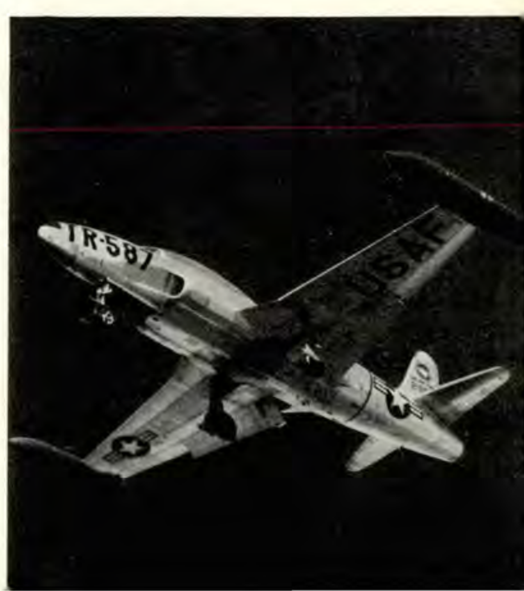
It should be noted that reduction in aileron effectiveness is also a high speed problem, because of aeroelastic effects. For equal aerodynamic designs, this is a more severe problem for swept-wing aircraft because of their geometry.

Aerodynamic reaction to the application of landing flaps must also be taken into consideration. Landing flaps are more effective in reducing stall speeds on straight-wings. The straight-wing aircraft gives less stall warning but less is required with good stall characteristics.

Yawed flight is much more critical to aileron control on the swept-wing aircraft because of the inherent high dihedral which promotes considerable roll, particularly at high angle of attack. Normally the pilot will be concerned with yawing only when landing in a strong crosswind. There is the high angle of attack condition and in effect there is a "built-in" yaw or sideslip, developing in intensity in direct proportion to the velocity of the surface wind. During such times, yaw cannot be avoided. If the swept-wing airplane is critical in roll control, additional approach and touch-down speeds must be used to compensate for this condition.

In conclusion we must once again consider the basic mission of the aircraft when discussing the merits of various designs. As we progress further with our studies and flight testing of new designs it must be remembered that our basic planforms may change somewhat. Design requirements between the transonic and the supersonic speed ranges will, in all probability, differ greatly.

In the interim, pilots should be thoroughly aware of the capabilities and limitations of their aircraft whether straight-wing or of swept design. The Pilot's Handbook covers every operational range of the military aircraft. Do not exceed the placarded limitations. Fly the aircraft as it is designed to be flown. ●



Material for this discussion of seat ejection problems was furnished by Republic Aviation Corp. Field Service Representatives.

...POSITION

TWO fatal accidents occurred last fall that could have been prevented. The lessons learned, as a result of these cases, can and should be understood by all pilots flying jet aircraft.

In the first accident, it was determined that the pilot used improper procedures while strapping in prior to the flight. This later prevented him from clearing the seat following an ejection.

In the second accident, failure of the pilot to use the armrests properly prior to ejection prevented him from using his arms in aiding him to clear the seat and open the parachute.

Although both of these accidents occurred in F-84 aircraft, similar cockpit configuration in other types of jet aircraft could well lead to like cases. FLYING SAFETY urges commanders and flight safety officers to establish immediately a vigorous and intensive training program within their own organizations. Let's see what one overseas squadron did to help itself: The first step of this program consisted of selecting an aircraft and rendering the canopy jettison and seat ejection systems inoperative.

Next, each pilot of that organization, wearing flying clothing and with a full complement of personal equipment, was instructed to secure himself to the seat in the same manner he would use in preparing for an actual flight. Then, at a given signal he assumed ejection position and started the sequence of movements he would use normally to eject and clear the seat. Had the ejection been real, the results might have been tragic.

Several critical factors were immediately apparent. Many incorrect techniques of strapping in were noted and some pilots attempted to actuate the canopy jettison and seat ejection levers improperly.

The most common error made by all pilots was the positioning of the alligator oxygen hose clip which secures the upper end of the oxygen hose (seat half) in a position for easy mating with the oxygen hose from the mask.

The majority of the pilots clipped it to the strap of the left shoulder harness. Technical Order 03-50-1 states the alligator clip will be attached to the clothing; however, most pilots favor the shoulder harness location.

With the clip secured to the harness in this manner, considerable difficulty was experienced in getting out of the seat after the seat belt was disconnected. The reason, of course, is fairly obvious. The clip tended to hold the harness in position over the pilot's shoulder. Time permitting, the alligator should be disconnected prior to ejection.

A second common error was the positioning of the .45 caliber pistol and the routing of the right half of the seat belt. With the pistol worn on the right hip, pistol butt pointing aft, most pilots routed the belt between the gun butt and holster.

With the seat belt and holster tangled up, the pilot has difficulty in clearing the seat. The leather pad and male section of the right hand seat belt lock tend to catch between the holster and the butt of the pistol when the pilot makes a forward motion to clear the seat.

In a few cases pilots wore the .45 pistol slightly forward of the left armpit. With the weapon so placed the clearance between the pilot's left arm and the inboard side of the left canopy seal channel becomes marginal. Under these conditions it is possible for the pilot to strike his left arm on the canopy seal channel as he ejects.

Improper positioning of the body in the seat preparatory to flight was another error found during the program; however, this error was not as frequent as others. For instance, a short pilot, using a minimum of cushions in the seat cavity, must raise the seat considerably to get the desired

"Each pilot, wearing flying clothes and full personal equipment . . . started ejection procedures."

is Everything!

vertical position. As the seat is raised, the clearance between the top of the back pack and the bottom of the headrest becomes marginal. (This applies particularly to the F-84 aircraft.) Although very little, if any, difficulty was experienced in catching the back pack under the headrest, the armored ripcord housing presented another problem.

With a minimum of clearance between the back pack and headrest, it is possible for the ripcord housing to catch on the lower lip of the headrest or along the aft edge of the guards which are installed on some aircraft. With the ripcord housing catching on the guard located back of the headrest, the pilots were unable to pull forward to clear the seat.

Preparing to Eject

The most common fault noticed was that the headrest adjustment in the F-84 varied greatly, depending on the height and size of the pilot. With the head thrown back far enough for the P-1A helmet to contact the face of the headrest, it was impossible for the pilot to tuck his chin in properly.

Many pilots neglected to police the cockpit. Some remembered to disconnect the radio jack and then neglected to unhook the oxygen hose. This latter is especially dangerous because upon ejection the rubber hose may stretch a great deal before the quick disconnect lets go. Several pilots have received face injuries as a result of the vicious snap.

A few pilots while practicing the motions of a fast ejection allowed the ebows to protrude on either side (outboard) of the armrests. This practice can result in severe injury to both arms and prevent the pilot from opening the parachute even if the seat is kicked free.

The P-1A helmet, B-5 life preserver, C-9 back type parachute, B-18 seat belt, URC-4 radio set and .45 caliber pistol, used in conjunction with the Mark IV exposure suit, presented additional problems as the pilot prepared to eject.

Some pilots wearing the above equipment had considerable difficulty in positioning their arms properly on the armrests.

As a result of the program established by this one organization, three particularly good recommendations were made. FLYING SAFETY believes they are worth passing on.

- Place the right hand on the canopy jettison and seat ejection levers, keeping the right elbow as close to the body as possible.
- Place the left arm spanwise across the body, keeping the left elbow tucked in, and grasp the right arm firmly with the left hand, holding the right elbow against body.
- In this position, the canopy jettison and seat ejection levers can be actuated and a clean ejection made without fear of injuring the arms.

One other factor to be considered concerns the adjustment of the headrest. Such adjustments should be made to suit the individual pilot prior to a flight. The job takes something over a minute on most models and is certainly well worth the effort.

Although not mentioned specifically by the reporting organization, we know that some injuries have been incurred during bailouts because pilots failed to position their feet in the stirrups properly.

Those footrests are placed on the seat for a reason—to get proper position of the legs during ejection. They were designed to get the pilot's feet back from the rudder pedals and the legs bent sufficiently to insure proper clearance of the windshield frame as the seat leaves the aircraft.

If you set up such a program for your pilots, make certain that proper use of the footrests is a *must*. We've seen many a bruised calf and black and blue tootsies on hapless souls who neglected to use the stirrups properly. ●

SUMMER FLYING

HERE in the ZI, we are now entering the summer flying season. Although we normally think of blue skies and balmy breezes through the summer months, 'tain't necessarily so. Let's look at the record.

Weather elements that are most often cited as contributing causes to summer aircraft accidents are thunderstorms, hail, rain, surface winds and turbulence.

Thunderstorms will be found over the states bordering the Gulf of Mexico and over the Ohio, Missouri and Mississippi River valleys. They are also frequent along the eastern edge of the Rockies with gusty surface winds in Texas. Hail, rain and turbulence are associated with the thunderstorms.

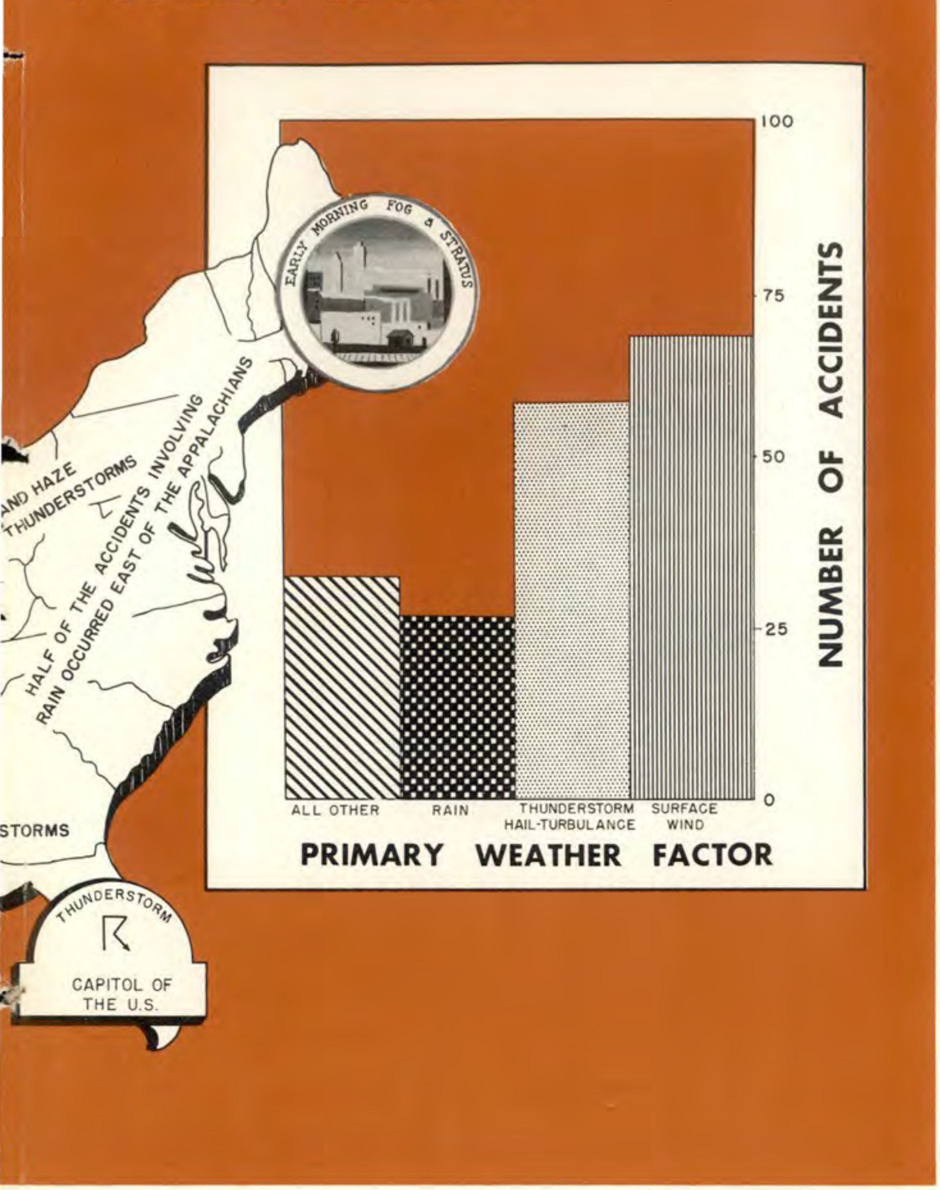
We must also consider low ceilings and visibilities. The New England and Mid-Atlantic coasts, the Seattle area and the coastal region of Southern California around Los Angeles will have lots of that type of weather. The hours from midnight to 0900 will be the time of most frequent occurrence. Certain industrial regions in the Ohio River valley are also susceptible to these foggy conditions.

You may wonder which portion of the United States reports the most "weather" accidents during June, July and August. We've made a study of that too and our records cover a six-year period. According to the record, the Great Plains States from Texas to Canada reported more than 56 per cent of the accidents. The region west of the Continental Divide reported only nine per cent and the balance of the nation reported the remaining 35 per cent.

Most pilots believe that the old thunderstorm is the greatest contributing factor in summer aircraft accidents. That, however, is not true. The seemingly inoffensive surface wind was the villain in 68 of the 194 summertime weather factor accidents. Sixty per cent of those were in the Great Plains States, with Texas alone reporting more than 25 per cent of the "wind" mishaps. Thunderstorms and associated phenomena, such as hail, accounted for about one-third of the accidents.

The majority of accidents caused by thunderstorms and associated

HAZARDS



weather occurred in the Great Plains States. About 60 per cent of the accidents attributable to thunderstorms have occurred in that area. This figure probably reflects the fact that almost all pilots are familiar with the frequent occurrence of thunderstorms over the southeastern part of the country. However, most airplane drivers are relatively ignorant of the fact that these storms occur with equal frequency over the prairies and along the eastern edge of the Rocky Mountains. Knowledge makes them reluctant to fly into the southeast during thunderstorm season. Lack of knowledge results in no qualms about flying over the Plains States. It is simply a case of not foreseeing the danger and therefore not being prepared to meet it. Or, we might say it boils down to this: more flights into a thunderstorm area, therefore more accidents caused by such summer storms.

Rain is another hazard, accounting for 33 of the 194 weather accidents. Wet runways and rain-blurred windshields were the direct causes most often cited. More than half of these accidents occurred east of the Appalachian Mountains.

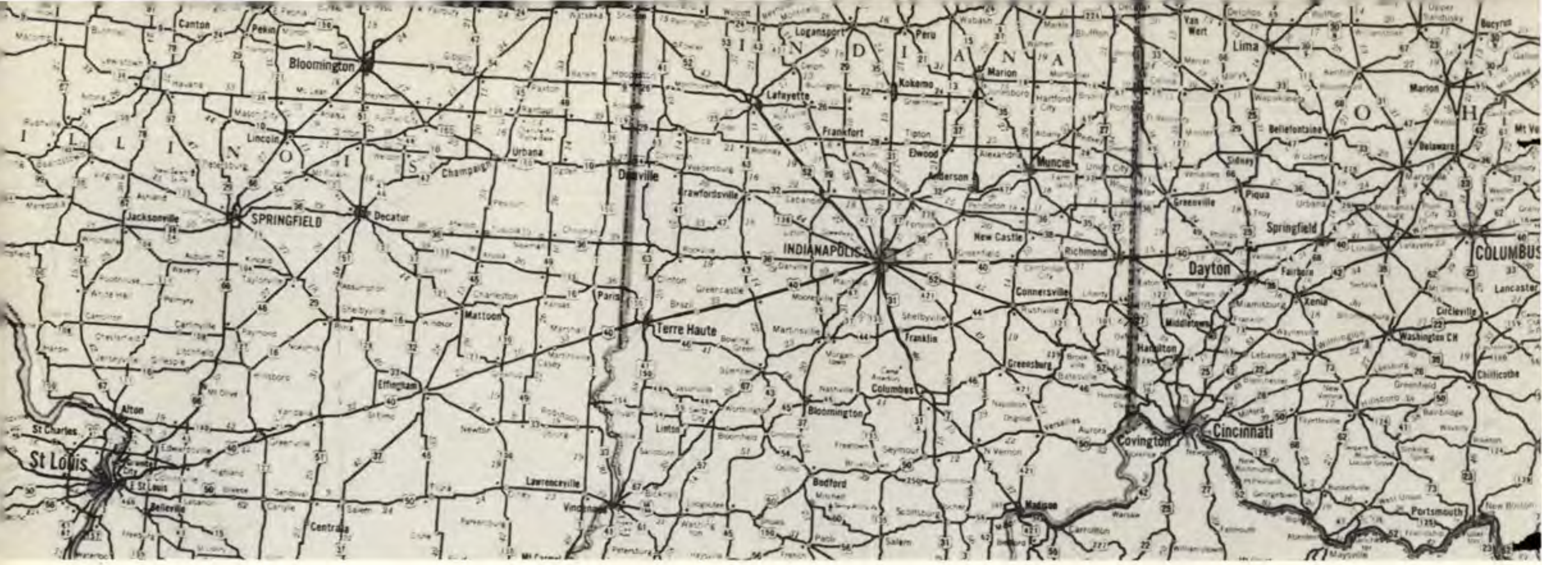
Always a danger in summer, particularly to jet pilots, is the effect of high temperature on air density, which in turn greatly affects the takeoff roll of jet aircraft. A condition of high temperature and low air density can exist anywhere in the nation. Before you take off, check with the weather people to determine temperature conditions. Then a quick reference to the applicable T. O. will tell you how these conditions will affect your particular type of plane. Always be sure to make this check when departing from a field at high elevation. The combination of heat and height can often be dangerous.

The accidents discussed in this article are those in which weather was a contributing factor. In only 27 of the 194 cases was weather the *primary* cause of the accident, and 25 of those cases involved thunderstorms or their offspring.

During the six-year period, five discrepancies were charged to weather forecasters. One involved a failure to forecast thunderstorms along a route, and four were cases in which IFR weather was encountered when VFR weather was forecast.

And now a word of warning to our readers! The facts and figures presented in this discussion are based on past occurrences and averages. We have outlined the areas of maximum occurrence of certain weather elements. However, under certain unusual conditions, any element could be encountered over any portion of the country. To plan your individual flights, check with the forecaster at your local Air Weather Service detachment. He has the latest information available and will do his best to help you plan a safe trip. ●

"The seemingly inoffensive surface wind was the villain in 68 of the 194 summertime weather factor accidents in a five-year period."



Facility Charts — — JET SIZE

by Col. Richard W. Philbrick, Commander, USAF ACIC, with F. H. Redmond

ON a yesterday over twenty-five years ago — 1927 to be exact — a young man named Charles A. Lindbergh took off for a non-stop flight from San Diego to St. Louis. His plane was a silver monoplane, built by Ryan Airlines Company of San Diego. "The Spirit of St. Louis" went on to fly non-stop to New York and then across the Atlantic Ocean.

The only charts or flight information publications Lindbergh carried on his flight across the United States were Rand-McNally state maps and a map of the U. S., which could be purchased for 50 cents at most corner drugstores. They showed railroad lines and main roads. On these maps he marked his route.

Although little weather information was available, it was the most important item in his flight plan. At that time flights might be delayed for days until the weather cleared. The term "IFR" had not been coined. The compass was the primary means of navigation, but generally speaking, instruments were not to be trusted.

Almost 10 years later, another pilot took off from Chanute Field, Illinois, on a flight to Wright Field, Dayton, Ohio. He was using the first Radio Facility Chart publication produced by the U. S. Air Force. These charts were published by the Air Corps Technical School, Chanute Field, and comprised 18 pages of charts and tabulated data. They were 8″ x 10½″ in size, held together by screw type fasteners.

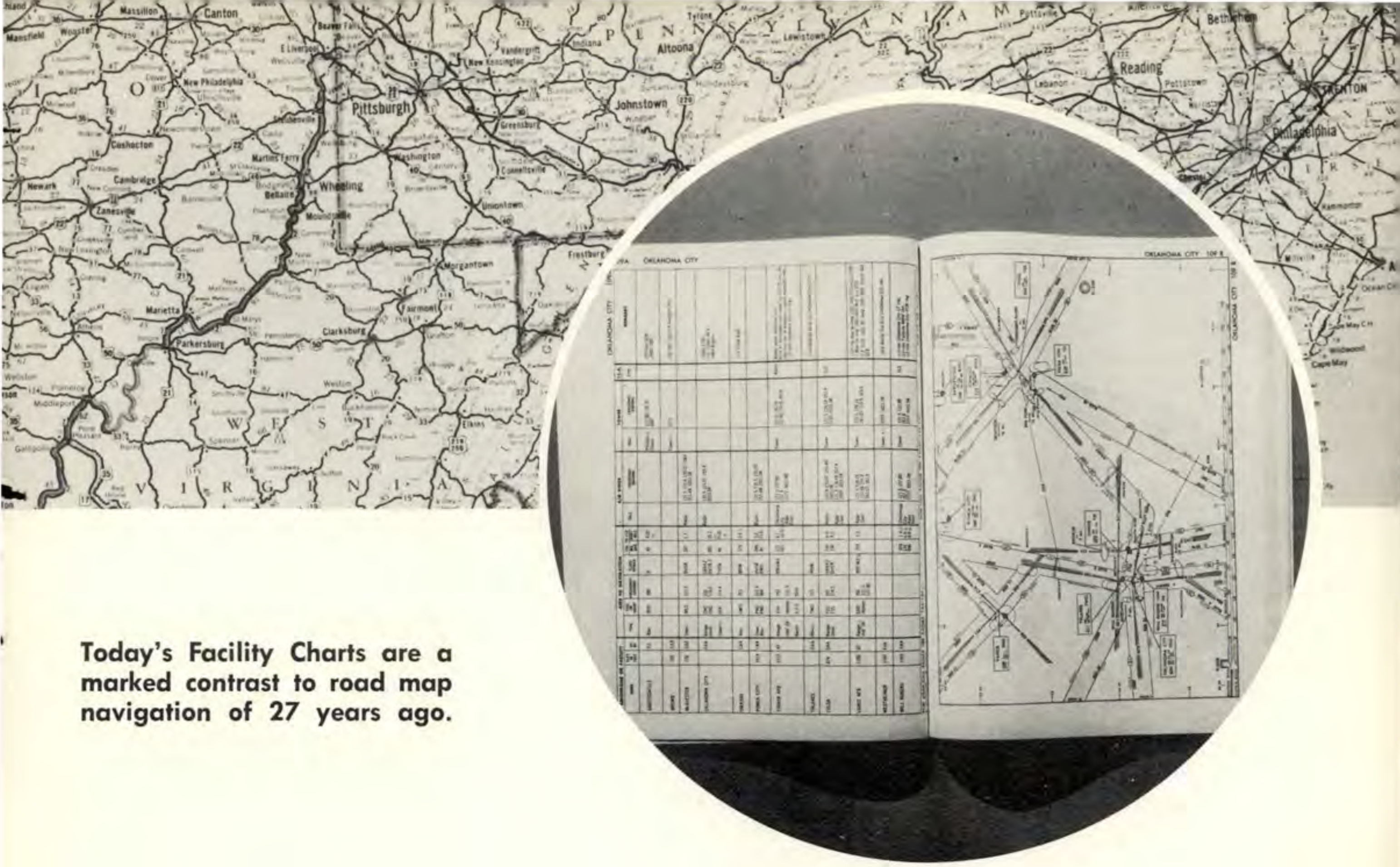
This pilot was flying a B-18, which had a low frequency aircraft radio receiver. Increasing installation of four course radio ranges by the CAA had called for a publication which would give pilots adequate information for navigation by this means. Airways had not yet been designated, but radio range courses had been aligned to permit pilots to follow them directly from one strategic location to another. The new Radio Facility Chart was satisfactory and Air Materiel Command undertook its publication in the Technical Order series.

USAF pilots were using essentially the same type of publication in 1947, but it had grown considerably. Designated airways, danger areas, VHF and HF direction finders, radar beacons, GCA facilities, landing field class and aircraft fuel available had been added. The book now contained 112 pages. No VOR facilities were listed. There was talk of standardizing this publication so that the USAF, the Royal Air Force and the Royal Canadian Air Force pilots would have publications of standardized format for world-wide use. This standardization has since been accomplished and is in the Radio Facility Charts and In-Flight Data issued today. The present publication covering the United States today has 201 pages and a separate publication is issued for VOR airways system.

Today when a jet pilot climbs into his aircraft, taxies to the end of the runway, gets his clearance from the control tower and zooms off, he carries an entirely new type of Radio Facility Chart. He does, that is, if he is cooperating in the USAF Aeronautical Chart and Information Center test and evaluation program, covering the new experimental Radio Facility Charts.

He selects a chart from the material which he carries in the leg pocket of his flying suit. Although it covers a vast area, this chart has been folded to fit compactly into a series of small envelopes. In the narrow confines of the jet aircraft cockpit, he consults this information-packed chart with a minimum of effort.

Reports from users of the standard Radio Facility Charts and In-Flight Data indicate that it is still considered a good publication. The Civil Aeronautics Administration recently re-



Today's Facility Charts are a marked contrast to road map navigation of 27 years ago.

quested copies of the U. S. publication for all their airway controllers to use in controlling military air traffic. Years of conference and collaboration with its users have made it the most complete document of its kind.

But when jet aircraft flew into the picture at some 600 miles an hour, the standard Radio Facility Charts could not be used satisfactorily. A jet aircraft could travel across any one of the 8″ x 10½″ charts almost in the time it took to say, "Where on earth does this blankety-blank route go from here?"

In the confines of a jet aircraft, the book must be balanced on one leg, while at the same time one hand is used by the pilot to turn pages. He has difficulty in looking down because of his oxygen mask, Mae West or other personal equipment. If the book slips off his lap onto the floor, he has to grope for it, or he can alter the aircraft attitude in an attempt to retrieve it. If he does, it is entirely possible that he will find himself at some location or altitude where he does not want to be. "Look, Ma, no hands," might be all right on a bicycle, but on a jet instrument approach it just won't do.

The deficiencies of the existing Radio Facility Charts were pointed out on 10 April 1953 during a visit by Major General Crabb (Chief of Staff, Air Defense Command), to Aeronautical Chart and Information Center Headquarters in St. Louis. As a result of this meeting, an experimental publication was developed to meet the requirements for high speed aircraft.

Air Defense Command representatives came to the Aeronautical Chart and Information Center and sat down at the conference table with the requirements and production personnel of the Chart Center. This conference resulted in the establishment of a fairly stable set of specifications for an experimental series of charts which could meet the requirements for use in high speed aircraft. A lot of questions were asked and answered in the conference. Some of the more important questions and answers included:

- How many charts are required to cover the continental United States allowing a large scale to depict the facilities adequately? *Twelve or thirteen.*
- What symbolization will be used for this chart? *The same as in the conventional publication wherever possible. If necessary, new ones will be developed.*
- How about the two airway systems? Do we issue a separate set of charts for them? *We will publish the VOR airway system on the back of the LF/MF chart, using blue ink for that side.* The first set of experimental Radio Facility Charts was issued early in July; all units of the Air Defense Command received distribution. Copies were furnished at the same time to other major air commands for their test and evaluation.

Thirteen charts cover the entire United States. Both sides of the charts are used, one side for the low frequency radio information and the other for the VOR. Generally, each chart covers a distance of 750 nautical miles east and west, and 250 nautical miles north and south. There is an overlap between charts of at least 50 nautical miles. For ease in handling and carrying, the chart size is 4½″x9″ when folded, and the folds can be turned like the pages of a book. Each fold is indexed to show the major facilities it contains.

For carrying purposes and orderliness, individual envelopes were designed to contain the charts. These have been divided into two sets: Charts 1 to 7 covering western United States, and 8 to 13 covering eastern United States. Envelopes for each set are punched at the bottom and loose leaf rings are installed to hold them together. The first envelope of each set shows an outline of area coverage for all the charts in the set.

The top fold of each chart gives the number and date of the chart, the general area designation and an abbreviated airdrome directory for that area. Only those active airfields with 5000-foot runways that have servicing and lighting facilities are included. This abbreviated directory indicates availability of instrument landing aids, primary tower frequencies, length of runways and fuel facilities. The back flap of this chart shows a legend of chart symbols, position reporting procedures and emergency radar interceptor procedures.

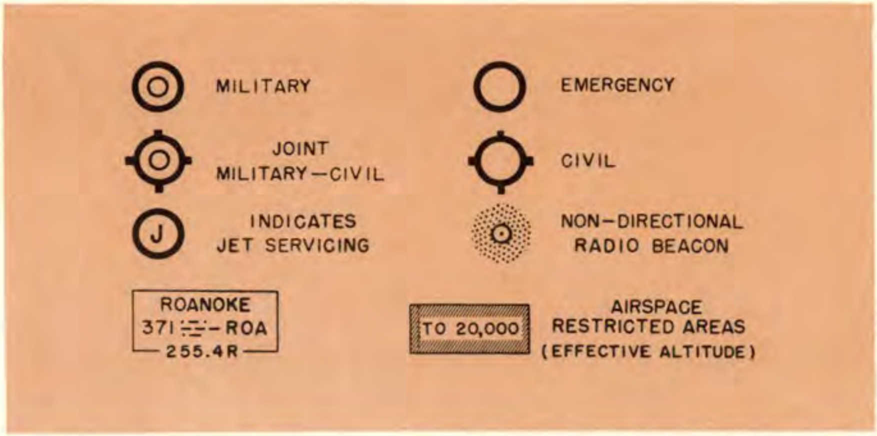
Specifications and symbols are used the same as in standard Radio Facility Charts and In-Flight Data, with several minor exceptions:

- New radio beacon and airdrome symbols in accordance with recently adopted international symbols.
- Use of a "J" in a circle leadered to a radio facility to indicate that an airdrome has at least minimum jet facilities.
- Use of altitude limits, upper and lower only, of danger areas rather than the conventional numbering system.
- Although the basic chart scale is 1:2,000,000, airways are portrayed at a scale of 1:3,000,000 to permit easier readability in congested areas.

ACIC makes every effort to insure that there are no errors or uncorrected information in this publication — experimental as it is — which might hinder flying safety.

Charts are not reissued on a definite schedule. However, whenever four major changes occur, a new chart is issued. It might seem that this causes undue delay in the inclusion of important changes in the chart. It is a fact, however, that the relocation of an air navigation facility involves more than one major change. Realignment of airways with new reporting points and minimum en route altitudes is also required.

It has been necessary to reissue some of the charts bi-weekly, others once a month, and several others even less frequently. Chart 11, which covers the New York area, has had a higher incidence of changes than any other and, accordingly, has had more frequent revision. Chart 2, which



Above, these symbols differ from those used in standard Facility Charts and In-Flight Data.

Below, Col. R. W. Philbrick is considered one of the top USAF authorities on photo recon.

covers the Great Falls-Rapid City area, has been issued less frequently than any of the others: one period of four months required only two new issues of the chart.

To insure, however, that pilots have access to all vital flying safety information, Military Aviation Notices are issued once every two weeks. These contain cumulative information so that the old one may be thrown away upon receipt of each new one. One Military Aviation Notice covers the eastern United States, the other the western. They are printed with the same bright red border used for most Military Aviation Notices. The 5¼"x9" size permits them to be inserted in the envelopes which hold the experimental Radio Facility Charts. Unless a change is considered critical, it is not included (such as a change in runway length of less than 500 feet). The MANs are considered adequate from a flying safety standpoint to amend the experimental Radio Facility Charts.

As a result of an interim evaluation report from the Air Defense Command, certain amendments to the experimental Radio Facility Charts have been made, such as the addition of UHF air/ground frequencies to identification boxes. First plans to insert U4 and U4R were complicated by USAF changes in channelization which made U5 the USAF channel for the frequency 255.4 megacycles. The compromise use of frequency is in line with the recent USAF decisions that frequency listings rather than channels be used in standard Radio Facility Charts.

Also, ILS approach legs and fan and bone marker beacons were added to the VOR side of the charts. Stick-up containing VHF and UHF channel listings was furnished for affixing to certain envelopes, and a special blow-up chart containing all blow-ups was issued as an experimental feature.

Major air commands have reported that the folded large sheet experimental chart is superior to the conventional publication. The following conclusions were reached from an evaluation of the comments and suggestions received from the commands:

- The experimental Radio Facility Chart is a definite improvement over the standard RFC, particularly with respect to chart presentation overlap and ease of handling.

Thirteen charts cover the U. S. Both sides are used, one for LF radio information, the other for VOR.

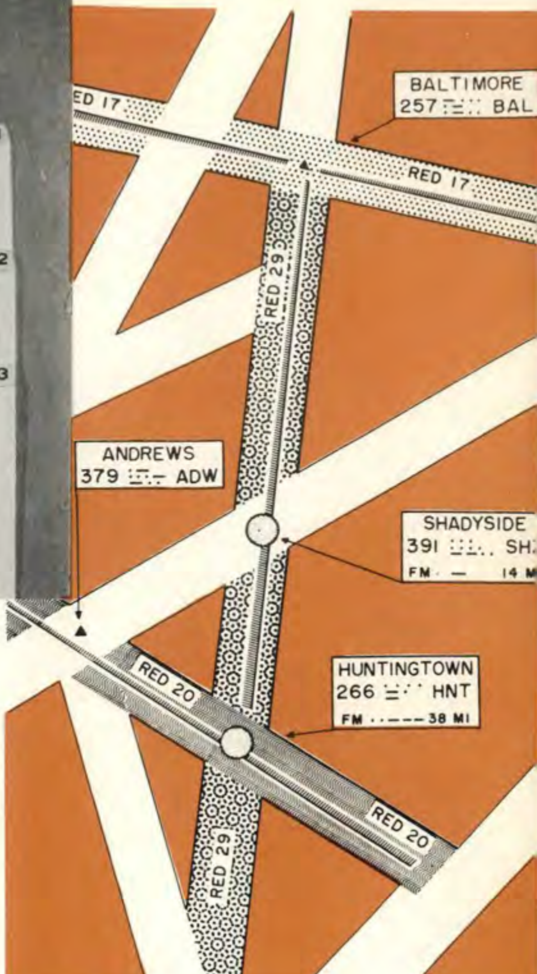


Chart II. Washington area blow-up.

• The size of the experimental chart is considered satisfactory because it allows for convenience in preflight planning and for en route change of flight plan.

• The indexing system and the envelopes are considered to be adequate; however, the envelopes should be made of a more durable material.

• The scale of 1:2,000,000 is considered satisfactory.

• The experimental RFC must include additional data before it can adequately replace the current standard Radio Facility Charts.

• Additional "blow-ups" are needed to portray congested areas in a more adequate manner.

To meet the requirements of ADC and other major air commands for additional supplementary flight information, USAF ACIC issued experimental In-Flight Data U. S. on 1 December 1953 for use in conjunction with the experimental Radio Facility Charts. This, as illustrated in the photo, is a long, slim publication, approximately 5¼"x10", which looks like an insurance policy. In this case, USAF ACIC believes the resemblance is more than physical. This booklet includes Special Notices, Radar (GCA) facilities, ILS facilities, Radar and YG Beacons and details concerning filing of flight plans and ADIZ reporting. It has 35 to 40 pages and can be expanded without difficulty if additional data is required to supplement the charts.

The success of its combination with the experimental Radio Facility Charts will be evaluated carefully. Questionnaires issued by USAF ACIC ask pilots whether any data have been omitted which they believe they might need.

Experimental work in USAF ACIC on improvement of the 13 radio facility charts covering the United States is a continuing project. Some items of experimentation, such as lightening or darkening the airway shading to insure better readability, may not be readily apparent to the user. A new system of showing blow-up areas, as exemplified by the Washington area blow-up on Chart II, should be of considerable interest to pilots who complain of difficulties in finding their way through the seeming maze of airways in some areas.

By using "zip-a-tone," a variety of textures makes it possible for the eye readily to "pick-up" the path of any particular airway. For example: Red airway No. 20 is shown by a strip which looks like a piece of herringbone tweed material. Red 17 is dotted, and the pattern for Red 29 is distinctly reminiscent of one of grandmother's calico prints. All these are designed to help the pilot find his way through areas made congested by the present complex airways system.

A lot of work has been done in other areas of the world to develop publications for use by jet aircraft. A miniature Jet Flight Information publication covering the Japan-Korea area uses the same format as the standard Radio Facility Charts and In-Flight Data publication, but also includes letdown procedures. This type publication has also been issued for use in the Alaskan area.

The Lindbergh flight of 1927 marked a milestone in aviation history. We marvel now at its success considering the limited navigation facilities available. The issuance of the first Radio Facility Chart publication of the U. S. in the middle thirties also was noteworthy. Interesting too, is the fact that the general format and content of the publication has served Air Force requirements up to 1953. What the publication of 1957 will be cannot be predicted today. But perhaps the development of the charts shown in the photo will be another milestone in the development of aeronautical information publications. At any rate, it seems that the future will bring a publication which is compact in size and especially designed for high speed aircraft, but which can be used with equal ease by pilots of conventional aircraft. ●

Keep Current

Jet Reverse Thrust—Jet aircraft in the future may have "reverse thrust" devices for better braking and landing. This development, which has been under study for several years, is designed to divert the power of jet engines so that it is available for braking purposes as soon as the aircraft has touched down on the runway.

Although still in the experimental stage, the thrust reversers will be tried on actual aircraft for further study. Of the many possible types of reverses studied, a "clamshell" reverser seems to be superior in view of design objectives. This clamshell is an extendable device and is stowed around the exterior of the jet engine tailpipe when not in use and is extended into the jet flow after landing. It could be fitted to jet engines buried in the wing, as well as jet pods and the tailpipes of many jet fighters. This device does not have a great effect on engine economy and makes possible a reversal of about 45 per cent of the available thrust.

The thrust reverser some day may make possible jet aircraft landings at all major air fields under all runway conditions.

★ ★ ★

End of the Line—Three more of the USAF'S high speed research aircraft are being retired after completing their useful life span of experimental work.

The XF-92A was the first deltawing fighter. It was capable of high subsonic speeds and made its first flight in 1948. Characteristics of the XF-92A included an Allison J-33 engine, midwing configuration and a protruding canopy bubble. Results of its many test flights at the AF Flight Test Center were valuable in the development of the F-102. The XF-92A will hang up its gloves at the Air Force Technical Museum.

Two stablemates, Northrop X-4s, are also being turned out to taste the grass. The X-4 featured two turbojet engines, swept-back wings and was semi-tailless. It was equipped with a tricycle gear and a pilot ejection seat. The X-4 also made its first flight way back in 1948.

One of the X-4s is going to the museum while the other will be used in a static display at the Air University, Maxwell AFB.

★ ★ ★

Anti-Icing for Jet Bombers

Sensitive nerve ends which constantly take the temperature of surfaces during flight, the compressor of the jet engine and electronic controls are being combined to answer the problem of anti-icing for jet bombers.

Thermal icing, of course, is nothing new. It was developed during World War II and put into service shortly thereafter. Still earlier methods were based on the principle of de-icing. In piston-engine aircraft the anti-icing method involves the installation of combustion heaters in the tail and nacelles, with hot air piped to the surfaces.

The jet aircraft presented the possibility of a better system with its ready made source of high-pressure, high temperature air. That source is the compressor. However, this air often runs over 700 degrees and its effect on the surface of the aircraft must be controlled. So, enter the electrical receptors. These have a resemblance to their counterparts in the human body, man's sensory nerve ends which report thermal extremes to the brain.

Each of the aircraft's sensing elements is a coil, sending signals through electronic nerves to an electronic control. This coil is made up of 13 feet of fine wire, wound up in an aluminum case about the size of a silver dollar. The nerve end is set flush into the skin on wing and tail surfaces.

As fluctuations in temperature occur, the wire's resistance to a small electric current also changes due to the peculiar properties of the metal alloy from which the wire is made. The changing resistance of the wire results in a signal which is picked up and interpreted by the electronic control regulator of the system. This device regulates the flow of heated air by operating a modulating valve. The regulator is set to maintain the surfaces at a constant 100 degrees while the system is in operation.

The anti-icing system itself is comprised of air ducts buried in the leading edges. These ducts must take the full pressure from the engines and are of stainless steel. Hot air is delivered direct to the inner surfaces of the skin, top and bottom, through a series of fine holes in the ducts. Sprayed through these, the air filters back through a series of small passages along the entire surface.

The pilot's part of this operation is very simple. He merely throws on a switch on the instrument panel when he wants anti-icing protection.

Left and above is Capt. T. E. Roberts' idea for using a chest type parachute as a shoulder harness in the event of a crash landing. Many crew seats are conducive to this system.

The Convertiplane embodies a new concept of flight, the unloaded rotor. This revolutionary aircraft is equipped with a rotor for vertical flight, and wings and a prop for horizontal flight.

Convertiplane Completed — A joint development of ARDC, the Transportation Corps of the Army and McDonnell Aircraft Corporation, has resulted in the XV-1 Convertiplane. This aircraft embodies a new concept of flight—the unloaded rotor. In other words, a machine equipped with a rotor for vertical flight, and wings and a conventional propeller for horizontal flight.

The primary mission of the XV-1 will be the exploration of the application of this principle to larger aircraft. Studies also will be made on the tactical use of the aircraft for reconnaissance, observation and other related missions.

In vertical flight or while hovering, the rotor provides all the lift. In forward flight, of course, the wings provide the lift. This allows the rotor to auto-rotate at its lowest drag configuration, avoiding the speed limitation encountered by conventional helicopters due to stalling of the blades when carrying lift at high speeds.

Each of the three blades of the rotor is powered by a McDonnell-developed pressure jet unit located at the tip of the blade. A continental reciprocating engine is provided on the aft fuselage to supply air to the jet units during vertical flight and power to the prop for forward flight.

The power available from the jets allows the use of a rotor having approximately half the drag of a conventional helicopter rotor. As the wings do not need to provide lift during takeoff or landing, they are about half the size of the wings for conventional fixed wing aircraft. Therefore, speed performance of the XV-1 is not penalized greatly by utilizing both rotor and wing.

The research program on the XV-1 will include much ground testing, instrumentation and preliminary flight test work, including full scale wind tunnel testing.

ODDS and ENDS

- The 179,000 rivets in a modern jet fighter would tower two and a half times as high as the Empire State Building if placed on top of each other.
- One of the Air Force's latest fighter-bombers, the F-84F, "breathes" as much air in a minute as an adult does in four months.
- At the speed of sound, the leading edges of a low flying aircraft grow 95 degrees warmer than the surrounding air; at 10 times the speed of sound they can reach 9000 degrees Fahrenheit.
- Another achievement in flight safety was recorded when Bell Aircraft's Helicopter Division at Ft. Worth flew 7569 test flights without damage to aircraft or injury to personnel in 1953. Total flight time was 2074 hours.
- The National Bureau of Standards has developed an altimeter which will measure altitudes as low as two feet. This non-quantized, frequency-modulated altimeter makes it possible for a helicopter pilot to know when his 'bird' is within several feet of the landing surface.

A new pilot-ejection seat developed by Republic is tested in composite picture below. The seat has a device which automatically disconnects the safety belt at the peak of the arc after ejection.

MIXMASTER MYSTERIES

By Major Russell G. Winegar
Gary AFB, Texas

BEFORE the recent action in Korea was a year old, a lone YH-19 was sent to the Far East for field service testing under combat conditions. This YH-19, capable of carrying a considerably greater load than any other helicopter then in operation in Korea, arrived on the scene about the time our Intelligence people were anxious to get their hands on a MIG-15, or any part thereof. So when a photo reconnaissance mission reported that one had crash-landed up east of Sinanju, a pilot, copilot and cloak-and-dagger team climbed aboard the new aircraft and headed for the crash site.

After the MIG pieces were picked up, it was necessary for the helicopter to churn through an area of busting flak to get back to home territory. Flak, obviously radar controlled, completely surrounded the YH-19. As every pilot knows, the most effective way to evade flak is to keep changing altitude, airspeed and heading. Changes of heading caused no problem, but rapid changes of altitude and airspeed resulted in the pilot's inadvertently exceeding safe airspeed. During evasive maneuvers, violent beats developed in the aircraft.

Fortunately, the pilot recognized his problem as blade tip stall induced by excessive airspeed, and was able to take immediate corrective action. The new helicopter got back to friendly territory without difficulty, its important cargo intact.

Because every helicopter pilot must be prepared to deal with stalls such as this, it may be a good idea to review the reasons for stalling and the corrective action that is necessary, once a stall is induced.

Now stalling, as applied to fixed wing aircraft, does not occur in a helicopter. There are, however, two types of stalls to which all helicopters are subject:

(1) Blade tip stalls, which may occur in high speed flight.

(2) Rotor stalls (commonly spoken of as "settling with power") which may occur during a vertical or low transitional speed descent.

Blade tip stall refers to a stalled condition occurring at the tip portion of a blade in the retreating half of the rotor disc during high forward speed. (See Figure I.) It is a result of the low speed of the retreating blade and of the high positive angle of attack that is necessary on the left side of the helicopter to produce the extreme tilt of the rotor needed for high speed flight. Or, to put the same statement in a slightly different manner, blade tip stall is similar to the stall experienced in frozen wing aircraft because of the slow speed of the retreating tip and the *high blade loading* of the outer section of the rotor blade. It is a localized condition and exists throughout only a small portion of the rotor disc.

Contributing factors to blade tip stall, in addition to a high forward speed, may be high gross weight, altitude, acceleration and power, turbulence, low rotor rpm and G forces. The effect of air turbulence or violent maneuvers in relation to safe airspeed (wherein blade tip stall ordinarily will not be encountered) cannot be overemphasized. Instances have occurred in which conditions of blade stall were produced at airspeeds of 60 knots or less, even at low altitudes, because of severe turbulence, gusty wind conditions or violent flight maneuvers.

Turbulence or any maneuver which increases the load factor reduces the

Recently much discussion has centered around helicopter flight characteristics. Here are the views of one experienced instructor on this subject.

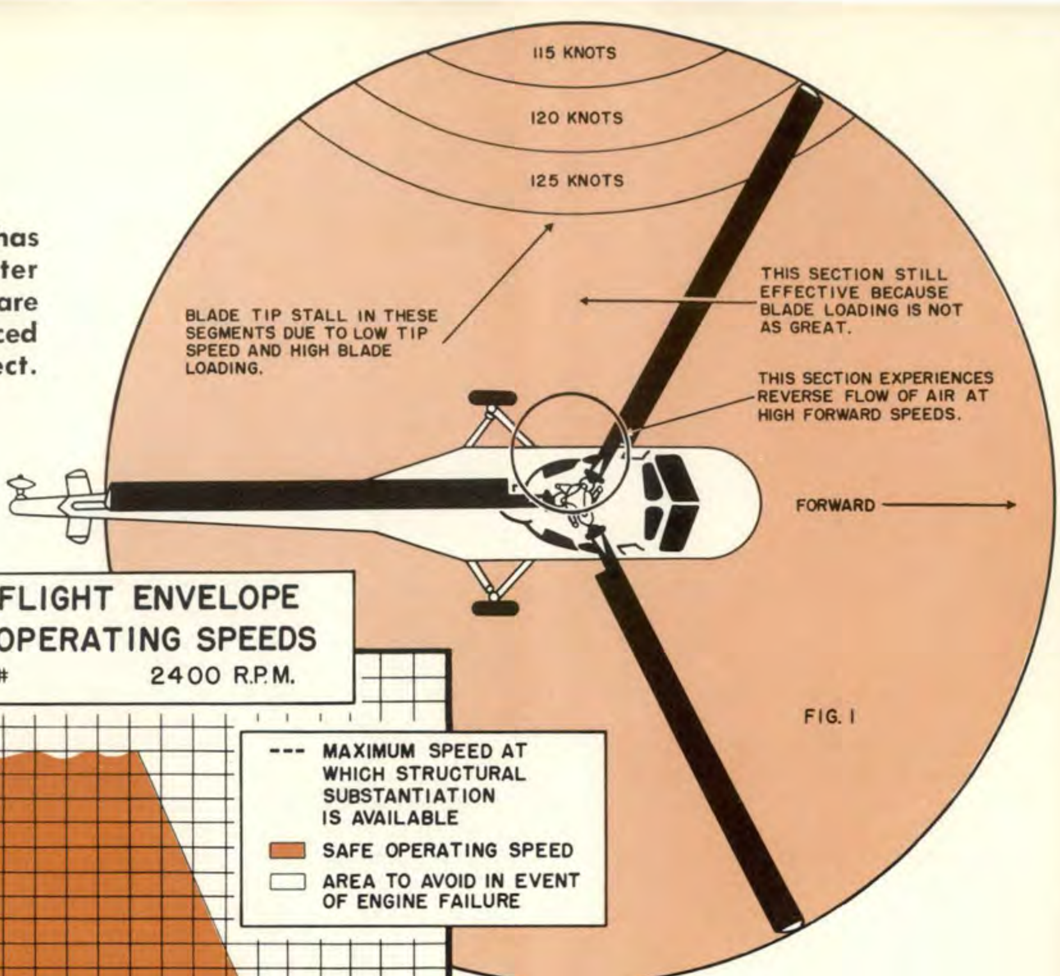
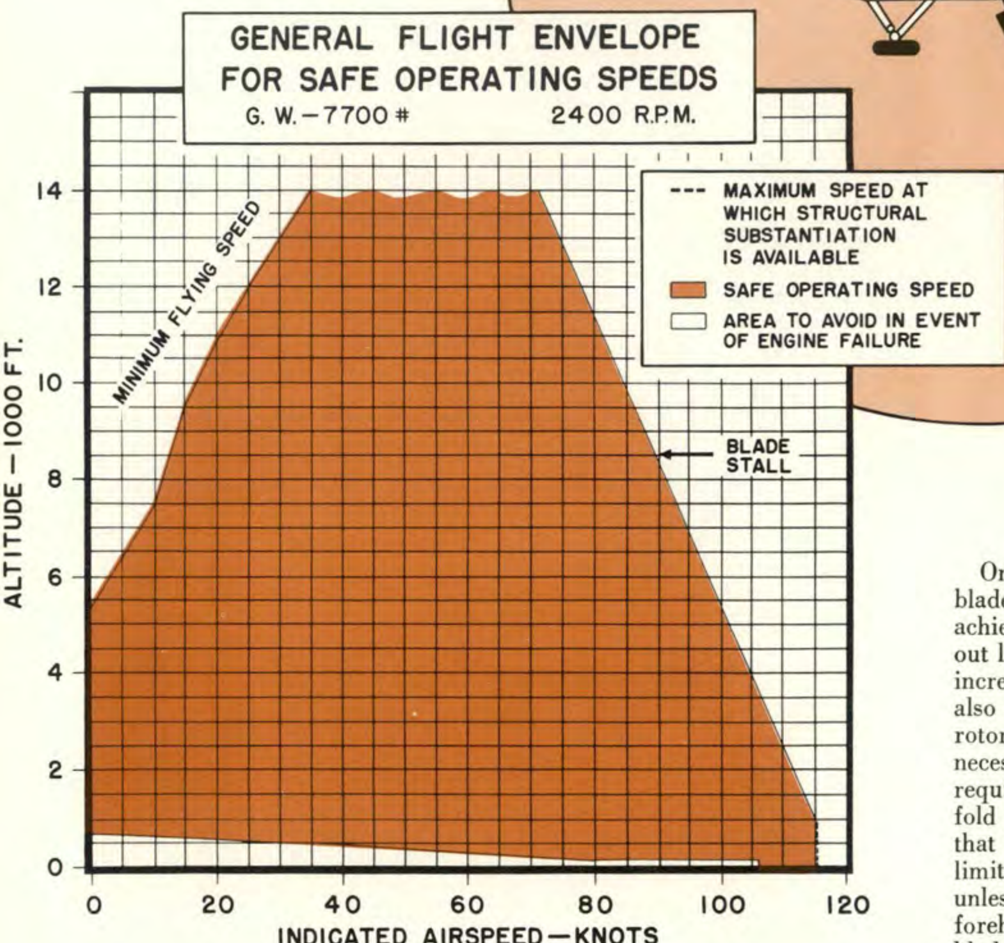


FIG. I



maximum forward speed at which blade stall will occur. *An additional load factor of one-tenth of a G reduces maximum speed for blade stall by 10 knots.*

The pilot will recognize blade tip stall by a peculiar roughness in the airframe and controls. The roughness will be in the nature of a three-per-revolution beat, occasioned by each blade reaching the stalling region, then recovering. This roughness will be felt even though the flight control servos are operating.

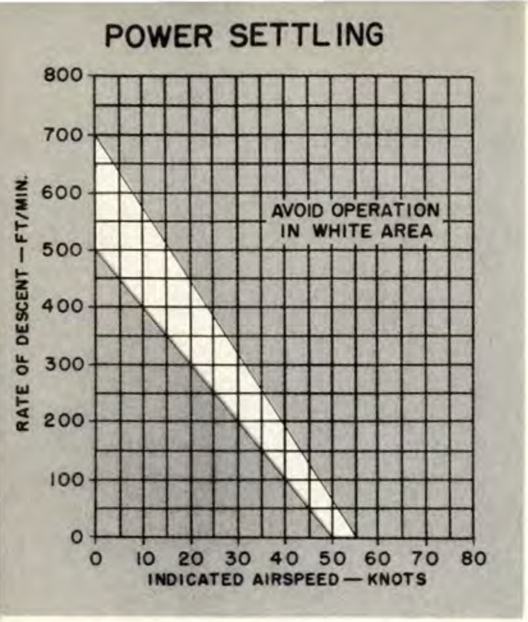
When blade stall occurs, it may be eliminated easily by accomplishing any one or a combination of the following:

- Decrease airspeed.
- Increase motor rpm.
- Reduce main rotor pitch.
- Decrease severity of the maneuvers.

Most rapid recovery will be effected if the pilot combines all four corrections. Figure I shows the locale of the tip stall and the approximate speeds at which it occurs.

One other point on the subject of blade tip stall correction. In order to achieve an increase in airspeed without loss of altitude, it is necessary to increase the manifold pressure which also increases the pitch on the main rotor blades. Therefore, the high speed necessary to result in blade tip stall requires high blade pitch and manifold pressure settings. It can be seen that power requirements therefore limit the maximum forward speed, unless blade stall is encountered beforehand. So how do you avoid a blade tip stall condition? *Do not exceed the airspeed allowable after proper consideration has been given to these factors: Altitude, rpm, load condition, turbulence and violence of maneuvers.*

As noted in Figure I, it is evident that the middle portion of the rotor blade is not subject to the tip stall just discussed. Although the airspeed of the middle portion of the blade is slower than that of the outer tip, it is still effective because the blade loading in that area is considerably less than that existing at the outer portion. On the extreme inner por-



tion of the blade, however, the airspeed becomes less and less until there is a complete reversal of airflow at high forward speeds.

"Settling with power" (a rotor stall) is a phrase commonly used by helicopter pilots to describe a particular state of flight that brings about a fast vertical rate of descent. This phenomenon is encountered during vertical or nearly vertical descent, when the rate of descent is at least 300 fpm and horizontal velocity is no higher than 10 knots. It is brought about by a reversal of airflow through the rotor, which forces the blades to operate at angles of attack above their maximum coefficient of lift. Studies have shown that blade stall starts near the hub and progresses outward along the blade as the rate of descent increases. The application of collective pitch and power, with no increase in airspeed, results only in stalling more of the blade area, thereby producing an even more rapid descent rate.

Settling with power is normally experienced by a helicopter pilot because he has miscalculated. He may find himself in this predicament as a result of:

- An attempt to hover out of ground effect at an altitude above the hovering ceiling.
- An attempt at hovering out of ground effect without exercising precise altitude control.
- A low-speed, steep, straight or spiraling, partial-power descent where the airspeed is inadvertently "zeroed."

Settling can be hazardous if encountered near the ground (below 1000 feet). Rates of descent exceeding 2200 fpm have been recorded during settling. The characteristics of settling are very similar to the feel of stall in a conventional aircraft. That is, roughness in the airframe and controls and some loss of control effectiveness. Directional control, particularly, becomes very difficult because of extreme force of torque.

The recovery procedure is also approximately the same as that used in a fixed wing aircraft. Drop the nose and accelerate into forward flight. Recovery also can be made by reducing collective pitch to the minimum, which will result in vertical autorotation almost immediately. This procedure, however, results in very rapid loss of altitude.

As mentioned before, the blade tip stall condition and the rotor stall condition are accompanied by roughness and vibration in the controls. During a blade tip stall the pilot is aware of a "beat" or resonance. It may be of help to discuss the various disturbances or mechanical malfunctions which will cause roughness or resonance in helicopter operation.

Here are some definitions of helicopter troubles as outlined in this article:

- *Control Unbalance* — Any rotating body, whether it is a wheel, a gyroscope or a rotor, moves in a given space pattern. If this space pattern is disturbed by an external force (which can be the air, an internal disturbance of the controls by the pilot or a disturbance set up in an auxiliary boost control unit), unbalanced forces will be transmitted by the rotor to its mounting structure in the helicopter. This unbalanced force may be of such an amplitude and frequency that a resonant response is obtained throughout the entire aircraft.
- *Tracking Unbalance* — A rotor which is greatly out of track may set up an unbalanced condition (tracking unbalance) which will be transmitted throughout the helicopter. This type of unbalance usually results in nothing more than a rough helicopter and a "beat" in the cyclic control stick. If enough track unbalance exists, it is possible that a combination of factors may result in resonance.
- *Damper Vibrations* — If one or more dampers do not provide sufficient damping, then resonance will occur if the frequency of the blades swinging about their drag hinges lags or leads the blade out of its 120° pattern, causing the helicopter to shake or vibrate. In turn, this vibration or shaking motion of the helicopter will aggravate the out-of-pattern condition of the blades, and both the blade out-of-pattern and the shaking or vibrating of the helicopter will build up until the helicopter is destroyed.
- *Hinge Bearing and Hinge Pin Vibrations* — Flapping hinge bearing or horizontal hinge pin bearing vibrations build up slowly over a period of time. Complete failure of this bearing will cause severe vibrations throughout the helicopter, resulting in possible resonance.

With all this information in mind, the helicopter pilot will probably come to the conclusion that blade stalls need not be particularly dangerous. That conclusion is certainly correct, despite widespread rumor to the contrary. As in any other aircraft, the pilot needs only to know what factors induce stalls, how to recognize the condition when he encounters it, and what action on his part will correct the situation. ●

ALTITUDE FT.	GROSS WEIGHT LBS.	RPM	
		2100	2400
S.L.	8500	74	110
	7500	85	115
	6500	96	115
5000	8500	57	93
	7500	68	104
	6500	79	115
10,000	8500		76
	7500	51	87
	6500	57	98

MAXIMUM SPEED AT WHICH STRUCTURAL

MAXIMUM SPEED

(NOT TO BE EXCEEDED BECAUSE OF BLADE STALL OR STRUCTURAL LIMITATION)

NOTE:

1. FOR ACCELERATED FLIGHT, REDUCE SPEEDS.
2. FOR MILD GUST CONDITIONS, REDUCE SPEEDS 10 KNOTS.

   FOR HIGH GUST CONDITIONS, REDUCE SPEEDS 20 KNOTS.
3. SPEEDS NOTED ARE INDICATED AIRSPEED IN KNOTS.


MAJOR
REX RILEY
AIRCRAFT ACCIDENT INVESTIGATOR
by STEVE HOTCH
A TRUE STORY
.... THE PRIMARY CAUSE OF THE ACCIDENT WAS MISJUDGMENT OF HEIGHT.... THIS COMBINED WITH THE CONTRIBUTING CAUSES — FAILURE TO RESET ALTIMETERS AND POOR VISIBILITY — COULD HAVE RESULTED IN A MUCH MORE SERIOUS ACCIDENT....... THIS IS WHAT HAPPENED.........
.... A T-33 PILOT AND AN I.P. WERE NUMBER THREE ON A NIGHT NAVIGATION FLIGHT.......
WEATHER WAS 4000 FEET OVERCAST, TWO AND ONE HALF MILES VISIBILITY, SMOKE AND HAZE WHEN THE FORMATION ARRIVED OVER THEIR DESTINATION..... ALTIMETER SETTING WAS 30.07
...UPON LOCATING THE FIELD THE FLIGHT LEADER ADVISED THE OTHER PILOTS...
... STAY TUCKED-IN UNTIL WE BREAK.... WATCH THAT HAZE AND STAY ON THE BALL......
THE HAZE ACCENTED THE FULL BRIGHTNESS OF THE RUNWAY LIGHTS.... REQUESTING THAT THEY BE DIMMED THE LEADER AND NUMBER TWO LANDED SAFELY........
THE I.P., IN NUMBER THREE, FLEW A WIDE BASE LEG AND TURNED ONTO A LONG LOW FINAL........
....3200 FEET FROM THE RUNWAY THE T-33 STRUCK A LARGE TREE!
...UPON IMPACT, POWER WAS ADDED AND A GO-AROUND MADE... THE TOWER REPORTED NO VISIBLE DAMAGE AND THE LANDING WAS COMPLETED....
...THE LEFT WING, LEFT FLAP AND INTAKE SUFFERED MINOR DAMAGE... NEITHER THE I.P. NOR THE STUDENT HAD RESET HIS ALTIMETER... TAKEOFF SETTING WAS 30.47 AND DESTINATION SETTING 30.07... THIS WOULD CAUSE THE AIRCRAFT TO BE 400 FEET LOWER THAN THE INDICATED ALTITUDE... INACCURATE SETTINGS PLUS HAZE MADE THIS INSTRUMENT PRACTICALLY USELESS AS AN AID IN DETERMINING HEIGHT ABOVE THE GROUND!!

The pilot, as well as the aircraft, must be in shape for every flight. Being in shape means caring for yourself just as an athlete trains for the Olympic Games or other athletic events.

YOU IN THE BLUE

FLYING SAFETY is indebted to the Douglas Aircraft Company, Inc., for the following article. Through their co-operation we are presenting highlights of their Flight Fitness pamphlet, prepared by the Engineering Div.

YOU, as a pilot, should be familiar with certain factors affecting the human body. Knowledge of these factors will assist you to carry out your flight missions safely and in an efficient manner.

Probably you've been exposed to quite a bit of this information previously. Most of it is contained in various medical publications but is not readily available or expressed in simple terms.

Just as there are restrictions on your airplane, there are restrictions on what you can do. You might say they were determined by design limitations practiced by the Almighty when He built you. These are built-in and must be remembered just as well as those in your airplane. When all is said and done, there is only one way the two of you can function effectively, and that is as a team.

The real purpose of this article is to bring sharply to your attention the fact that you can put additional restrictions on your team. They are under your deliberate control and you can't blame the Almighty or science for failures occasioned by your own deeds or misdeeds.

Human Restrictions

Restrictions on the human body can best be expressed in terms of the lack of power to overcome physical stresses. These vary depending upon environment. Flying presents a number of stresses which are found only in this particular field. One group is classified as natural stresses because they are built-in and are not induced by our own efforts. Let's examine some of these stresses and see how they affect your ability as a pilot.

EXPOSURE TO ALTITUDE WITHOUT OXYGEN — We're not going to delve too deeply into this subject. It's a continuing subject with us and we'll be hitting it again soon in FLYING SAFETY.

However, just remember that oxygen is as necessary for the functioning of the human body as it is for the combustion of fuel. Your body uses oxygen in much the same fashion by combining it with a carbon compound to produce energy and gives off carbon dioxide as a waste.

Be sure to review your technical directives on the use of oxygen at frequent intervals and carry them out religiously.

EXPOSURE TO CARBON MONOXIDE — Carbon monoxide, when absorbed by the blood, can be extremely dangerous, as we all know. It reduces the amount of hemoglobin available for carrying oxygen to the tissues and makes the transfer of whatever oxygen is present difficult. It is absorbed by the blood more than 200 times more readily than oxygen and is more difficult to dislodge from the blood.

The danger of carbon monoxide, especially in combination with lowered partial pressure of oxygen at altitude, cannot be overemphasized.

FLYING SAFETY covered the dangers of carbon monoxide poisoning in the May issue. If you didn't read it, better get a copy and dig in right now.

EXPOSURE TO RAPID ALTITUDE CHANGES — Rapid pressure changes, incidental to changes in altitude, present no problem if you are in good physical condition, since normal clearing of the ears will permit balancing the pressure between the middle ear and the outside air.

The problem arising from exposure to rapid altitude changes when flying with a severe cold may well come under the category of "asking for it."

EXPOSURE TO NOISE AND VIBRATION — Noises in aircraft are derived principally from the propeller, exhaust, moving parts of the engine and aerodynamic sources. Noise intensity is measured in decibels. Research indicates that a noise level of 116 decibels, when sustained for over a period of six hours for eight successive days, may be of sufficient intensity to cause irreparable hearing loss.

Helmets, earphones and earplugs all have their place and certainly do help but there's no denying that excessive noise, over protracted periods, causes a lot of fatigue. Keep that in mind and remember that a couple of mills churning in your ear can slow up your reaction time, but plenty.

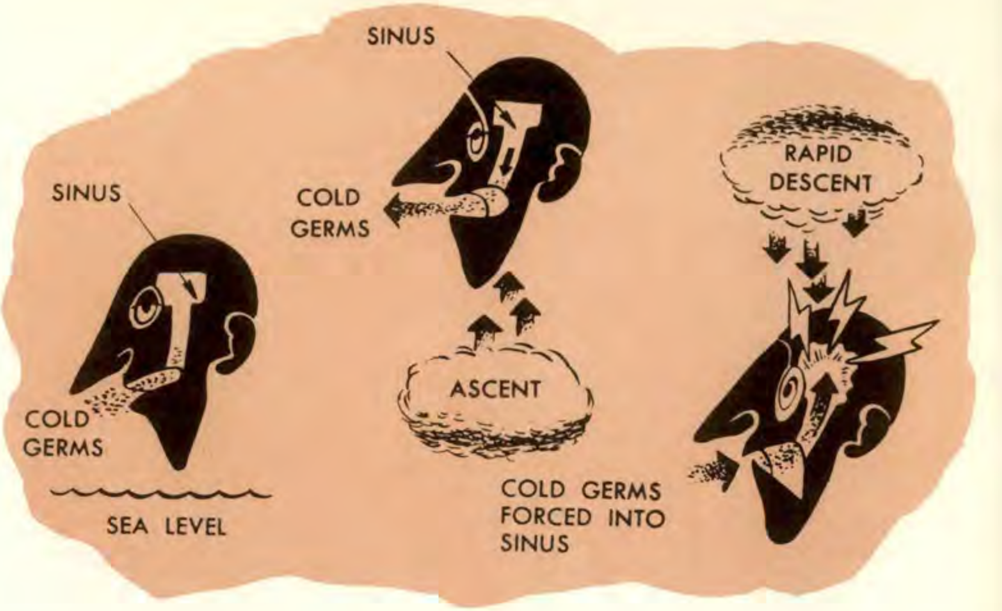
EXPOSURE TO MOTION — Some people tend to become airsick easily. Others are never bothered. There's no one single cause for all cases. The symptoms are very clear and unmistakable. If you are susceptible, you will learn for yourself what your best course of action should be, what food items to avoid and how much of what motion you can take. Consult your flight surgeon and work out together the best plan for you.

EXPOSURE TO VISUAL DISTURBANCES — There are a number of disturbances and distortions that can occur during flight. Haze, color distortion, motion paralax and vertigo are familiar to all pilots. Also, certain optical illusions such as those caused by lights reflected from water or scattered lights in unsymmetrical patterns on the ground, can cause confusion and disorientation. The only logical answer is "use those instruments!"

The Self-Induced Stresses

Exposure to the following self-induced stresses is within your control. Read 'em and remember 'em. It's your neck that's out, and, quite possibly, several others may be on the block with it!

INADEQUATE REST — We don't need to dwell on this one. You *know* how much sleep you need. If you deliberately skip this one factor, brother, you're looking for trouble. In case you don't know, lack of sleep reduces your efficiency and this in turn reduces your tolerance to stresses and slows reaction time.



COLDS — We're not going to dwell on colds in this article. You've been warned many, many times about leaping off into the blue when a head-cold is raising hob with your system. We've classed colds under self-induced stresses because they mean much more in flying than in your ordinary terrestrial existence. The cartoon depicts just how cold germs louse you up when flying.

SELF-MEDICATION — See May 1954 FLYING SAFETY. If you want to put the doctors out of business, best you get a license to practice.

ALCOHOL — It shouldn't be necessary to dwell on this subject that's so near to the heart of so many. Alcohol slows down mental performance and reaction time and it takes many hours for its effects to wear off. In modern aircraft the slow jockey may well be the dead one. Either join the AA's or play it real cool. Remember, *you* are the worst judge of the effects of alcohol upon your system and perhaps little realize what it does to your fitness.

POORLY CONTROLLED EMOTIONS — An untroubled mind is one of the greatest assets you can have. This is especially true when you consider the mental tasks and reactions required of you while flying. With split-second tasks to perform you may find yourself really behind the eight-ball if you have been flying along worrying about your finances, love life, mother-in-law or other equally disturbing conditions.

If your problems seem too great for you to solve, if you should worry constantly, you'd better take them to your banker, lawyer, doctor or chaplain. It's a cinch you shouldn't fly under mental strain. It leads to distraction from your normal functions, doping-off and if continued, to a case of psychoneurosis. Then, if you haven't fouled-up enough in the meantime to need an undertaker, you'll probably require the services of a good psychiatrist.

EXPOSURE TO ACCELERATIONS — There are four kinds of accelerations that pilots may expect to encounter:

★ Moderate G lasting for some time. This is the kind encountered in pulling out of a dive (aircraft, that is). This causes the blood to be thrown into the lower part of the body and if it lasts long enough, the heart does not get enough blood to keep up the circulation. Black-out may result.

★ High G of short duration—less than a second. This is unavoidably built into the ejection seat in order to get a trajectory that will clear the empennage.

Position yourself correctly prior to an ejection and there's no sweat on this one.

★ Sudden forward deceleration. This is encountered in crashes. The threat from this kind of deceleration

RAPID DECELERATIONS CAN BE DANGEROUS

is the chance of developing a gunsight complexion. Proper use of the shoulder harness will preclude this kind of a mess.

★ Tangential G of short radius. This is encountered in tumbling and buffeting. We can't give too much of an answer on this one, yet! Apparently not too severe unless the blowtorch gets pretty far gone.

UPSET STOMACH — This condition may vary from a mild tummyache to one accompanied by excruciating pain. Flying should not be attempted when suffering from this condition since your efficiency and tolerance to inherent stresses will be considerably lowered.

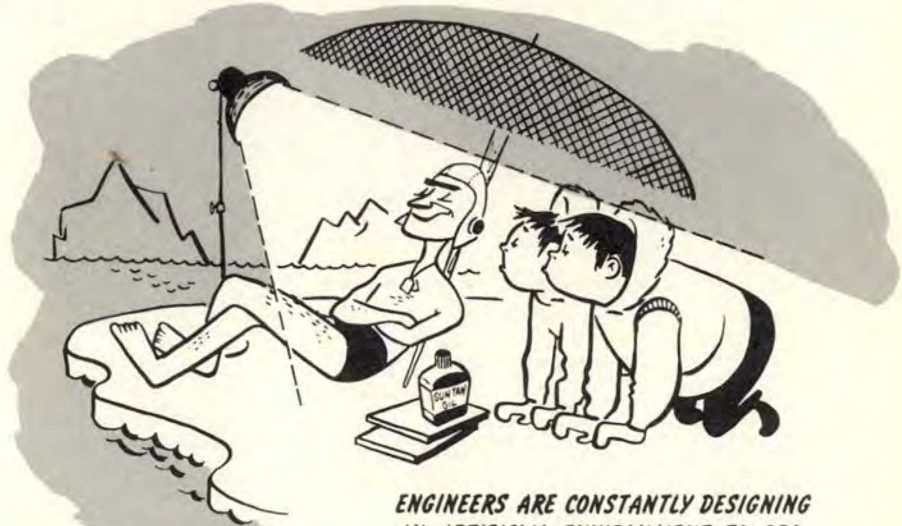
Distension of gas in the stomach and intestines can be the cause of these symptoms. Avoid gas-forming foods especially if you are going upstairs. If you want to know what gas-forming foods are, see your long-suffering flight surgeon.

SMOKING — There is one very sound reason why smoking can reduce the fitness of the pilot. The carbon monoxide resulting from incomplete combustion of the tobacco is the same as that which comes from the engine. The combined effects of the carbon monoxide and reduced oxygen at altitude can be harmful.

Remember, too, that excessive smoking can affect your night vision a great deal. The old depth perception can really get knocked off center if you go charging through the black of night, leaving a trail of tobacco ashes behind.

One last thought on tobacco. Maybe this doesn't apply to you, but it could! Many pilots have been known to yank off the oxygen mask long enough for a quick smoke. Figure it out. Mix one faulty regulator (leaking type) with one match (lit) and step clear! It has happened.

SMOKING, LIKE OTHER - ER - THINGS —IS BEST IN MODERATION! JUST DON'T OVERDO IT!



ENGINEERS ARE CONSTANTLY DESIGNING AN ARTIFICIAL ENVIRONMENT TO PROTECT YOU

HEAT AND COLD — We could write reams on this subject but for the sake of the record we'll only say: Dress for the occasion. Uncle has invested a lot of dough in developing and procuring adequate flight clothing to meet the demands of practically every clime. When you are issued gear for protection, learn the reasons for it and get familiar with its use. You can't keep fit if you let yourself get exposed to even uncomfortable degrees of heat or cold.

EMPTY STOMACH — Food to the human body is like fuel for an engine. Fortunately, the mechanics of energy conversion in the human body do not require a continuous supply of food. Your body also has the ability to store up reserve energy permitting you to function between "refuelings." To function efficiently, however, you must maintain regular meal schedules — preferably on a three-meal-a-day basis.

The reason for this is simple. If you allow too much time between meals, your potential energy level drops below that required for your efficient operation before you refuel your engine again.

Eat right and feel right!

To boil all of this down just remember that important stresses affecting pilots have been covered briefly. This information has been offered to impress upon you that:

- Stresses exist which are detrimental to flight safety.
- Other stresses may develop as a result of your failure to maintain physical fitness.
- These stresses are not only detrimental individually, but their effects are also ADDITIVE and as such may result in the failure of your mission and may even cost your life.

To quote that well-known Ground Safety cliche, "The life you save may be your own." Play it cool, brother, and stay loose. ●

Natural Stresses

Exposure to altitude without oxygen.
Exposure to carbon monoxide.
Exposure to rapid altitude changes.
Exposure to noise and vibrations.
Exposure to motion.
Exposure to visual disturbances.

Self-Induced Stresses

Inadequate rest.
Colds.
Self-medication.
Alcohol.
Heat and cold.
Empty stomach.
Upset stomach.
Smoking.
Poorly controlled emotions.
Exposure to accelerations.

POSITION
is everything

As the title implies, proper position means the difference between a successful ejection or possible failure. If you haven't already done so, be sure to read the article, starting on page 12.

★ ★ ★

FLYING SAFETY realizes the value of a bit of cheesecake. YOU looked at the gal, didn't you? Now, don't skip the story.

Barbara Ruick — MGM.


Mal Function
Mal looked with scorn on rocket sled
"Just junior hot rod," so he said.
"These science guys, it's plain to see
"May kid the troops, but not fool me."
Mal insults the whole test crew
As this poor dope is wont to do.
He needles on while Jato men
Hook rockets up and then—oh then—
Placed on sled, flat on back
No-hands Louie, down the track.