JULY 1958

FLYING SAFETY

UNITED STATES AIR FORCE

contents

Volume Fourteen • Number Seven

USAF PERIODICAL 62-1

Lieutenant General Elmer J. Rogers
The Inspector General USAF
Department of the Air Force

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

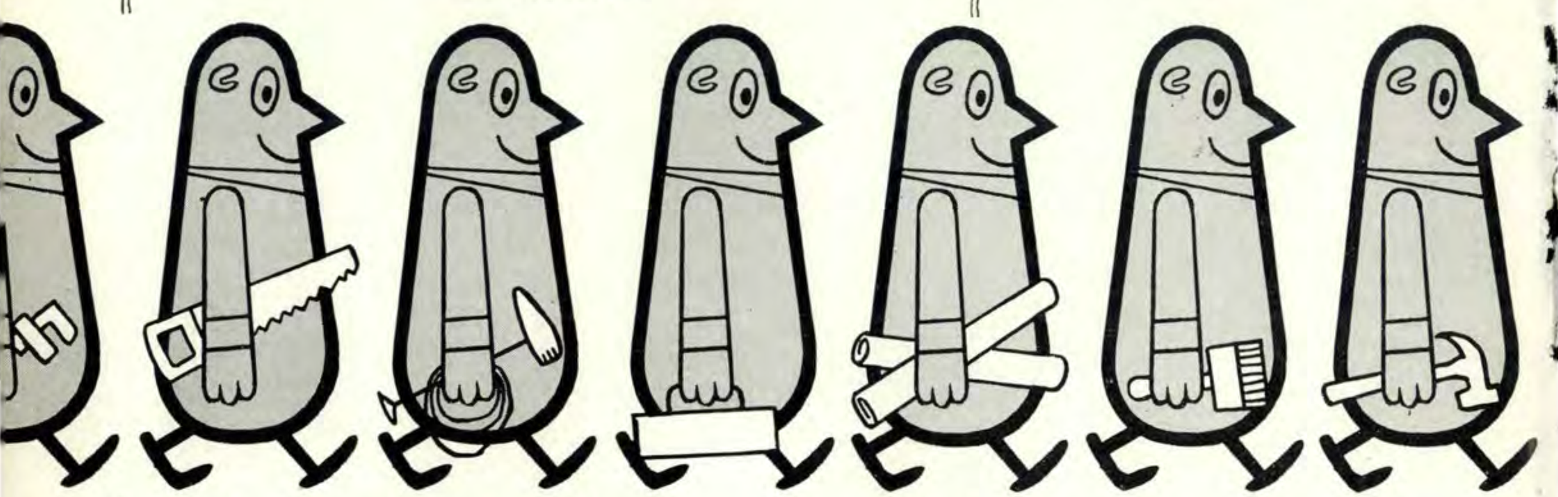
Major General Joseph D. Caldara
Director of Flight Safety Research
Norton Air Force Base
California

Colonel Daniel M. Lewis
Supervisor of Flight Safety
Publications

Lieutenant Colonel Ralph R. Springer
Chief, Editorial Branch

•

Editor	Major Vernon R. Stutts
Assistant Editor	Major Francis D. Hessey
Managing Editor	William Johnston
Art Editor	M/Sgt Steven A. Hotch
Production	Major Ben H. Newby
Editorial Assistant	Amelia Askew
Distribution	A1/c James D. McFall, Jr.



the editor's view . . . . . .

'Tis said that when it rains, it pours—and it's pouring these days. Changes are coming about fast and furiously, and most of us are having trouble just figuring out when what is going into effect where. To complicate matters, the changes are vital as well as overlapping.

Foremost among the changes affecting pilots are the new rules concerning traffic control procedures—where you can fly, when, in what, and most importantly, how. Overlapping this is the recent shift to Greenwich Time for traffic control. One mistake can foul up a whole system. Recent changes in communications procedures and frequencies may still be new to some. Add to this some sweeping changes that may be experienced in allied operations following the implementation of the new aircraft maintenance manual, AFM 66-1 due out 1 July. Throw in a new data book scheduled to replace the Supplementary Flight Information Manual—also due out about 1 July. Consider also the new equipment and the uses thereof, and we've all got problems. The word is—KNOW BEFORE YOU GO.

Vernon R Stutts

SUBSCRIPTIONS—FLYING SAFETY is available on subscription for $2.50 per year domestic; $3.50 foreign; 25c per copy, through the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Changes in subscription mailings should be sent to the above address. No back copies of the magazines can be furnished. Use of funds for printing this publication has been approved by the Secretary of the Air Force and the Director of the Bureau of the Budget, 18 July 1956. Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payment can be made for manuscripts submitted for publication in the Flying Safety Magazine. Contributions are welcome as are comments and criticism. Address all correspondence to Editor, Flying Safety Magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Prior to reprinting by non-Air Force organizations, it is requested that the Editor be queried, advising the intended use of material. Such action will insure complete accuracy of material, amended in light of most recent developments. The contents of this magazine are informational and should not be construed as regulations, technical orders or directives unless so stated.

CROSS FEED

LETTERS TO THE EDITOR

Note from Korea

Your publication has recently come to my attention. It will make a most excellent source of reference material for several of the courses now included in the curriculum of this institution. Will you please add us to your regular mailing list?

Lee, Chun Soo
Lt. Col., ROK AF
Deputy for Research & Study

★ ★ ★

Stop, Sir!

May I compliment Major Jim Price on his excellent article entitled "That Sudden Stop," printed in your March issue? Airspeed control is certainly a "must" in executing a safe and optimum approach and landing.

I should like to invite further attention to the relation of angle of attack and airspeed. Where an airplane, such as a fighter, is always landed at a given flap setting and within a narrow weight range, a given angle of attack will establish a given airspeed and vice versa. However, the airspeed-angle of attack relationship is a function of weight and flap setting.

For airplanes such as the C-130, B-47 and B-52, where the landing weight can vary over a wide range, and in the case of the C-130 where flap setting is the pilot's choice, the airspeed-angle of attack relationship can vary considerably. For the B-47, for example, your approach speed is determined for your particular landing weight from an approach speed chart. I am implying, in other words, that there is one angle of attack that will provide any given airspeed for a particular weight and flap setting.

Again, let me say "more power to you" in emphasizing the need for airspeed control in approach and landings.

C. E. Littlejohn
Operations Engineering
Lockheed Aircraft Corp.
Georgia Division

★ ★ ★

From the Navy

I've read Major Price's article "That Sudden STOP" published in the March issue. It is an excellent article as far as it goes! I have a couple of comments, however. Academically speaking, the angle of attack varies inversely at the SQUARE of the airspeed for the same lift (or the same aircraft weight in unaccelerated flight).

Secondly, if the landing weight of a particular aircraft is fixed, then all the comments of the article apply. If, however, the aircraft landing weight can vary appreciably percentage-wise, such as a fighter type landing with or without a "large" store, then the problem gets more complicated. To hold the best approach angle of attack, the airspeed must be increased as aircraft weight is increased.

For example, if an aircraft is normally flown at an approach airspeed of 130 knots at a gross weight of 15,000 pounds, it should be flown at about 139 knots with a 2000-pound store (at 17,000 pounds gross weight). For varying gross weights, the angle of attack and *not* the approach airspeed must be kept constant. A reliable angle of attack indicator would be an excellent primary or secondary landing approach instrument. This instrument would also be of use during the turning portion of the approach where airspeed is not a true indication of angle of attack unless 1G flight is maintained. The same comments apply in a qualitative sense to the power required for approaches made at varying gross weights.

Needless to say, we of the Navy are vitally interested in this subject. Landing short results in a fatal "Sudden STOP" at the aircraft carrier's "spud locker," and a hot landing can result in breaking the aircraft's tailhook or the carrier's arresting gear with equally disastrous results.

LCDR Douglas S. Mackay USN
U. S. Naval Air
Special Weapons Facility
Kirtland AFB, New Mexico

★ ★ ★

"Fursty" and its Flying Safety Program

The primary flying mission of the 7367th Flying Training Group is to assist the German Air Force in training its men in the basic jet flying course. We are using T-33As and our section is designated as the "7367th Flying Training Department." We have both American and German instructors and supervisors: Sixty-five USAF instructors and seven supervisors; thirteen German instructors and six supervisors. We also have 104 German students being trained in the basic course, the instructor course and an instrument refresher course. Our department is composed of two sections of three flights each.

We like the organization of our flying safety program here at "Fursty." We feel that we do get right to the core of flying safety—THE PILOT. We have a department Flying Safety Officer and German Air Force Assistant. In each flight we have a USAF Flight Flying Safety Officer with a GAF Assistant.

Our organization has a Department Standardization Board composed of four men. Each flight has a Flight Standboard Officer. These men in the flying safety jobs and flight standardization positions perform their functions with a great deal of enthusiasm and as an extra duty—their primary duty being IPs.

Our flying safety and standboard sections work "hand-in-glove" in promoting standardization and flying safety, for standardization promotes flying safety. Each month we have a Department Flying Safety Conference with supervisors, GAF Air Base FSO, Flight Surgeon, Flight FSOs, Flight Standboard Officers and representatives from the Academic Department, AACS, Base Operations, Maintenance and Standboard. We discuss any new problems that may have come up during the past month, and any possible hazards to flight safety, and new material sent to us by the Directorate of Flight Safety Research. Suggested briefing lists for the next month are presented to the FSOs and Stand Officers, as well as a talk by someone like the Flight Suregon or an AACS representative.

When the meeting is over, the Flight FSOs and Stand Officers prepare a briefing plan for the next month which is turned over to the Supervisors, Department FSO and Standboard. Each month three of the Flight FSOs present a briefing on a major subject to put in our files for future reference. This briefing can be brought up-to-date and used in the future.

Here is a GAF Flight FSO's Plan which was used, together with the briefing which he turned in, for other FSOs to use if they wanted to:

DATE	TIME	SUBJECT	BRIEFING OFFICER
11 Feb	0800	What is Flying Safety?	Lt. Reed
14 Feb	0800	European Area Planning (X-C)	Lt. Hotchkiss
24 Feb	0800	Winter Weather	Lt. Gandy
27 Feb	0800	Survival	Lt. Reed

2. In addition to the above, the flight will continue the daily emergency briefings.

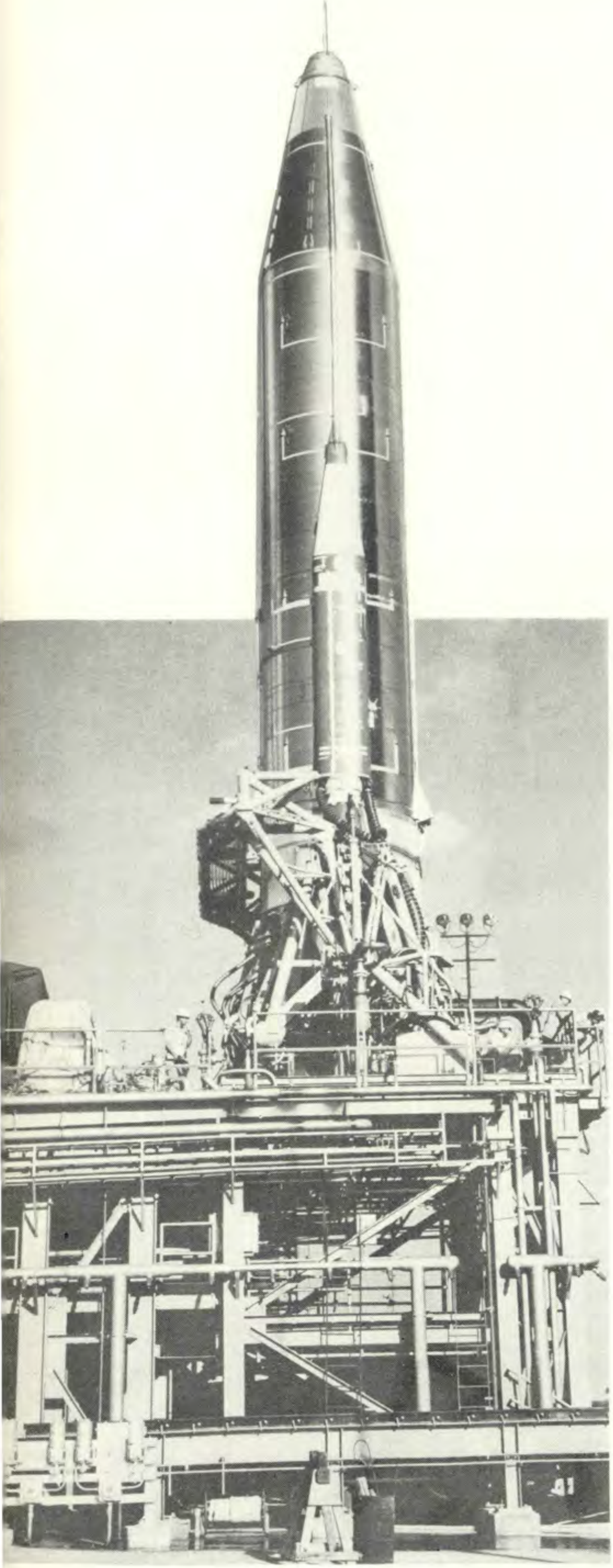
3. The Flight Standardization Officer is also assisting in the flying safety program for this flight.

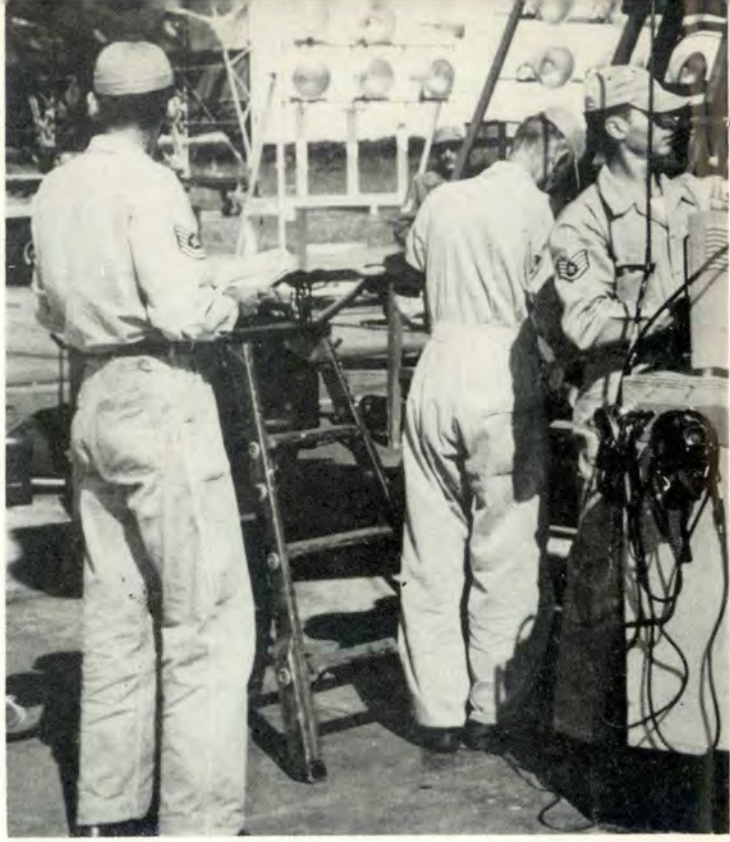
4. The Flying Safety Officer for "C" Flight is Lt. D. B. Reed.

I hope you will note through this letter and the briefing plan, the great number of men that we have actively working to promote flying safety. We get every instructor and student into this flying safety campaign—a full year campaign. We feel that we have a dynamic program—one that hits the weakest link in flying: THE PILOT.

1st Lt. Thomas L. Brattain
Dept. Flying Safety Officer

★ ★ ★





The mighty "Atlas" missile points skyward on its launching pad at Canaveral.

Of Missiles

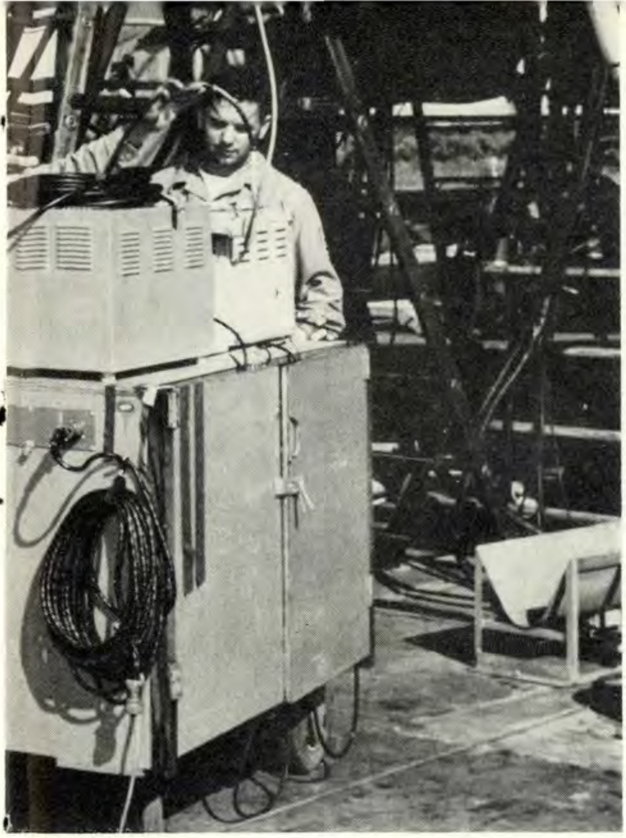
Lt. Col. Paul E. Cool, Chief,

What is "Missile Flight Safety?" Is it some nebulous combination of words and phrases that mean we cross our fingers and hope? Or is it part of a basic pattern—built-in and meaningful to all who plan and operate this relatively new facet of airpower?

Responsibility for missile flight safety has been assigned to The Inspector General by the Chief of Staff, United States Air Force. Acting for The Inspector General, the Director of Flight Safety Research has initiated the planning actions for missile flight safety to parallel the present successful aircraft flight safety program. This article reviews the basic policy concepts of the missile flight safety program.

It is essential that the missile safety program be integrated fully with the aircraft flight safety program. The reasons are pointed out in recent statements of two of the foremost authorities on airpower. General Thomas D. White, USAF Chief of Staff, has stated "The missiles that are getting the headlines today are but one step in the evolution from aircraft to piloted spacecraft." This viewpoint is supported by General Orval Cook, USAF, Retired, President of the Aircraft Industries Association.

He said, "Just as we begin to enter the so-called 'missile age,' it suddenly appears that it is only a way station; that the next step is to add a man to a missile. Then we give this manned missile another missile to fire at the target, and we are right back where we started—back to



Man today has a fantastically increased reach—both in space and in time. The author reviews the basic policy concepts of the missile flight safety program.

Missile airmen swarm over the Snark during preparatory stages leading to an actual launch. The Thor, below stands almost ready to go at Air Force Missile Test Range in Florida. The Snark is intercontinental, the Thor is intermediate.

Snark crew runs various tests during count-down prior to launching.

and Men

Guided Missiles Br., DFSR.

the manned vehicle! All we have done is to provide man with a fantastically increased reach—both in space and in time."

The missile program will parallel the aircraft program. A careful analysis of the missile safety problem however, is necessary in order to see it clearly. There are so many similarities and so many differences between missiles and aircraft that it is easy to get entangled in comparisons and contrasts if an effective missile flight safety program is attempted from this approach. It is only by starting with the overall mission of the Directorate of Flight Safety Research that a clear-cut concept for a missile flight safety program can be developed. This mission is to conserve the combat capability of the Air Force.

From the vantage point of this concept it is clear that an effort must be made to prevent those mishaps which are obviously identifiable as accidents. Such mishaps are injury to personnel, damage to property other than missile, and impact off-range. Each of the above occurences represents some gross departure from the planned functioning of the missile in its flight path. Each mishap demands that a full investigation be made to avoid similar occurrences in the future.

So far the missile program parallels exactly the aircraft program. However, at this point, let's examine the information input which such a program would provide. From the experience gained to date in missile accident prevention, it has become apparent that the data available on any single missile flight is extremely meager.

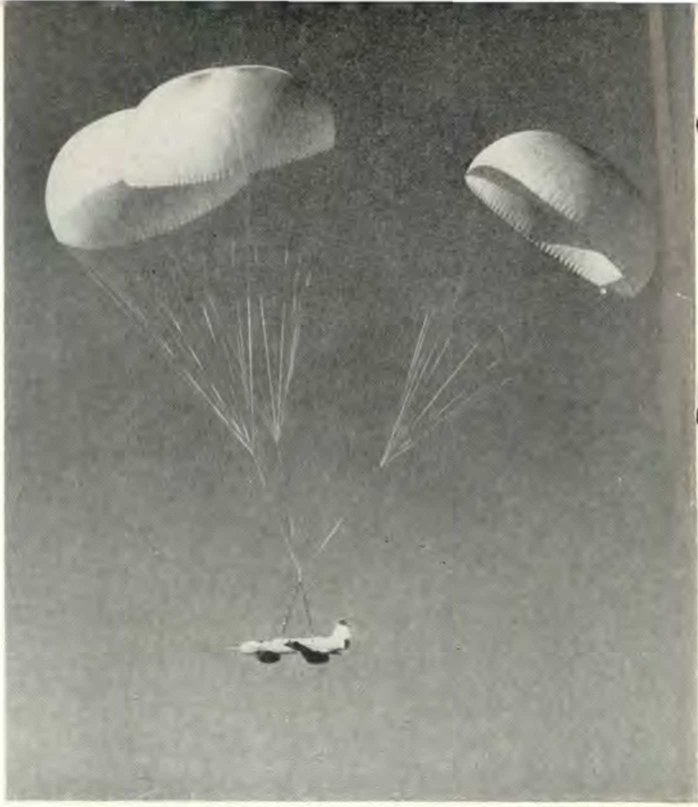
The reasons are inherent in missile design. First, there is no pilot to relate the circumstances regarding any malfunction. Second, the telemetering system by which malfunction information is relayed to the ground in research and development tests is limited or non-existent in training launches by operational units. This is because the operational unit trains with the missile in as near the tactical configuration as is possible. In this configuration there is little or no space or weight allowances for telemetering systems.

Third, the total lifetime in flight of a missile is extremely limited when compared to an aircraft. This time may vary from a few seconds to several hours as compared to many thousands of hours for an aircraft. In summary, missile malfunction data is very difficult to acquire.

It is clear that should any missile flight safety program be limited to the above scope, it could not be considered an accident *prevention* program. Rather, it would be an accident reaction program with little data available as a basis for reaction. In order to expand the data input to the point where sufficient information will be available for accident prevention, it is essential that data be gathered on all missile failures in tests by operational units. It is true that such data may be called reliability data rather than safety data. But this is a play on words. A reliable missile is a safe missile. An unreliable missile is a definite safety hazard. If missile reliability can be improved, then safety is automatically improved before an accident occurs. This is true accident *prevention*.

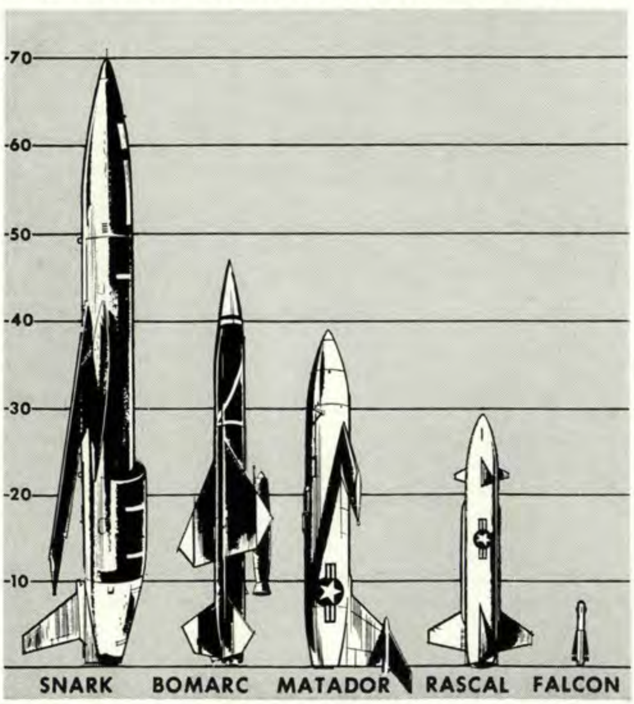
During research and development tests the missile safety program interest is directed toward the application of missile accident prevention by good range safety practices. These practices must insure that a malfunctioning missile is contained within the range safety boundaries, rather than insure that a failure will not occur. The very reason for the research and development phase is to identify deficient areas and correct these deficiencies prior to delivery to operational units. Of course, those mishaps which involve injury to personnel, damage to property other than missile, or impact off-range must be investigated for legal reasons when they occur in research and development as well as in operational units.

Air Force Regulations 62-8 and 62-14 have been revised to outline these concepts and procedures for investigating and reporting missile accidents and incidents. The revised regulations now are being coordinated in the Air Staff and will be distributed at an early date.



No longer a one-shot weapon, the Martin Matador at $100,000 per copy floats to the ground after flight at the Air Force Missile Development Center in New Mexico. Recovery and re-use will save millions.

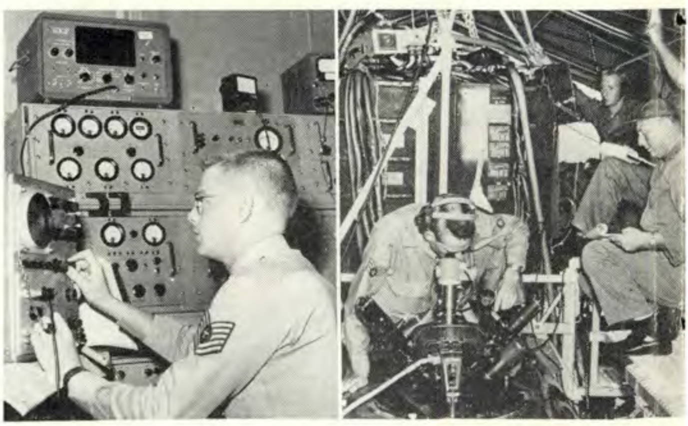
Comparison of Air Force missiles from 70-foot Snark to 7-foot Falcon.



What has been the experience gained to date in the missile safety activities? On the green side of the ledger is the outstanding safety record attained by research and development and operational units. Only one injury and a few instances of extensive property damage have been reported. In the "caution" column of the ledger however, is the fact that 16 missiles have impacted outside a cleared safety area. Fortunately, none of these involved injury to personnel, or damage to property other than missile. Any one of them, however, could have been a serious accident.

In the red column of the ledger, there must be more thorough investigations of missile failures in operational

Ground equipment and guidance system of Snark get pre-flight.



units. Of course the missile is expendable, but this is not the whole story. It is justifiably expendable only if it performs its mission. Expenditure of a missile in an unsuccessful training mission represents an avoidable dissipation of the combat resources of the Air Force.

The question often arises within the Air Force: How will the missile flight safety activities mesh with the ground safety activities? The answer is that the ground safety activities are predominant before the application of launch power to the missile, while the flight safety activities are predominant following the application of launch power. This means that ground safety activities do not end at this point and that flight safety activities begin before this point. For example, the ground safety function includes responsibility for fire fighting should the missile impact in the launch area. Furthermore, any action involving safety of flight which occurs before application of launch power is the concern of flight safety personnel. On an exact parallel with the procedures which have been established in the aircraft flying safety program, flying safety personnel are concerned with improvements in missile design, manufacture, transportation, personnel, training and so on, to the extent that these affect

A member of a Snark guided missile crew makes a final check of a wing fuel tank prior to launching at Patrick Air Force Base, Florida. The Snark missile has traveled more than 6000 miles on a single flight.

Figure 1. Overlapping areas of interest in ground and flight safety.

safety of flight. Figure 1 illustrates this overlapping area of interest.

One of the most striking features of this concept of a missile safety program is that some of the by-products of the safety effort have a promise of being at least as valuable as the safety product itself.

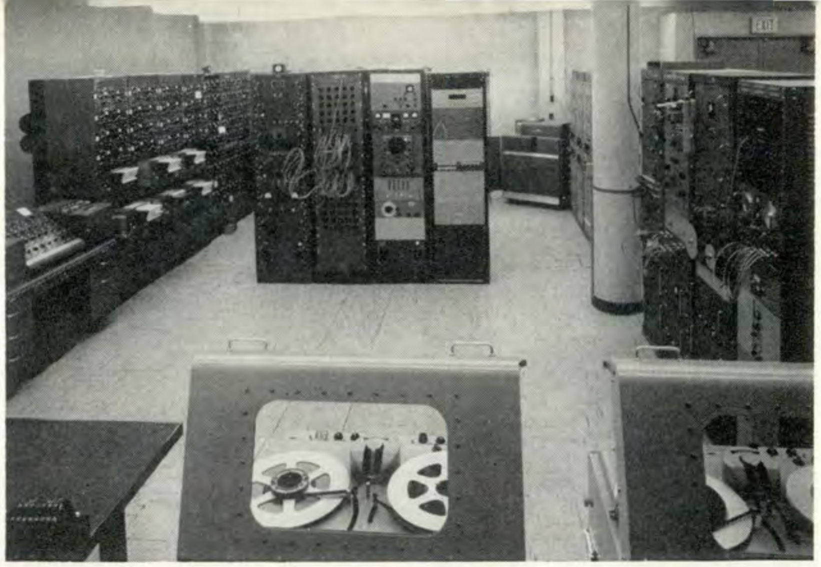
The first by-product is an increase in reliability. To the extent that missile flight safety investigations can determine the cause of missile failures, then missile reliability may be improved. In peace-time, this increase in reliability can be expressed directly in the terms of savings in the dollar resources of the Air Force. These savings will be used to purchase additional combat capability.

The second by-product of the missile safety program is an increase in operational effectiveness in combat employment. As reliability is improved through investigations of missile failures, then a corresponding benefit in missile operational effectiveness is achieved.

To summarize, the mission of the Directorate of Flight Safety Research is "To conserve the combat capability of the Air Force." In the missile flight safety program, this will be done by:

- A conservation of the dollar resources of the Air Force through an increase in reliability.
- An increase in missile operational effectiveness in combat employment through an increase in reliability.
- The prevention of missile accidents—which in themselves represent an avoidable dissipation of combat capability. ▲

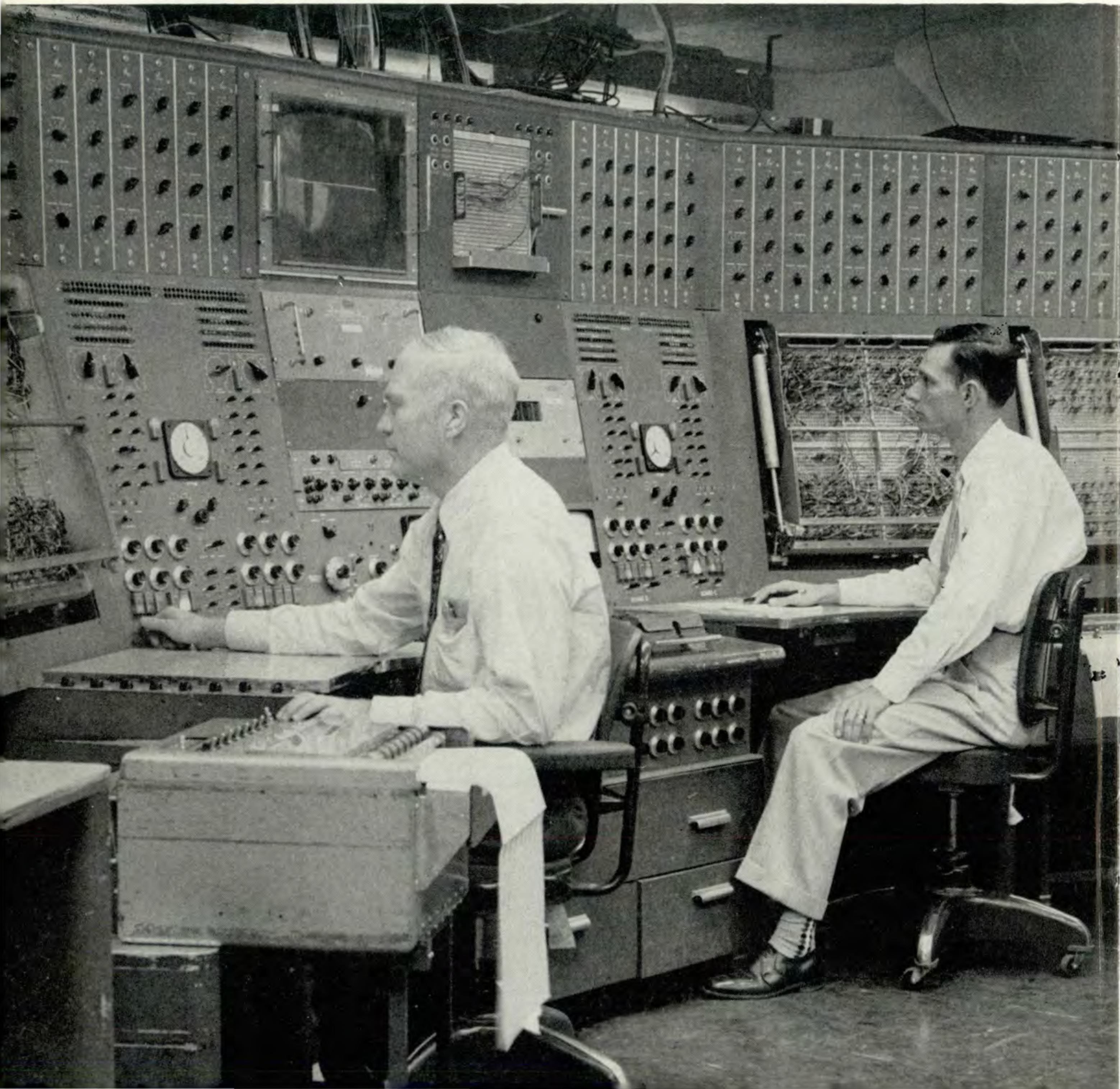
The Snark roars aloft and begins test flight over the Atlantic.

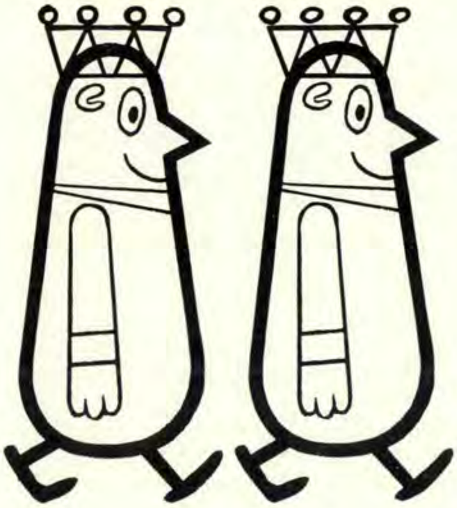


The Convair analog computer shown here in operation is in an airconditioned, dust-free environment. Operators watch attentively.

REIGN

Harry Morgan
Senior Dynamics Engineer
CONVAIR—San Diego



OF THE  ROBOTS

Not so many years ago it was sufficient to load an exact duplicate of the airplane wing or tail with sand bags to simulate on the ground the load which designers and engineers predicted for the article while in flight.

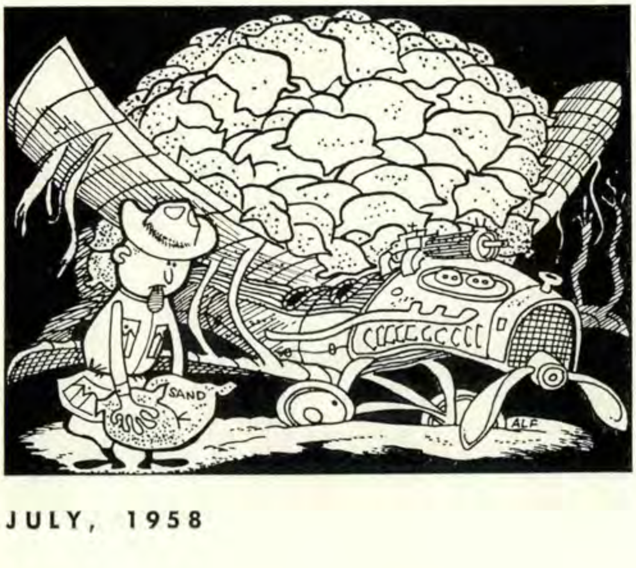
A test pilot stood the airplane on its nose and screamed down in a vertical dive, pulling out soon enough to clear the ground yet gradually enough not to "black out" from the acceleration effects. Hollywood glamorized this as the 9G pullout, and time and time again the hero put on his silk scarf, stuck a wad of gum on the plane for good luck and soared off to prove his bravery.

But what else did this prove?

The airplane stayed together, true, but how much less structure was needed to do the same job? One of the key design assumptions that always must be proven is structural integrity of the finished article. However, additional structure means additional weight, and excess structural weight cuts down the range of the aircraft, thus reducing its potential worth.

The question became one of demonstrating how much margin of safety the aircraft had. How light could it be and still provide the necessary strength? New techniques were needed, and the latest advances in instrumentation provided the solution.

The early method of instrumentation consisted of posting strain gages all over the aircraft to turn the stresses and strains experienced by the structure into electrical signals which were recorded on oscillographs. With these records, a measure of the stress could be found by observing the variations in the electrical signal as the airplane was flown through the most punishing maneuvers it could be expected to perform.



True, the process of reading these films was tedious and time consuming, but it was felt to be necessary. The results were satisfactory, and the margins of safety could be determined by judicious interpretation of the readings taken at different times in different maneuvers. For more complex structures, such as the Delta wing, however, the method becomes questionable. Furthermore, with high performance aircraft, temperature problems make this approach even less satisfactory.

Fortunately, new tools became available to the industry—the analog computer and the digital computer—the first able to perform continuous multiplication of two varying quantities, if they were transformed into electrical signals; the second able to perform hundreds, even thousands, of calculations in an extremely small interval of time when the variables, once again were in the form of electrical signals. A third tool was developed—the magnetic tape recorder—which can record electrical signals continuously with a high degree of accuracy.

The playback unit feeds these signals to automatic equipment which performs the tedious calculations necessary to obtain the required results—how much stress is being placed on the airplane or missile wing during every conceivable type of maneuver. The reliability of these items was improved to the point where the designers and engineers felt confidence could be placed in them to demonstrate how much additional strength was left in the structure when it experienced its greatest stress.

Convair's F-102A is the first aircraft to have completed a structural demonstration program utilizing this type of instrumentation. The methods used and the degree of success achieved is the interesting story that follows.

The left wing of the test airplane was instrumented with flush-mounted pressure pickups on upper and lower surfaces. All pickups were tied to a common manifold system for reference. The pressure difference between the upper and lower surfaces was transformed into a frequency-modulated electrical signal, and several such differences were mixed to form a composite electrical signal, which was impressed on the magnetic tape as the airplane was flown through its maneuvers. Similar pickups were handled by this same technique in demonstration of the vertical tail.

In testing an aircraft such as the F-102A, safety is considered uppermost; and, therefore, demonstration to the maximum design load factor (the equivalent of the old "9G" pullout) was not done immediately. The aircraft was first tested statically on the ground to its full design limits. Then, it was flown at 50- and 80-per cent of the design limits at Edwards Air Force Base. The tape from this test was flown immediately to Convair's San Diego data reduction facility.

Immediately upon receipt of the tape, an exact copy was made, so that the original information would always be available for reference in case of damage to the tape while working with it. The tape copy was then run through the playback unit, and the recorded pressure analogs (electrical signals) were fed into the analog computer. Here, a summing up of the pressures over the entire surface was performed; the results were continuous time histories of the loads in the structure during the maneuvers.

Since the tape recorder was turned on only during a maneuver, several maneuvers could be performed during the same flight. As many as 20 to 25 maneuvers have been performed on a single flight. Incidentally, about the same time is required to obtain the load histories for 20 to 25 maneuvers as would be necessary to obtain them for two or three. The limit to the number of maneuvers is merely the tape capacity of the recorder or the fuel capacity.

Once the resultant histories were obtained from the computer, the peak loads of the 50-per cent maneuver and the 80-per cent maneuver were plotted; and, with a level flight solution, an extrapolation to 100-per cent design conditions was made and compared to the results of the static test. If no difficulty was indicated, the airplane was cleared to fly to 100-per cent design conditions, sometimes within three days of the previous flight.

If the safety of the plane and the pilot at 100-per cent conditions were at all in doubt, permission would be given to perform a less severe maneuver where safety was assured, and the new results were studied before full clearance was granted. Naturally, only one 100-per cent design condition was flown per flight; however, this condition could be repeated several times if the pilot felt that the maneuver was not flown as severely as required on his early attempts.

As an additional safety precaution, the pilot's remote-reading, center of gravity accelerometer was closely checked against the telemetered data obtained from a duplicate instrument, before performing maneuvers on each flight.

Other key functions also were constantly checked on the ground by telemetry. Subsequent to each flight, the accelerometer used for ground-monitoring and tape recording was checked against the pilot's call-off from his instrument during a standard type of maneuver. For asymmetrical maneuvers, a chain with stops was fastened to the control stick, at the pilot's discretion, allowing him to select 50-, 80- or 100-per cent full aileron throw in a bank or rolling maneuver, as the flight plan required.

The pilot had a rudder-pedal force indicator available for use in steady sideslip maneuvers. In the cases of bank and sideslip maneuvers, again the 50- and 80-per cent results were examined and the plot extended to theoretical 100-per cent design conditions. These results were compared to static-test values before clearing the airplane to actually fly the 100-per cent maneuver.

In the F-102A program, the digital computer was used chiefly as a check on the analog method. In addition, however, it provided information about the internal stresses in the structure that was beyond the capabilities of the analog computer with the present data reduction system. Where the loads compared unfavorably with the design predictions, the digital computer could resolve the design problem with the measured pressures, rather than the calculated (design) loads as inputs, giving the internal spar stresses and so on.

The pressure pickup-tape recorder system of measurement has proven satisfactory and may be used as an alternative to the strain gage technique where the structure has great complexity or where other considerations make it advisable. This technique furnishes to the designer full-scale data which has not been available previously using strain gage methods. An idea of the reliability of the new method is gained from the results of the wing root shear investigations where the worst case had an estimated accuracy of seven per cent.

In this day of supersonic interceptors, today's design must fast become a flying fact, if it is not to become obsolete before it can be mass produced. Solution to the various design problems encountered takes time. Between prototype and production, the only way-station is testing. Hence, the speed with which clearance can be given to fly the airplane to full capability is the most important result of the flight loads and demonstration program.

The net result of the instrumentation and data analysis method used on the F-102A has been to obtain more complete structural integrity information without sacrificing valuable time in the endeavor to make the aircraft operational.

The silk scarf of the pioneer aviator is no longer suitable for use with a modern-day, pressurized G-suit, and if the pilot should chew gum, his voice transmission would be too garbled for the ground monitors to understand. Likewise, modern flight-testing furnishes the answers to problems which the early designers and engineers never even worried about, but the net result is still the same—structural integrity of the new design is proven before the aircraft is put into general service for unrestricted use. ▲

General Curtis E. LeMay, Air Force Vice Chief of Staff, presents the Kolligian Trophy to Major Samuel W. Tyson.

THE KOLLIGIAN TROPHY AWARD

Major Samuel W. Tyson of the Military Air Transport Service is the first to receive the new USAF Flying Safety Award, The Kolligian Trophy. Major Tyson was presented the award at the Pentagon on 7 May, by General Curtis E. LeMay, Air Force Vice Chief of Staff.

The award was established by Mr. Koren Kolligian in memory of his son, First Lieutenant Koren Kolligian, Jr., USAF, who was declared missing in his T-33 aircraft off the Farallon Islands near San Francisco, California, in 1955. The new award will be presented annually to the pilot or aircrewmember who most successfully dealt with an inflight emergency during the preceding year. General Thomas D. White, Air Force Chief of Staff, selected Major Tyson as the winner from among forty nominations submitted by the Major Air Commanders. He received the trophy for his outstanding performance in handling a prolonged inflight emergency on a C-97 transport aircraft on 8 August 1957.

His aircraft, with two of its four engines inoperative and with 67 people on board, was successfully flown near wave top level for approximately six hours and safely landed at Hilo Airport, Hawaii. His performance was one of the finest exhibitions of professional ability and judgment in the annals of military aviation.

• MAJOR SAMUEL W. TYSON •

Wherein a Lieutenant pops a question and thereby 'volunteers himself' to help find the answer. This time he gets involved in the whys and hows of the new Weapon Systems Concept and his immediate reaction is——

I knew the minute the words left my mouth that I had stepped into a bear trap. But despite the feeling that I had cut the hair that held the sword, I didn't really care. I was sore about it, and so were all the rest of the guys in the outfit. Somebody had dropped the ball. That's all there was to it. *There we were flying some of the world's newest and finest airplanes—with some of the world's oldest and most dilapidated equipment. It just didn't make sense.*

It all happened at the old man's periodic Pilot Meeting. You have to admire that guy for his guts. He calls these meetings and lets everybody sound off about what's bothering them. He gets a lot of petty gripes, it's true. But at the same time he gets a good look at the way we see things, and I suspect a good idea about our overall morale. And there are a lot of stupid things that come up in these sessions.

Like me. I had explained the problem, finishing up with what I had calculated to put me in real solid, "But. Sir, why does a top notch operational outfit like ours" (with a heavy accent on that part) "have to put up with such nonsense?"

And suddenly I felt real stupid. At the moment I didn't really know why. I just did. And there was no way of backing out. I stood there waiting for him to speak.

He smiled, sort of sympathetic-like. Then he turned to his staff which was up on the stage with him, and asked, "Anybody want to take a crack at answering the Lieutenant's question?"

The silence was piercing. The Director of Materiel was squirming and scratching his neck, and for a moment I thought I had a big gold star coming for fingering the guy. Then he spoke. "Colonel," he says, "it's getting pretty close to lunch time, and I really can't do justice to the question with a quick reply. Let me say categorically, for now, that we've done all we know how to do to get the equipment. And in order to answer the question properly, let me recommend that we set up a special briefing at a later date to let everybody in on why things happen the way they do. Say a week from now."

Then, looking at me in a way that told me I had had it, he added "And if you can make the Lieutenant available, I'd like to have him help me."

For the next two minutes I just quit living while the old man took his time to ask the whole outfit, "Is there anyone here who thinks he can give a good explanation for the overall problem involved?"

Again that piercing silence, and I'm still not with the living. Nobody volunteered. None dared!

"Okay. Set it up for Tuesday afternoon. Two o'clock. Who else has a . . .?"

I didn't hear the rest of what went on. I just sat there in a dazed condition trying to figure out how I'd gotten myself into this mess. All I did was ask a simple, reasonable question.

I was still sitting there when the Director of Materiel tapped me on the shoulder. The last guy was just vanishing out the door, and I didn't even remember anybody hollering "Attention" when the old man left. I must have jumped up and slumped back down subconsciously.

"Sorry I didn't have time to give you a good answer," he says. "I fixed it up with your commander to have you work with me until next week so we can get things prepared. How about dropping by my office after lunch, and we'll talk about it?"

"But, Sir! I was supposed to fly this afternoon!"

You can guess where I was at one o'clock. Right up there in Headquarters looking for the D/M's office. I found it, but instead of its being the torture chamber that I had imagined, it turned out to be a real pleasant office —in which sat the best looking secretary I ever hope to meet, either here or elsewhere.

"Rrrr-Hhhh-Iiii-Pppp," I breathed. "Pardon?" she said, in a voice that crawled all the way up my spine. "Oh, you must be the Lieutenant the Colonel is expecting. Go right in."

My legs didn't want to take me, and I didn't want to go, but suddenly I found myself standing in front of the Colonel.

"I see you've met Janice," he said, laughing. This guy was reading me like five-inch headlines. "Don't let it shake you. She has that effect on all of 'em. Now let me tell you why I asked for your help. Uh...Lieutenant...."

I suddenly came back to earth while he repeated himself.

". . . I'm glad you asked that question this morning. It gives me the chance I've been looking for for a long time. It's something everyone should know and understand—but seldom takes the trouble to look into. It is a long and complicated story but let me see if I can summarize it for you.

"First of all, let's take a look at the big picture. The Air Force is organized on a functional basis and directs its operations through established command channels. The efforts of the USAF functional elements are applied to provide weapon systems which will enable us to perform our mission.

"For this reason we have a complex of specialized commands which are interdependent and mutually supporting. This form of organization permits the necessary concentration and development of separate specialized skills and thus provides for the minimum requirements of physical resources, personnel, facilities, dollars and equipment. You'll notice I said minimum."

He paused. "You'd better sit down, Lieutenant. This might take some time. And quit watching the door. She won't come in unless I ring for her. Now to go on!"

"But, Sir!" I muttered weakly and ineffectually. The Colonel went on.

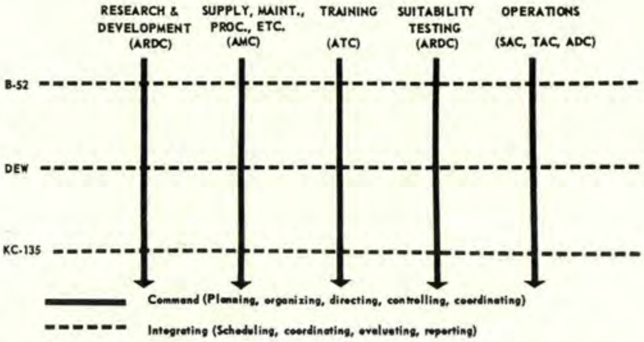


Figure 1. Coexistence of the functional and weapon systems concept.

"Our policies and regulations recognize the interdependency of all Air Force organizations. They emphasize that the efforts of each must be related in terms of mutual endeavor and time-phasing of actions. They do not replace or usurp functional management. Instead, they supplement and assist the functional elements of the Air Force in assuring that their separate missions are completely and satisfactorily achieved.

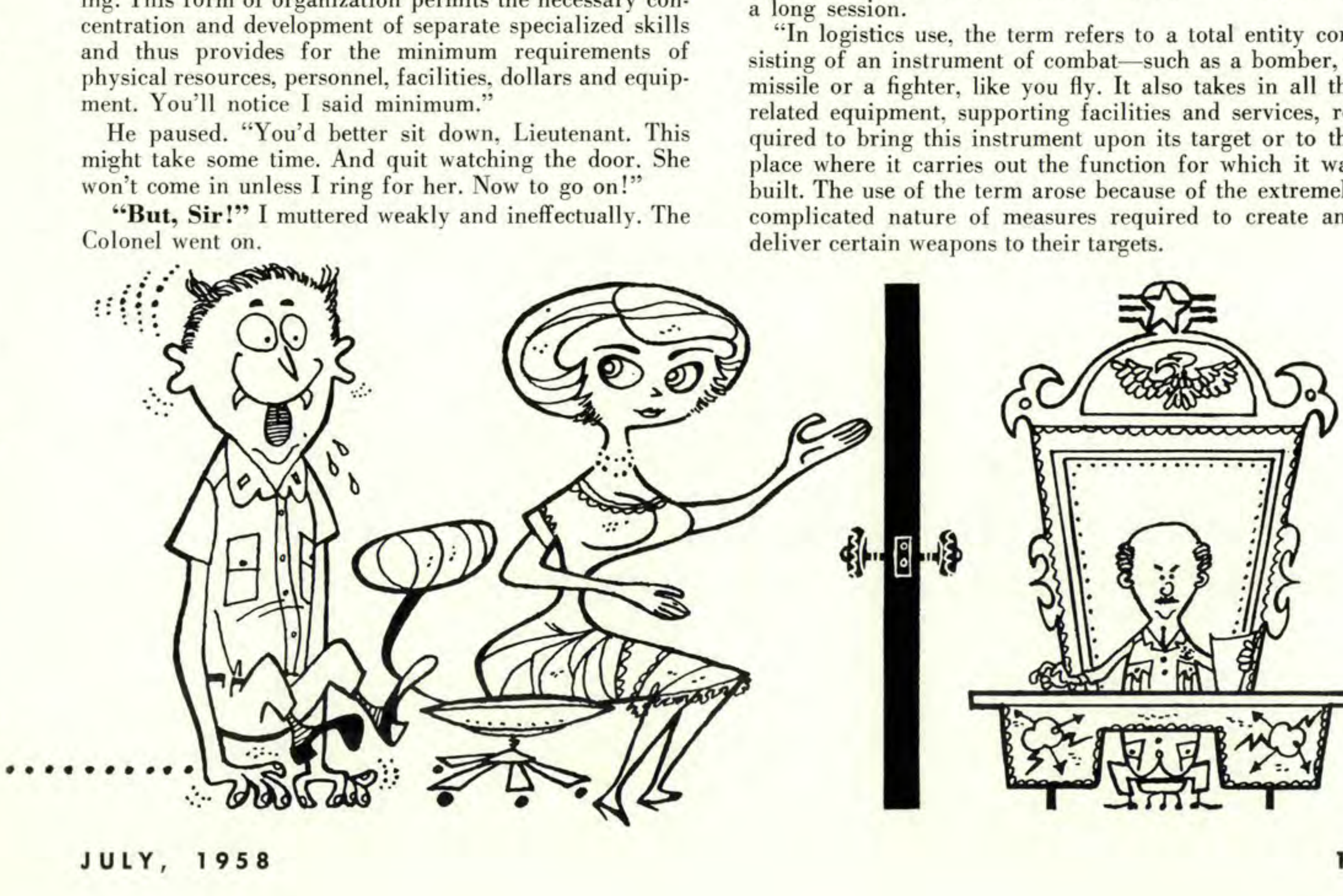
"In itself, the total effort can be termed a method for integrating. It provides for time-saving, simplicity in coordination and communication, and a method for evaluating functional performance. Here is a chart which portrays the difference, yet the coexistence of the functional and weapon systems concepts." (Fig. No. 1.)

"But, Sir! I don't see how I can help you." I checked the door again, hopefully.

"You'll see, Lieutenant . . . ." "Are you familiar with the phrase 'Weapon System,' Lieutenant?"

I subsided and nodded. It looked like I was really in for a long session.

"In logistics use, the term refers to a total entity consisting of an instrument of combat—such as a bomber, a missile or a fighter, like you fly. It also takes in all the related equipment, supporting facilities and services, required to bring this instrument upon its target or to the place where it carries out the function for which it was built. The use of the term arose because of the extremely complicated nature of measures required to create and deliver certain weapons to their targets.



"Different systems may be conceived but they usually involve measures for coordinated action in training, logistic planning, strategic operations, tactical operations, air defense and transport. Each system begins with the concept of the instrument of combat itself, leading through to its manufacture, then to its testing, then to its passing through logistic channels, and finally to its use against the enemy. Each step in this movement is provided with services and facilities.

"Creation and delivery consist of four essential ingredients, namely, determining the nature of the instrument itself; providing a carrier or vehicle, the facilities and services so that its use may be timed with the march of events, and providing the instrument with armor.

"In general practice we usually refer to the whole package as 'the F-104 Weapons System.' This identifies just about everything it takes to operate a '104 except the all-important man in the cockpit.

"Everybody in the Air Force gets in on this thing whether they want to or not. However, the big burden of the problem comes to focus within ARDC and AMC.

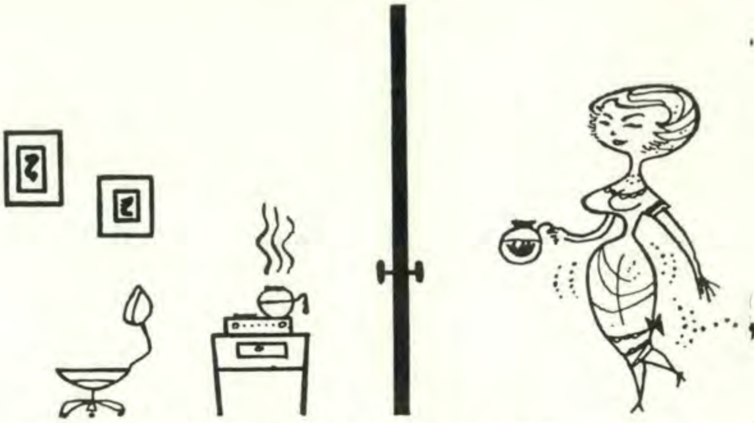
"You look a little tired, Lieutenant. Would a cup of coffee help out? I can ring for Janice."

"Yes, Sir! That would be real nice, Colonel. You do that, Sir. Yes sir. I could sure use a cuppa coffee."

"Calm down, Lieutenant."

Janice came in the door and things started looking up. Maybe I could weather this afternoon after all. I hoped she would take about a week to get the coffee poured. Nope. Too efficient. Just like I knew she'd be. In a moment I was back eyeball to eyeball with that Colonel. He started in again before I could take a sip of the nectar she had brought in.

"Lieutenant, Weapon System Project Offices, sometimes called WISPOS, are established jointly by ARDC and AMC. These offices are responsible for assuring that all efforts of affected Air Force agencies are integrated and properly phased to assure timely delivery and support of the complete weapon system. In addition, WISPOS provide the decisions and direction to the weapon system contractors, and act as the focal point for any required



contacts between Air Force agencies and contractors in regard to system programs.

"The WISPO is the key to the Weapon System Integration effort. It is this agency which is responsible for assuring that all actions required of the functional activities in connection with a specific weapon system, are scheduled in appropriate sequence and with necessary timeliness. It is then expected to assure that all Air Force activities are informed of the action sequences and dates. It must then review accomplishments to determine that necessary actions have been taken.

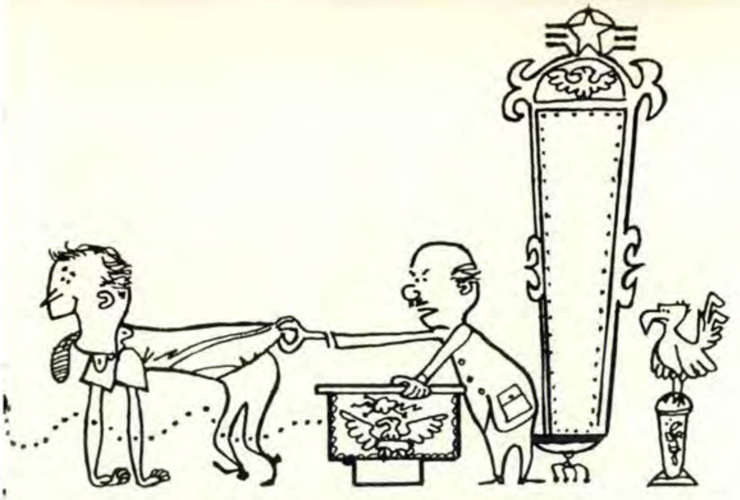
"Further, it must be able to identify deficiencies and accomplishments and to pinpoint the functional agency responsible. Ultimately, when deficiencies are of the magnitude to impair program accomplishment, WISPO must present these deficiencies with a comprehensive analysis to as high a level as is necessary to obtain the proper adjustment."

"But, Sir. How does WISPO do all these things?" In spite of myself I was getting interested.

"To perform its responsibilities, WISPO has access to the planning and actions of all Air Force and industrial agencies involved in development, procurement, support and operation of a weapon system. It reviews these plans and actions to assure the proper time-phasing of functional performance. The Weapon System Phasing and Equipment Management Groups are organized to assure the interchange of information essential to accomplishing the responsibility of the Weapon System Project Office.

"Weapon System Integration is the business of maintaining surveillance of all aspects of a weapon system, specifically in the integration of plans and programs. This is to make sure that all commands and industry time-phase their respective areas of activity to provide a complete and supported weapon system when required. Whenever an element of the program is out of phase, it is WISPO's duty to point out this fact to the responsible agency of the Air Force or industry. If that particular element continues to be out of schedule, this office must take necessary action to advise higher authority of re-programming or corrective measures required to realign or rephase the program.

"Weapon System Phasing, as you might guess from what I've just said, is an important cog in the machine. It is the scheduling element. It is the agency responsible for scheduling the accomplishments of interrelated actions to assure the timely availability of a complete and supportable weapon system. Events must be controlled within the lead times that dictate their starting and completion dates. The lack of control of these significant events can cause delay of delivery to the operational inventory . . . even limit the system's combat capability.



"Yes, Janice?" The heavenly body had just orbited into the room. How had I missed her entrance?

"No, Janice, the Lieutenant and I don't need any more coffee. I'll ring if I need you." Could it be possible that this gorgeous weapon system, er—girl, was even remotely interested in a lowly lieutenant? Regretfully I lifted my sagging jaw back to battery position and turned back to the Colonel.

"But, Sir! I could have used some more of that coffee."

"Down boy," said the Colonel, "it's back to business for us."

"There is one other agency in the system. This is the Weapon System Phasing Group. It is organized under the direction of WISPO to assist in integrating the Air Force functional efforts in terms of a specific weapon system. This group is composed of representatives of Headquarters USAF, ARDC, AMC, ETC, Using Command and other services and agencies as required.

"The integrating job of the Weapon System Project Office is a continuing effort. In recognizing the complexity of the integrating effort, Phasing Group operations must be strongly emphasized since it provides a means of assisting WISPO in accomplishing its integrating job. One of the functions of the Phasing Group is problem-identification. It is not a problem-solving agency. The solution of an identified problem is always accomplished by the Air Force functional agency of primary interest. WISPO, in performing its integrating function, may occasionally require the functional agencies to report progress directly or through the Phasing Group. This, however doesn't shift the responsibility for getting the job done.

"These Phasing Groups are established to provide a means for insuring the integration of the efforts of all activities participating in development, testing, procurement, production, maintenance, training, support and use of a weapon system. Prior integration will permit functional activities to more clearly understand and plan for performance required of them in support of any weapon system program. It will permit earlier identification of deficiencies and broader evaluation of the impact of such deficiencies on all USAF functional areas. It will also permit coordinated approach to the resolution of deficient areas and overcome to a significant degree, the difficulty of communication generated by the organization complexity and magnitude of the U. S. Air Force.

"And that's about it, Lieutenant. That is as far as the big picture goes. I think you can see now that the problem of getting the most up-to-date gadgets into the new weapons at the right time is a large and important one."

"Yes, Sir. It's not as simple as I thought. Guess I popped off with a short fuse, Colonel."

"Okay, Lieutenant, now you should be able to see some of the ways that this whole thing applies to us right here.

"Next Tuesday I want you to be able to describe some of these direct applications—as well as a rundown on the big picture as I have just described it."

"But, Sir—I don't think I'm qualified—"

"You will be, Lieutenant. Of course, you'll have to be in my office a lot."

"Yes, Sir!"

"Some of the more important points I'm sure you will want to bring out, are the necessity of planning an operation, whether it be a flight of two in the local area or the move of the entire outfit to a new location. The basic principles are the same.

"Another point is the necessity of deciding what you need, and letting the right ones know about it in time for the wheels of progress to grind them out for you.

"Keeping adequate records on all operations, regardless of how big or small, is another important point. It's a recognized fact that when all the records on all the small operations in this astonishingly big Air Force of ours are assembled in one central location, they do provide a lot of vital information.

"Reporting malfunctions as they occur and reporting them fully is still another important point. It does nobody any good to write up a 781-2 or an Unsatisfactory Report by merely stating, "Aircraft broke." Every bit of information that is known should be reported. Speaking of URs, Lieutenant, there's a new deal going into effect this month. Take along this copy of the brand new AFM 66-1 and read it over. There's some new and important data in here that all pilots should know about, now.

"Well, you've listened to this diatribe long enough. If you're fast enough you can probably talk Janice into letting you drive her home before that Captain from down the hall gets to her."

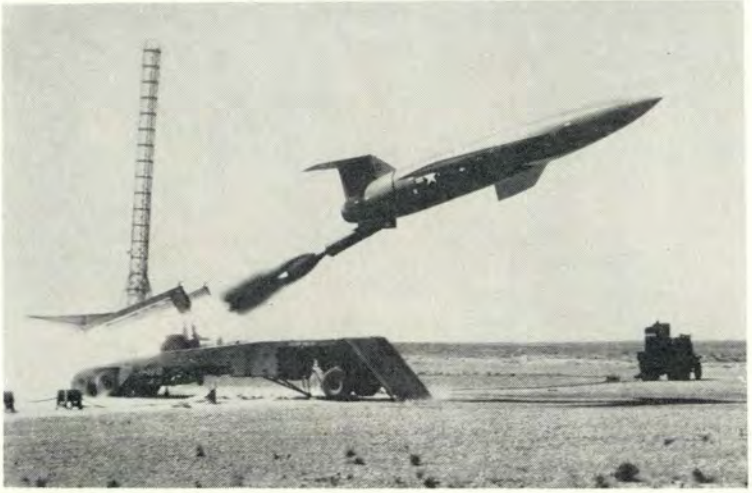
He was grinning a little now and things were definitely looking up . . . 'way up. Maybe this wasn't going to be too bad, I thought.

And I swear Janice must have been listening to the whole thing because when I opened the door she was standing there—purse in hand.

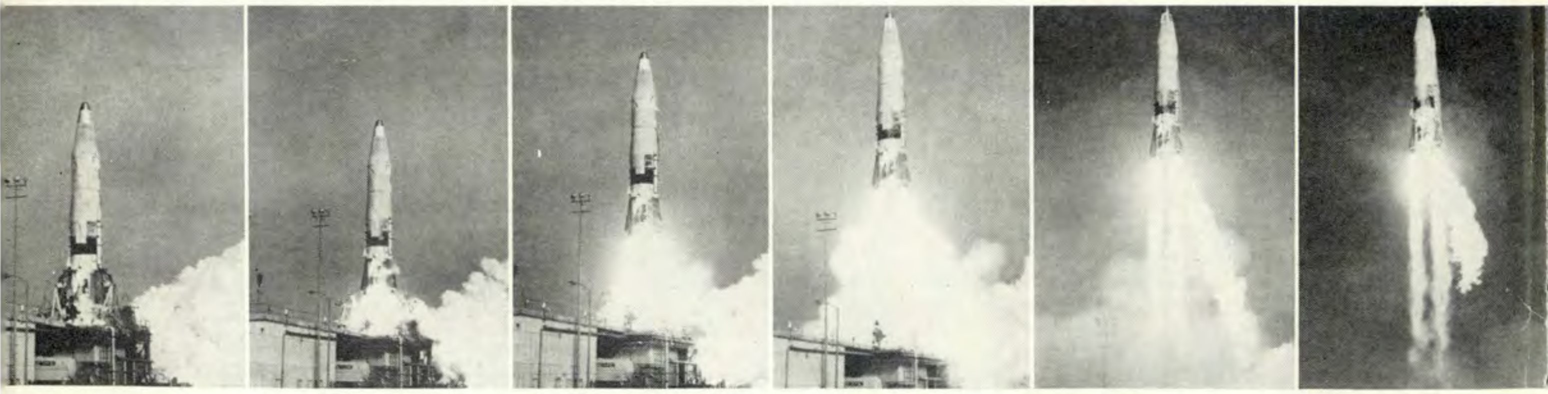
No, Sir. Not bad, a—tall! ▲

PASS IN REVIEW

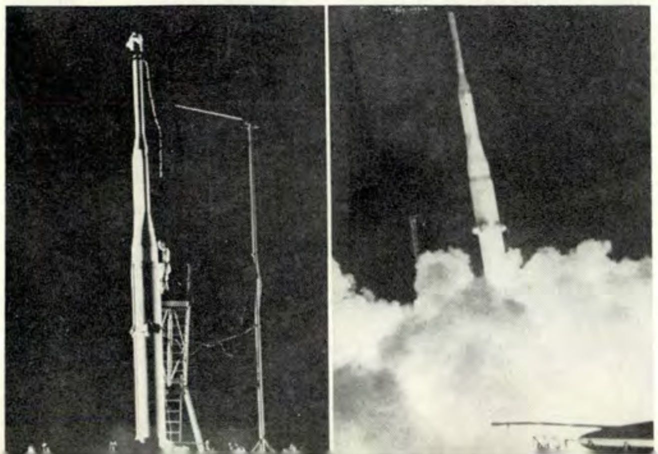
The Martin Matador and its successor the Mace. The Mace, carrying a conventional or atomic warhead, has a self-contained guidance system and is carried on launcher towed by truck. Booster rocket for takeoff is jettisoned for cruise.



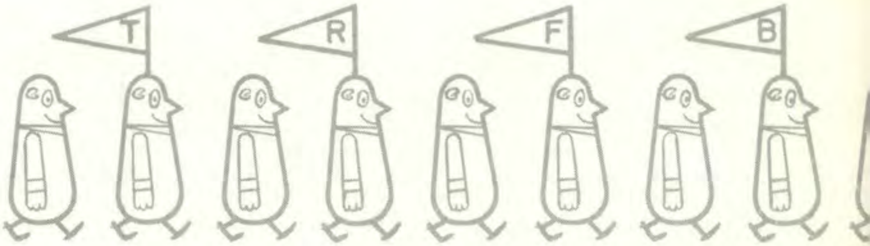
A high speed camera records the majestic rise of an Atlas intercontinental ballistic missile from its launching pad at the Air Force Missile Test Center at Cape Canaveral, Florida. The Atlas is in production at San Diego, California.



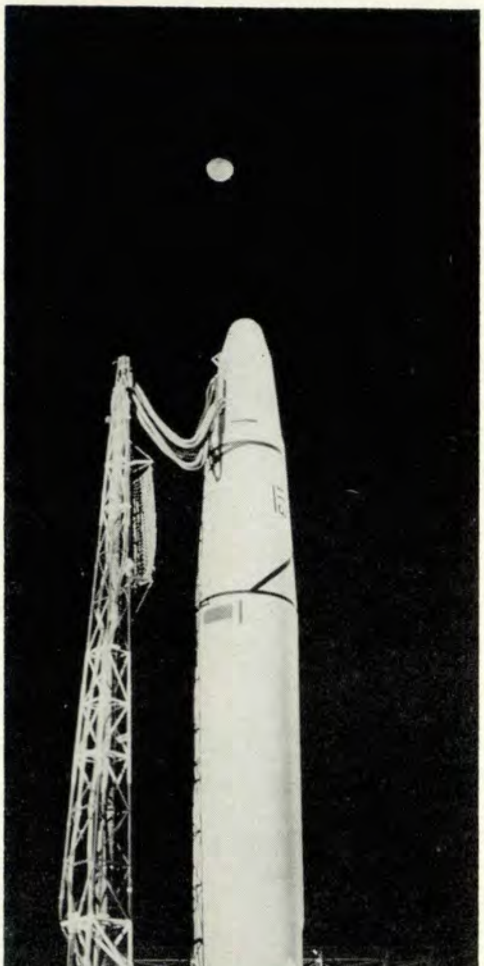
The X-17 test missile blasts off into space to provide information on the problems which arise when a warhead re-enters dense atmosphere.



The Lockheed USAF X-7, a test vehicle used in development of new engines of ramjet missiles, is dropped from a B-29. It is recoverable.

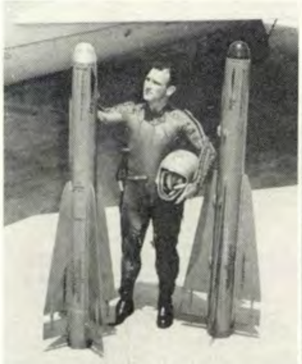


Missile airmen are trained on the Snark at Cape Canaveral, Florida. These men will be assigned to an operational unit after their training at the missile test base.



The Florida moon appears to be the target of the Thor on a recent night launch. The Rascal, below, is towed to its site with escort.

The punch in the interceptor team is supplied by the Hughes Falcon in the infra-red and radar seeking models, below. At right, are two shots of the Boeing IM-99 Bomarc interceptor missile on pre-dawn test firing at Patrick Air Force Base, Florida.



An old girl takes on new life with the addition of new power pills in the form of two General Electric J-47-23 engines.

REVAMPED REFUELER

Charles D. Brown, KB-50 Project Engineer,
Hays Aircraft Corp., Birmingham, Ala.

"Strike Force of TAC Deploys Non-Stop to Overseas Base." This type of news is being heard more and more nowadays. Even so, most of us can remember that only a short time ago, mass deployment of tactical aircraft non-stop over a great distance would have been impractical, and in many cases, impossible.

Perhaps the single most important advancement in military aviation that makes such operations possible is the development of aerial refueling techniques. Aerial refueling actually is nothing new. The feat was first accomplished in June, 1923, by two Air Force aircraft. This first aerial refueling was done by manually lowering the hose from the "feeder" aircraft to the "receiver" aircraft. The hose was then manually inserted and fuel was transferred by the force of gravity. From these crude beginnings, aerial refueling has developed to the point where it is considered routine in the Air Force of today.

As a part of this advancement, vast improvements have been made in the equipment and aircraft that are the tools of aerial refueling.

One of the latest additions to the Air Force's lineup of refueling equipment is the three drogue KB-50J and KB-50K aircraft. Many pilots are now familiar with the Hayes modified KB-50 tanker which is presently operational on a worldwide basis. Now the jet augmented KB-50J and KB-50K are taking their places as a first class, higher speed, higher altitude tanker aircraft.

At first glance the new KB-50J and KB-50K are very similar in appearance to the old B-50 which was once one of SAC's first line strategic aircraft, and itself a receiver aircraft. But, since the B-50 was phased out as a bomber in 1953, vast changes have been made to the old reliable. The noticeable external features include a slim, refueling pod installed on the underside of each wingtip and at the old tail gunner's position. These three pods, with the associated internal systems, allow simultaneous refueling of three receivers and makes possible mass deployment of tactical aircraft squadrons overseas.

The next new external feature noticed on the KB-50J and KB-50K would be the two J-47-23 jet engines at the old pylon tank locations. The addition of the refueling pods presented complex structural and aerodynamic problems. These were finally licked. But when the addition of jet engines to the KB-50 were initiated, many serious problem areas made this change appear impractical. Subjecting an existing airframe and engine to the much higher performance, for which it was never designed, opened up new questionable areas of wing stress, dynamic loads, flutter fatigue, vibration and effects of jet wake on receiver aircraft. The entire capabilities of the airframe and engines had to be scrutinized in a new light, and by so doing, the engineers were able to select a proper position of the jet engines to achieve a successful improvement to the KB-50.

Internally, the modification of a bomber type aircraft to a three-point tanker aircraft requires many changes. For instance, the electrical system has been redesigned and now contains eight 400 amp generators instead of the six 300 amp generators that were standard on the B-50.

Among the more significant new systems in the KB-50 jets are the addition of an altitude control unit and an automatic approach system to the autopilot. Pilots especially will appreciate the significance of these devices as they aid in reducing pilot fatigue on long refueling missions. Actually, almost every system in the old B-50 has been modernized and modified to produce a modern and efficient aerial refueling aircraft.

To mention a few more changes, up-to-date radio and electronic equipment has been incorporated to provide all types of communications, navigational aids and rendezvous equipment for receiver guidance. Also, two separate hydraulic systems have been installed to drive the refueling pumps and provide 900 to 1000 gallons per minute, total fuel flow through three reels or for jettisoning, in case of an emergency.

Formerly, two of the major handicaps to aerial refueling of jet aircraft were that tanker aircraft were generally slow and restricted to lower altitudes. The addition of the two J-47 jet engines has overcome these handicaps to a great degree by increasing airspeed and altitude capabilities.

Pilots who have been checked out in the B-29s and KB-50s should have little trouble handling this addition to the Air Force arsenal. A comparison of a few elements of performance of the KB-50 with and without jets indicates the superiority of the new aircraft. (Fig. 1)

The pepped-up KB-50 holds higher and faster while two F-101s take on a refresher drink.

	KB-50	KB-50 Jet
Takeoff Gross Weight	150,000 lbs.	150,000 lbs.
Takeoff Distance	4100 ft.	2900 ft.
Distance to Clear a 50-foot obstacle	5125 ft.	3625 ft.
Time to Climb	36 min.	17 min.
Formating Speed	192 kts. EAS	243 kts. EAS
Climb Fuel Used	4500 lbs.	4300 lbs.
Climb Speed	162 kts.	210 kts.

Figure One

The table shows performance for takeoff from sea level and climb to 25,000 feet under standard day conditions for an aerial refueling mission. Takeoff distances and distances to clear a 50-foot obstacle are shortened by approximately 1/3 for the new aircraft at the same gross weight. Time to climb to refueling altitude is cut by more than 50 per cent. The problem of achieving higher tanker airspeeds to enable receiver aircraft to stay well above stall airspeeds while in contact has been greatly reduced. As indicated by the chart, formating airspeeds will be some 45 to 55 knots higher than was previously possible.

The new KB-50 jet contains the latest and most reliable rendezvous equipment available. The range of this equipment is given as from 160 to 200 nautical miles. However, in practice, the tanker can start giving the receiver pilot range and bearings for homing in as soon as UHF radio contact is established. The equipment is powerful enough to give range and bearing signals from any position around the clock from the tanker. Rendezvous and contact at night is made easier by a series of floodlights and a beacon mounted on the vertical stabilizer. This beacon is visible for 30 miles in clear weather.

Pilots of receiver aircraft who are accustomed to the boom and receptacle refueling method should have little difficulty in change-over to the probe and drogue method. Probably the biggest difference between the two methods is that the reel operator cannot fly the reel as a boom operator does a boom. The reel operator has no control over the flight of the reel and drogue other than to extend or retract it. The receiver pilot flies his aircraft into complete contact with the drogues. Even pilots who have never accomplished aerial refueling should experience little trouble with a receiver checkout.

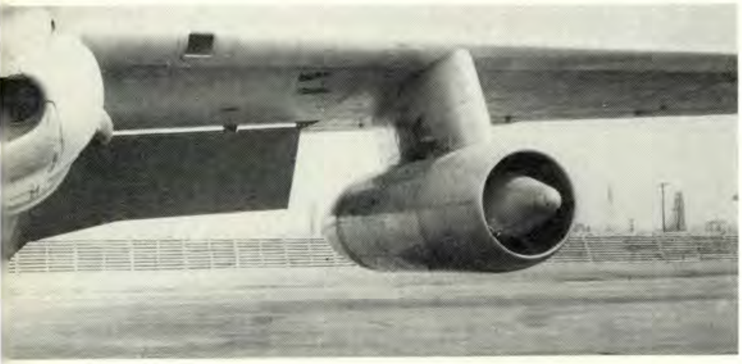
New type probe and drogue equipment has virtually eliminated the problem of fuel lost due to spillage during a normal disconnect. Actual spillage should be less than one pint of fuel, for as the pilot eases back to disconnect, the flow is automatically shut off in the refueling hose at approximately 55 feet of drogue extension. In event of an accidental or emergency breakaway, the flow of fuel is stopped at the nozzle with very little fuel spillage.

Two separate fuel systems have been installed in the new tankers, one for the tanker's use and one for refueling fuel. Normally, gasoline will be carried in the tanker's system for use by the four reciprocating engines and also the jet engines, while JP-4 is carried in the refueling system for fuel transfer. The two systems are so designed, however, that they may be interconnected and various combinations of tanks may be used depending on the mission. This means that a certain number of the tanker's fuel tanks may contain jet fuel for refueling purposes when it is desired to service a large number of receivers, but at a shorter range. Conversely, all refueling fuel tanks can be utilized to carry tanker fuel for long ferry missions. In event of an emergency, refueling fuel can be jettisoned at a rate of 1000 gallons per minute or more. Even the tanker's fuel can be transferred through the interconnecting valves and jettisoned with the refueling fuel at the same rate.

The versatility of the KB-50 jet has been demonstrated by its ability to fly any type formation which the receiver pilots desire. For example, should the receiver pilots desire a line-of-breast formation, the additional thrust exerted by the two jet engines enable all aircraft to stay in line even during a 180-degree or 360-degree turn. Therefore, the problem of a receiver aircraft catching up with the lead aircraft after a turn is eliminated.

As mentioned earlier, the technique involved in making contact with the probe and drogue method is not difficult and most pilots should have little trouble. Flight tests have shown that the optimum technique for making contact with the drogue is to accelerate into contact from a point 10 to 12 feet directly aft of the drogue. The drogue will normally be in a position outside the disturbance area created by the receiver's jet intake when the receiver is stabilized 10 to 12 feet aft of the drogue. Also, this position allows sufficient distance to build up a closing speed of three to five knots.

Below, are three views of the J-47 engine as installed on the KB-50J.



Closing at a slower speed and attempts to "chase" the drogue reduces the possibility of a successful hookup. A straight forward acceleration without large control movements has proved to be the best technique for a successful hookup. If the receiver begins closing from a position farther out and forward acceleration is slow, the drogue will be pulled slightly toward the intake and then swing outward as the intake passes. This causes the drogue to oscillate, making contact difficult.

Once hookup is accomplished, the receiver absorbs the extra drag of the drogue and use of rudder is required to maintain position. Normally the receiver makes contact with the drogue at the trail distance of the hose which is 62 feet back of the tanker's refueling pod. The automatic refueling valve in the tanker will open when the drogue is moved forward approximately 10 feet. Therefore, the receiver must push the drogue forward this distance to obtain fuel flow.

It might be well to note here some of the differences in technique involved in receiving fuel from a boom and receiving fuel from a drogue-equipped KB-50 jet. The boom type refueling operation requires excellent technique and coordination both on the part of the receiver pilot and the boom operator. The receiver pilot must move forward and up from the observation position at about the same closure speed, however, the pilot will feel and must overcome the effects of the tanker downwash.

The receiver pilot then must maintain the correct position behind the tanker before the boom operator can maneuver the boom into contact. In the probe and drogue type hookup, the drogue, once extended, cannot be maneuvered by the operator. The receiver pilot has complete control of the contact and flies his aircraft directly into contact with the drogue which trails in a position below any disturbance area created by the tanker downwash.

When refueling is completed, breakaway is made by the receiver slowly dropping aft of the tanker. As the receiver drops back the hose is reeled out to its full length automatically stopping fuel flow in the hose. Further movement aft by the receiver pulls the probe from the

The F-100s shown over Honolulu during Operation Zebra last November refueled from KB-50s over Pacific.

drogue and contact is completely broken. The receiver should back out of contact as straight as possible because the drogue will return itself rapidly to its trail position.

The efficient rendezvous equipment and refueling ability of the KB-50 jet has given Air Force tactical fighters and bombers the capability of striking an enemy quickly and at long range.

Strike forces now can go into action at any point on the globe within a matter of hours from the time an enemy strikes. Actually the KB-50 jet can go anywhere the fighters go and can refuel aircraft on the ground as well as inflight. This means that in the event of wartime dispersal, fighters can carry a traveling "gas station" right with them and can operate from the same airfields.

The KB-50 jet is not only proving its value as an aerial refueler, but is also being utilized as a control "mother" during mass fighter operations. Because of its extensive radio, radar and navigational equipment, it is being kept airborne during large fighter aircraft maneuvers, especially overseas, to provide around the clock traffic control. In this capacity, the KB-50 jet is able to give navigation fixes and also serve as an airborne filling station. The advantages of having a "mother" aircraft flying at 25,000 to 30,000 feet with UHF and VHF radios, and a long range relay capability are fairly obvious.

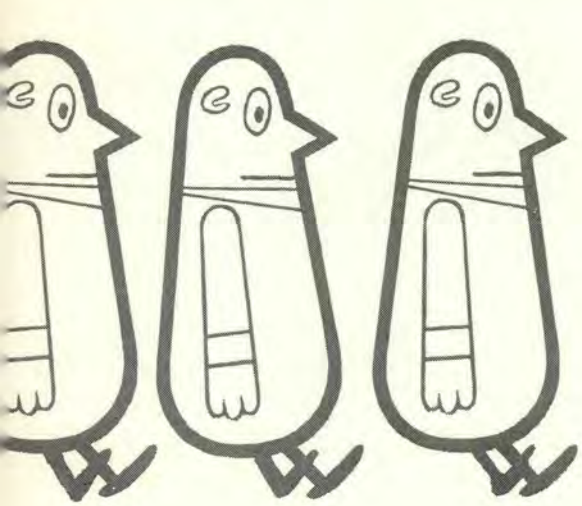
The jet model KB-50 presents no special flying safety problem, neither does the aerial refueling operations with this aircraft. Proper coordination and technique on the part of receiver pilots along with a thorough knowledge of their aircraft are the keys to successful refueling operations.

It is essential that reel operators stay constantly alert for any possible malfunction of the refueling system, and that they maintain good coordination with receiver pilots. KB-50 jet pilots will encounter few problems in being checked out if they learn the aircraft and its associated equipment thoroughly. The same old rule of safe flying applies: "Know your aircraft; stay on your toes and the rest is easy." ▲

Here are some specifics of contact on which all receiver pilots should be briefed. This comes from OCAMA, coordinated by ARDC.

- *The probe and drogue refueling equipment is designed with a response rate of eight feet per second (airspeed and altitudes are variables) within its design limits. Correspondingly, an excessive contact or breakaway speed exceeds these limits; consequently, the optimum contact and breakaway speed differential has been selected at three to five knots. The results of excessive over-take speed is generally hose whip; excessive breakaway speed develops over-loads on the refueling equipment.*
- *To enable the equipment to respond satisfactorily, the receiver must stay within a 30-degree cone of operation centered at the Hose Reel Unit fairlead. The inherent tendency of the receiver to move outside this arbitrary operational area when in the proximity of the tanker, markedly reduces the designed response rate of the Hose Reel Unit.*
- *A series of hand signals can be standardized between pilots of tanker and receiver to aid in operation under radio silence. For instance, a receiver may join a tanker to request fuel by a "drink" sign, and fall back into the refueling position for contact.*
- *It is extremely important that the receiver knows the meaning of the green and amber refueling lights, and the wave-off signal (flashing amber light) used in an emergency. With these visual aids and the hose markings (white bands), absolute radio silence can be maintained. And to reiterate, it is not necessary for the refueling operator to see the refueling contact operation; he has his control panel with adequate lights and other indicators to follow the operation easily.*
- *In making the actual contact and once in the contact position, the receiver should advance at the proper closing rate without any hesitation prior to drogue contact. Any hesitation at the point of contact will tend to cause the drogue to move away from the aircraft, because of disturbances in airflow in that area. Any attempts of the aircraft to "chase" the drogue once the disturbance is caused will tend only to aggravate the condition. Should a receiver, through hesitancy at the point of contact, cause drogue disturbance, he should retard from the proximity of the drogue (which should immediately stabilize) and commence another approach without interrupting his closing rate with adverse power changes or maneuvers.*
- *Should receiver overrun the drogue on a missed contact, receiver should retard throttle and pull straight back. This will minimize the possibility of hose drogue lodging in wing slot of receiver aircraft.*

CAUTION: Do not pull down or up unless absolutely necessary to avoid a mishap with a tanker.



Here's a good-natured dig at the design engineer by a Reserve Officer who takes an objective look occasionally at the problems besetting the pilot.

Model for

Col. Alfred L. Wolf, USAFR, 1001st Operations Gp,

Writing for sheer pleasure is a bit luxurious. A more ethical procedure is to teach. Many means exist for this: Drama, the Allegory, the Fable, Poetry.

But the Air Force invests so much in making its pilots into minor league scientists that a more scientific approach may be better, employing the critique or the hypothesis. Few scientists worth their salt skip the opportunity to frame and publish a nebular hypothesis. Kant had his "Critique of Pure Reason." Einstein advanced his "Theory of Relativity." So why should I not conjecture on the "Origin of the Species, T-Bird?"

In doing so, in these columns it may be that confirmation of my startling postulates as facts will be forthcoming. The exposition of my theory will be bound to serve to exemplify a moral. But I will reserve this serious grist for the "Conclusion," as Aesop reserved the stating of his "Moral" 'til the Fable had been related.

In the beginning, as I see it, Walter Beech must have searched far and wide and located and employed a pygmy who hated people. This must have happened some five or six years prior to his completion of the first T-11. I base this belief on the necessity of adequate lead time for this pygmy's particular task. He was the man who Beech must have employed to build the control lock for the T-7, T-11 and the C-45.

Certainly no one without malice toward mankind and the ability to walk upright in the tightest places could have achieved such a fiendish result. All of us remember, and some of us still battle with the end result—that inaccessible, unwieldly and almost impossible to engage, control lock.

Walter no doubt chose this man to insure the purity of the race of pilots. Any pilot who could continue to fly aircraft, faced with the necessity of coping with this tortuous device was tempered, just as is hot metal thrust in liquids. But he also had to be sure the system was as bad as possible, which explains the adequate lead time given our pygmy to display his malevolent genius to its fullest flowering.

I find myself a little troubled by this lead time factor in the next phase of my hypothesis. I believe, by empirical logic, that this particular pygmy then went on to devise the fuel system for the A-31, the Vultee Vibrator. Who else but this man could have split the total fuel supply into 16 tanks—as I remember it—each with its own organ stop in the pilot's console?

Surely here was a device to separate the pilots from the mice. On the other hand it may have been that because of the very lead time requisites for perfecting such awful systems, this single pygmy had assistants, a staff or even partners in crime to help him on this.

You see, his time had to be available at least seven or eight years before the appearance of the T-33 so he could work full time for Bob and Courty Gross on its fuel system. And the external evidence is such that no T-Bird pilot can doubt that this very man with this combination of background, experience, physique and motivation was the only creature who could, in only seven or eight years, have produced such refinements of evil as are displayed in our Air Force's first standard jet trainer.

What other man would have split the meager (timewise) supply of fuel into seven unequal and fairly unpredictable portions? Who else would have been fiendish enough to omit gages for the tiptanks? Who would have relished the pleasure in the doubts this could instill in the student's mind?

In how short a time can one come up with an electric system where to get fuel from some tanks you turn them on, and from others you turn them off? Who could relish secretly the humiliation, if not danger, to a normally built student involved in placing not only the switches but also the reset fuse buttons out of reach for all but a contortionist?

And think of this chap's joy in learning that the instructors normally require that placards be read before the switches are activated, knowing full well that only an owl could swivel its neck enough to achieve a line of sight relationship with these placards! One supposes our friend coordinated with the helmet, eyeshade and oxygen mask manufacturers to insure the impossibility of a pilot's being able to read these placards.

And, of course, to top this pygmy's cup of fortune was the fact that on this job he was for the first time working on jets, so that if he did trip up his victim, as indeed he surely felt he must, he would achieve not merely a momentary fuel failure but, for the first time in his work, the much more grim flameout!

Dear fellow student, soon I will point my moral. But we scientists are human so, after elaborating my carefully reasoned hypothesis, I want to add an addendum based on mere suspicion. It is about the dastardly companion to the T-33, the synthetic

Mayhem

Andrews AFB, Md.

trainer known and feared as the "C-11." I have not learned whether this is a Link device or the product of a competitor. But my suspicion is that our hate-inspired dwarf went on to new heights after his job at Lockheed as a special assistant to the project engineer on this modern torture rack.

When I became an instructor, one of the trade secrets I learned was to curb the spirit of the student who was too hot. If he thought he knew everything about landing, spoil his approach just as he was about to set it down. That's fine, but my thesis (not hypothesis) is that we must not go too far.

Let's not either break the student's spirit nor waste his time. What is added to the ability of a jet pilot by being able to contort, complicate and speculate? The jet's the thing, and if all the fuel came from one bucket with—or without—one tap or faucet until it was consumed, my belief is the pilot would be thinking about more important things, looking at more important things, and doing more important things than ceaselessly waging the battle of fuel.

The author does not intend this as the indictment of any pygmy, living or dead, nor of his employers. Rather, he intends for us to look about an aircraft and their systems equally critically in a constructive endeavor to improve our birds. This hypothesis merely chooses a well known example of an all too current ability of ours to overlook unnecessarily inefficient, complicated and, worse, sometimes dangerous features in aircraft which we fly. "Familiarity breeds contempt," but this contempt won't help the unlucky victims of these systems. ▲

The magically suspended Indian rope was considered pretty good support in the days of Pukka Sahib when everyone who was anyone had a basket full of cobras. Not so now. This gorgeous gal, name of Ingrid Goude, figures that the rope needs a helping hand to keep it up right. You can't argue with the fact that our modern weapons need many helping hands to keep them up. The little guys are certainly willing to lend a hand. How about you?

ALPHA α IS THE ANGLE

C. E. "Chuck" Myers, Jr., Engineering Test Pilot, CONVAIR—San Diego.

A test pilot who is rightfully concerned with the high rate of landing accidents puts forth his bid for installation of angle of attack indicators in all fighter planes. Chuck is also sold on the three-degree glide slope for all landings.

"α" **is the Greek symbol** used to denote angle of attack. Angle of attack is defined as the angle between the mean aerodynamic chord of an airfoil and the velocity vector of the relative wind. Practically speaking, it is regarded as the angle between the longitudinal axis of the fuselage of an airplane and the relative wind.

Optimum Airspeed—a very disturbing "crash and burn" landing approach accident generated within me a desire to learn more about how airplanes fly and specifically what variables the pilot must consider in order to perform an approach at the optimum airspeed. Until this eventful day I had been content and exceeding happy because airplanes *did* fly and I *flew* them.

I had learned to follow a number of general rules which had been handed down over the years and thereby was able to successfully return to the chocks each day in time for the beer muster at the not too distant club. In the safety of this dimly lit, well-padded environment I had been free to describe the skill which I had exhibited in conducting the days training mission in my Grumman F8F. On the afternoon of the fateful day I was conspicuously absent and those in attendance spoke in low tones and drank their beer in rapid gulps. A dauntless member of the illustrious group had gone "straight-in" without warning—while flying in the prescribed manner.

Nothing is more shocking than to be hanging contentedly on the prop of a Bearcat at 83 knots, 60 feet above the ground, about to pickup the LSO's first signal when suddenly the horizon tips an additional 30 degrees and the ground leaps toward the cockpit. It wasn't the fall that did the damage, it was the sudden stop. My! Look at the pretty orange flames!

"Weather conditions at the time of the accident, sir? Beautiful day, sir. Scattered clouds, bright sun high in the sky . . . wind? Yes sir, plenty of wind, at least 15 with gusts to 20. Yes sir, it was my first pass of the second period; by the end of the first period I was getting the feel of the machine; had the speed down to 80 knots so you see I had airspeed to spare just prior to the accident. Yes, I was low on fuel near the end of the first period . . . sir?

"You say that the airspeed required varies with airplane weight . . . yes sir, I was in about a 20-degree left bank and . . . yes sir, I suppose I should have allowed a couple of extra knots for the possibility of the rough air kicking me into a steeper bank."

I asked a lot of questions and did a lot of thinking between the inquiry and the day a month later when I brought the same model aboard an aircraft carrier in the Gulf of Mexico. The discussions included such variables as gross weight, bank angle, vertical component of the thrust vector, lift, drag, angle of attack, attitude, airspeed, rate of descent, and the means by which the pilot maintains the proper relationship of one to another during an approach.

The problem. Fighter aircraft accident summaries for the past five years show that in excess of 30 per cent of all accidents for the Air Force and Navy have occurred during some phase of landing. These accidents fall into one of the following categories:

- Undershoot (collision with the ground).
- Hard Landing: Late attempt to flare; not enough speed to flare; fast at flare; balloon and subsequent stall from five to 10 feet above runway.
- Stall During the Approach: Steep turn either because of close downwind or overshooting crosswind. Incorrect airspeed/gross weight relationship.
- High Sink Rate: Traffic pattern was so tight there was insufficient time for a reasonable glide slope. Pilot forced to perform power-off tight turn to final.
- Overshoot (ran off far end of runway): High over the fence; fast over the fence; excessive holdoff; combination of above.

Nearly all of these accidents are classed "Pilot Error." Is this then an indication that our fourth generation pilots are unequal to the task of flying the present breed of fighter? Perhaps this is the case. However, before passing judgment let us review the problem which faces the modern fighter pilot.

Variation in airplane gross weight. The landing gross weight of today's fighter airplane may vary as much as 10,000 pounds through the expenditure of fuel and/or weapons during the course of a mission. The optimum wings-level approach speed varies about four knots per thousand pounds. The recommended landing-approach speed is based on a typical landing gross weight.

Pilots generally will not fly at less than the recommended approach speed when below the typical weight; however, they will usually add an excessive amount for safety when approaching in a heavy condition. Landing with an extra 10 knots increases the kinetic energy which must be dissipated by about seven per cent. Whether or not this is of consequence depends on runway length and condition; at the very least it increases tire wear considerably.

More importantly, if the pilot uses his normal flare technique, touchdown will be delayed until the speed deteriorates to a normal value for touchdown. Ten knots of excess airspeed at the flare will amount to a loss of 1500 feet of runway during the ensuing "float." This condition establishes a perfect environment for the "balloon" and stall type of accident. The net result of 10 knots of excess speed will vary from excessive tire wear to structural failure either from a hard landing or rolling over rough terrain after slithering off the end of a wet runway.

Bank angle. The added dynamic load, or increased G, in a turn has the same effect as increasing the gross weight would have on the performance of the airplane. In order to maintain the optimum approach angle of attack when rolling into a turn, the airspeed must be increased by applying additional power or by increasing the angle of descent.

Load Factor and Stalling Speed in Turns

Angle of Bank	Load Factor	Increase in Per Cent Stalling Speed	Actual Stall Based on 100 Kts
10 degrees	1.01	0.5	102
20 degrees	1.06	3.0	104
30 degrees	1.15	7.0	108
40 degrees	1.31	14.4	114
50 degrees	1.56	25.0	124
60 degrees	2.00	41.4	142
70 degrees	2.92	71.0	170
80 degrees	5.75	140.0	240

Table One

The required increase in speed is related directly to the dynamic load which, in a balanced turn, is equal to one divided by the cosine of the angle of bank. The dynamic load increases slowly in shallow banks, reaches a value of 2G at 60 degrees, and builds up rapidly as the bank becomes still steeper. (Table 1)

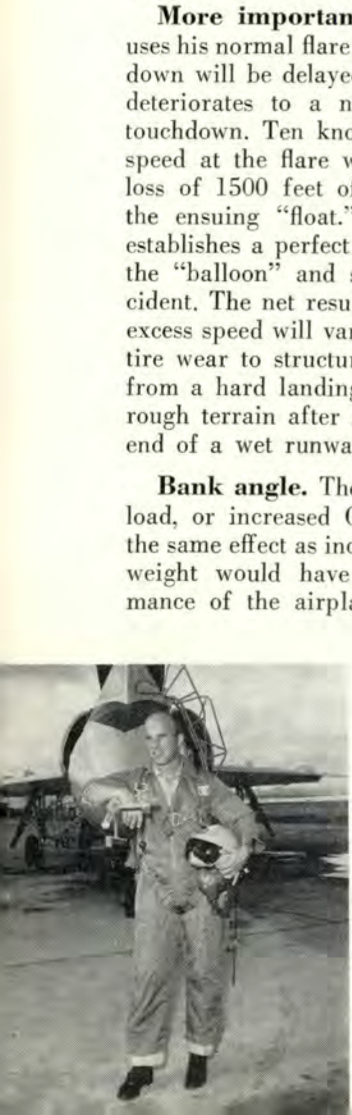
With most fighters, the optimum angle of attack can be maintained in turns by applying enough power to increase the airspeed about 6/10 of a knot for each degree of bank up to 40 degrees. In steeper turns it would be advisable to raise your speed by at least one knot per degree of bank. The power should be increased while rolling into the turn; when rolling out, power must be reduced to less than that required for optimum wings-level speed in order to dissipate the extra speed.

Because he doesn't know exactly how much the speed should be increased for the different bank angles, the pilot usually adds too much and comes out of the turn fast with no choice but to reduce power to idle so as to return to a reasonable wings-level speed. Such a transition usually results in a high-sink rate which is difficult to overcome, especially when one considers the slow-acceleration characteristics of a turbojet engine.

Stall speed. The stall of an airfoil occurs when the character of the airflow changes abruptly from streamline to turbulent; separation occurs, circulation and lift deteriorate and pressure drag increases. The point at which an airfoil stalls is strictly a function of angle of attack. The term "stall speed" is meaningless until associated with a gross weight. The two may be combined to define a lift coefficient which in turn identifies the angle of attack.

The pilot, to be aware of how near the airplane is to a stall, must have either a plot of stall airspeed versus gross weight or a cockpit presentation of angle of attack. The plot, to be complete, would have to be stall speed versus gross weight per angle of bank whereas the angle of attack at which stall occurs is the same regardless of the bank angle.

Power required and power available. A typical set of power required versus power available curves for a jet fighter are presented in Figure 1. Curve AE represents the power required at the minimum gross weight while curve A '''E''' is a similar curve for the maximum gross weight. The dash lines represent constant angles of attack. The angle of attack at which this particular air-



"Chuck" Myers is a graduate of both the Army Air Corps and Navy flight training. During World War II and the Korean War, he accumulated more than 100 combat missions.

In 1954, "Chuck" graduated from the Navy School of Test Pilot Training and served two years. He then resigned to become project pilot on the SFX-1, "Pogo Stick." Since September 1956, he has served as a test pilot for the F-102A and F-106A all-weather interceptors.

plane stalls is 20 degrees. The optimum angle of attack for a landing approach has been determined to be 12 degrees. Examination of the curves reveals the following facts:

- Less power is required to maintain level flight at B (170 knots) than at A (240 knots).
- To maintain level flight at D (118 knots) requires more power than to fly at *either* points A or B.
- The margin of power available for acceleration is represented by the vertical distance between any point and the power available curve. This margin decreases with an increase in gross weight and/or angle of attack.
- The optimum approach speed varies with gross weight from 157 knots (light) to 177 knots (heavy). Points C, C" and C'" have only one thing in common: They are all oriented on a line of constant angle of attack.

Flying at angles of attack to the left of B B'" has become commonly referred to as flying on "the back side of the curve." Most approaches are made slightly on "the back side of the curve," but not further to the left than is represented by CC'". Such an approach permits the pilot to cross the fence at a minimum speed consistent with safety and yet allows plenty of margin for acceleration, should it be necessary to take it around.

The stall area is difficult to define on some of the modern fighters. In any event, this area should never be approached since at typical landing weights there will be little or no power available for recovery from such a condition. For an airplane having characteristics as depicted in Figure 1, a stall warning device, if installed, should be set to react when the angle of attack reaches line DD'" (18 degrees). The pilot responds to the warning by applying military power which will bring him back toward CC'" without sacrificing altitude.

The pilot of the high performance fighter should have a mental picture of the comparable family of curves for his particular model, or he must have at least memorized a half dozen weight/airspeed/thrust points in order to fly each approach at the optimum speed.

Approach Flight-Path Angle. There are basically two categories of approaches:

1. Power approach with a glide slope of between two and four degrees. The rate of descent varies between 500 and 1000 feet per minute.
2. Idle power approach with a glide slope of between seven and 10 degrees and a rate of descent between 2500 and 3500 feet per minute.

The first type of approach should be flown at the optimum airspeed for the existing gross weight, a value which may be determined, when operating bomber or cargo type aircraft, prior to beginning the approach by making reference to performance charts. This same power approach is currently being recommended for landing high-performance fighter aircraft.

The second approach, preceded by a hard break and tight pattern, is a "tactical leftover" from World War II. It is sometimes flown by fighter pilots to demonstrate their skill but under the guise of being a safe approach since the field could be made should the engine quit while in the traffic pattern—an extremely rare happening with jet aircraft.

Such an approach is a necessary part of the flameout pattern for fighter aircraft. The approach must be flown at 20 to 30 knots above optimum speed to allow for the flare, a maneuver which must be started at least 100 feet above the runway.

Vertical Thrust. When performing a power approach at a three-degree glide slope, a high-performance fighter may have an attitude of between eight to 10 degrees, nose up. Analysis of the forces involved during such an approach reveals that the vertical component of the thrust vector is contributing between 600 to 800 pounds to the total lift of the system. This contribution allows the pilot to fly the airplane about three knots slower than would be possible during a steeper idle-power approach, not considering the aforementioned airspeed pad required to flare from a steep approach.

Lift Augmentation. Another family of variables which the pilot must consider when determining the airspeed for a particular approach are the various devices employed to increase lift during low-speed flight. They include flaps; slats; boundary layer control and combinations of these.

The final approach speed may vary as much as 25 knots depending on the extent to which the above devices are used.

Optimum Approach Speed. In determining the optimum approach speed for a particular configuration, the flight test agency considers the following:

- Stability.
- Controllability.
- Stall characteristics.
- Power available vs. power required.
- Forward visibility.
- Desire to land as slow as possible.

Figure one. Power required and power available for a typical Century Series fighter.

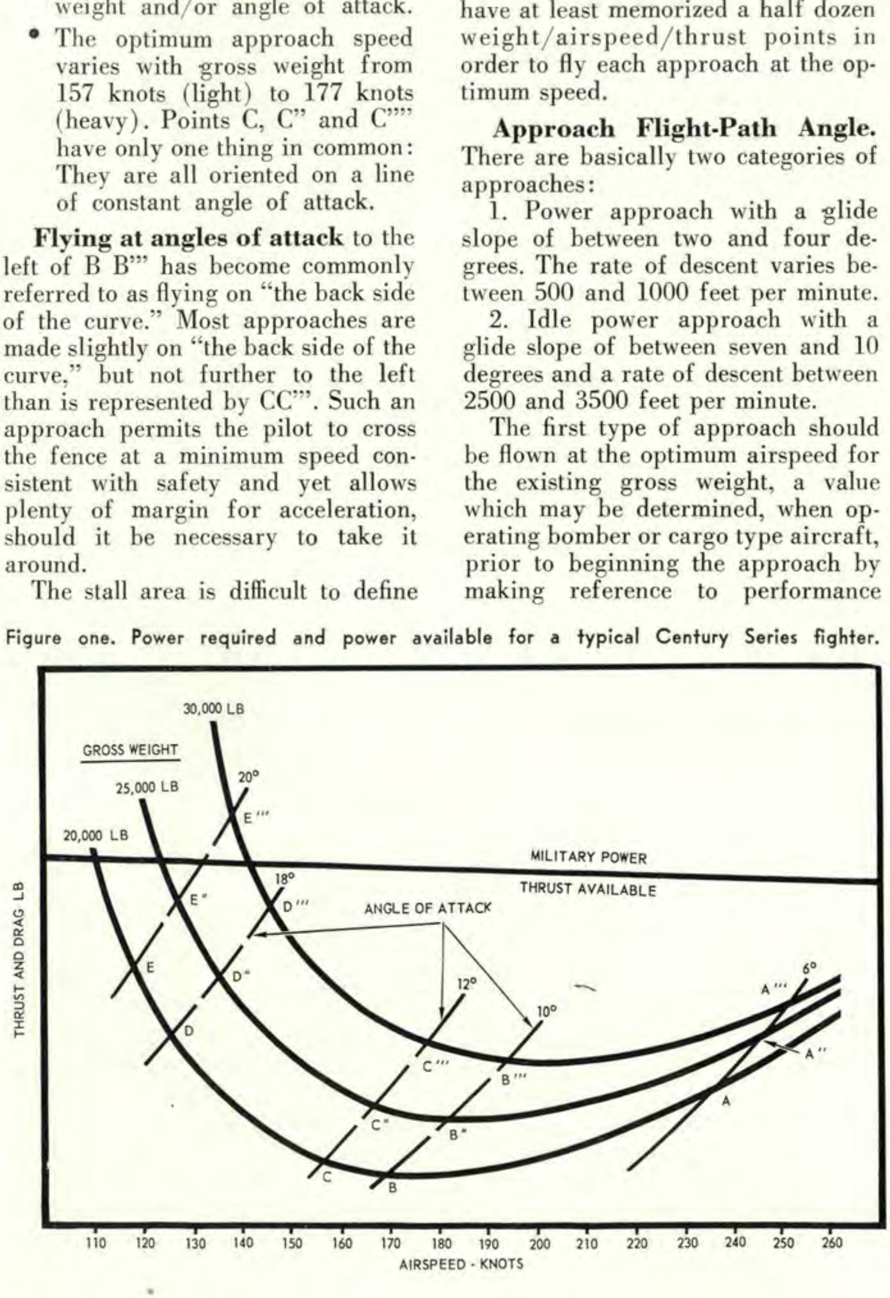


Figure 2. Angle-of-attack standard panel.

- Sufficient speed to allow for flare.

The published recommended approach speed is a practical figure for a typical gross weight. If the aircraft is to be landed at other than this weight, the pilot must add or subtract accordingly if he is to perform the approach at the optimum speed.

Tools for the Pilot. The equipment available to the pilot of the high-performance fighter for solving the landing-approach problem is the same old airspeed indicator his father used 20 years ago.

The kid who is all wrapped up in a 30-degree bank on a five-degree glide slope with 70 per cent fuel aboard and one-half flaps, is expected to run through a mental calculation which will yield the optimum speed for this particular condition, as well as tell him how far he is from a stall. The ungarbled "word" is that he is incapable of performing this task. If he had one additional piece of information available he could solve the problem in a second.

The information to which I refer is *Angle of Attack.* Regardless of the angle of bank or gross weight, if the airplane is at the correct angle of attack for the configuration, it will be at the optimum speed for the described flight condition.

Utilization of angle of attack as a primary reference instead of airspeed is not a revolutionary idea. Wilbur and Orville resorted to angle of attack to accomplish flight at max C_L in order to overcome a power deficiency. In later years we became more interested in speed than lift efficiency, hence the airspeed indicator, a wonderful device for navigation but a meager aid for a precision landing approach.

Use of Angle of Attack During the Approach. During the turn from downwind to base the pilot slows the aircraft by reducing power and maintaining altitude until the approach angle of attack is reached. During the descending turn from base to final, power is adjusted to maintain the approach angle of attack.

In doing so, the airspeed which results will be the optimum airspeed for the current gross weight, bank angle and normal acceleration. This same angle of attack will dictate the optimum airspeed during the final approach.

Experience has proved that the safest landing approach during visual flight conditions is the same as the approach which is flown under instrument conditions. This approach is characterized by a two and one-half to three-degree glide slope with sufficient power to maintain the correct approach airspeed. The common rule, "Control airspeed with attitude and rate of descent with power," applies specifically to flying an instrument letdown, not a landing approach, as some have inferred.

A more practical approach technique is that prescribed by the U. S. Air Force Manual for Jet Instrument Flying. It says to make corrections to the flight path with elevator and change power to maintain the airspeed within limits of plus or minus five knots of target speed. This same technique is used to maintain the desired angle of attack, with the limits being plus or minus one-half degree.

The technique described is a rather mechanical process which will suffice to solve the approach problem. However, I recommend that we proceed directly to a more advanced technique which I refer to as flying "The Big Picture." Transition to this superior flight technique requires two major steps:

- Installation of a satisfactory angle-of-attack detection system coupled with a suitable cockpit presentation in all fighter airplanes. This presentation should include stall warning.
- Put into effect a brief but intense educational program on the "power-required versus power-available" performance curves for the particular aircraft the pilot will be flying.

Once aware of the "Big Picture" and equipped with the proper hardware, the embryo pilot not only will be able to fly his airplane safely at the optimum airspeed throughout an approach; he will be able to maneuver the machine at low speed in a manner which would have previously required years of experience. He will cease to fly in a mechanical fashion; instead he will react according to the total situation.

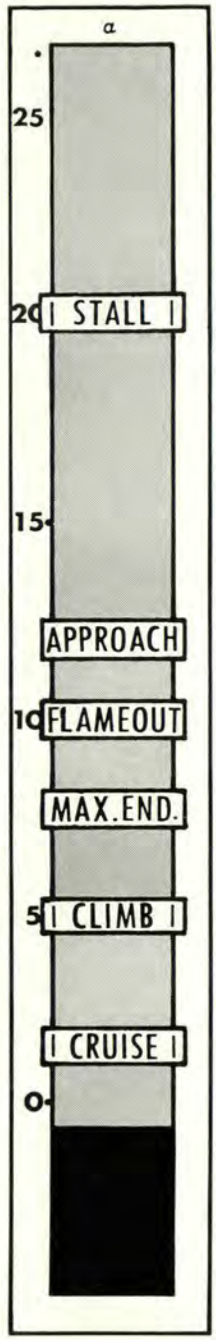


Figure 3. Angle-of-attack vertical display.

Additional utility. An appealing aspect of a good angle of attack system is its utility. The same presentation which is used for landing will provide the pilot with an index for ac-

Figure Four. Vane type angle-of-attack detector. Figure five. Probe type angle-of-attack detector.

complishing the following for all altitudes and gross weight combinations:

- Maximum endurance speed.
- Best climb speed.
- Best cruise speed.
- Maximum distance glide.

Very often the second and third items are functions of engine performance as well as angle of attack. However, flying the angle of attack will allow operation at very near the correct speed. This will be much nearer than can be accomplished by the present method of attempting to memorize the performance figures for all altitudes and weights.

The other two items are functions of C_L/C_D and are therefore directly related to angle of attack. It is evident that, if properly presented, the angle of attack indicator could become the one most useful instrument in the cockpit.

Presentation. The presentation of angle of attack should be simple and direct. Figures 2 and 3 are recommended for retrofit on standard instrument panels and futuristic vertical displays. The dial type presentation should be mounted near or in place of the airspeed indicator in the current "Sacred Six" arrangement.

Sensing Devices. In flight testing, the most successful means of determining angle of attack has been through the use of a nose-boom mounted, mass-balanced vane. Such an installation has satisfactory response and exhibits a minimum error but is a bit too vulnerable for use at an operational level.

The two types which have been used to supply angle-of-attack information to fire-control systems during the past few years are shown in Figures 4 and 5. They are referred to as the "vane" and "null-seeking probe," respectively.

Both the vane type and the later versions of the probe are rugged and require little more care than the pitot tube of an airspeed system. The probe has better response characteristics in the low speed area than the vane, the latter being afflicted with lag and a tendency to overshoot, both characteristics a function of its inertia.

Summary. As was previously stated, angle of attack instrumentation is not a revolutionary item; many pilots who read this article have conducted evaluations of various systems during the past 10 years. The results of the evaluations were not very gratifying. Most of these pilots are in agreement as to the potential value of angle of attack, especially as a landing aid. However, they were dissatisfied with the response, accuracy, flyability and presentation of the systems they evaluated.

The lack of immediate success has created a false impression that angle of attack is of little value as a primary instrument. My own experience and that of many of my fellow pilots during the past year has convinced me that angle-of-attack information is of great value to the pilot. Further, I'm convinced that there are systems available which perform well enough to warrent installation in all fighter aircraft.

As a partial solution to the landing problem and to aid pilots in realizing maximum performance from their aircraft, I suggest installation of an available angle-of-attack system—plus an aggressive program to develop these systems to the point where angle of attack may relegate airspeed to its proper role. ▲

SOME FIGURES DON'T LIE

Some office wag said the other day that a sack dress was just a bag full of goodies. This might be but who can tell anymore? In this day of mechanical marvels who knows for sure that figures don't lie?

One thing for sure, the figures on aircraft accidents that we get in the shop here are well screened, wrung out and hung up to dry before we start drawing any conclusions from them. When we judge that we have enough statistics to draw one of these conclusions we turn on the machine and sometimes some very interesting figures pour out on a little punch card. Here's some that came out just recently. And they don't lie!

In the fiscal year 1957, AMC reports that the Air Force had 10,379 inflight engine failures which resulted in subsequent engine removal. This includes recips and jets. In the jet category 4,471 occurred. Breaking it down further, we found that 3,061 of these inflight jet engine failures happened in single-engine birds. That is a goodly number of first class emergencies for the brain bucket boys to cope with. Don't get the impression that in all of these 3,061 adrenalin-injected flights that complete loss of power was incurred. These reported failures include those groups of malfunctions which you detected in the moan and groan category prior to laying a big fat egg.

How did the lads come out score-wise in meeting these emergencies? Surprisingly well. When you figure the dead engine glide ratios and sink rates of the modern interceptor aircraft, our boys have done a magnificent job. Less than 10 per cent of these single-engine, jet inflight failures resulted in either accident or incident. This, we think, is proof that our pilots, on the whole, are reacting in a highly professional manner to some very nasty situations. All pilots and others should get into prevention and detection of potential failures before they happen inflight. Only in this way can we stop-gap this accident potential and better the record.

Training and discipline are obviously at a high level in many of our units. Emergency procedures evidently have been well rehearsed. The red bordered pages of the Dash One are getting the attention they deserve. For this we can all give thanks and praise to the fine pilots who responded so well when faced with the ultimate in rough situations.

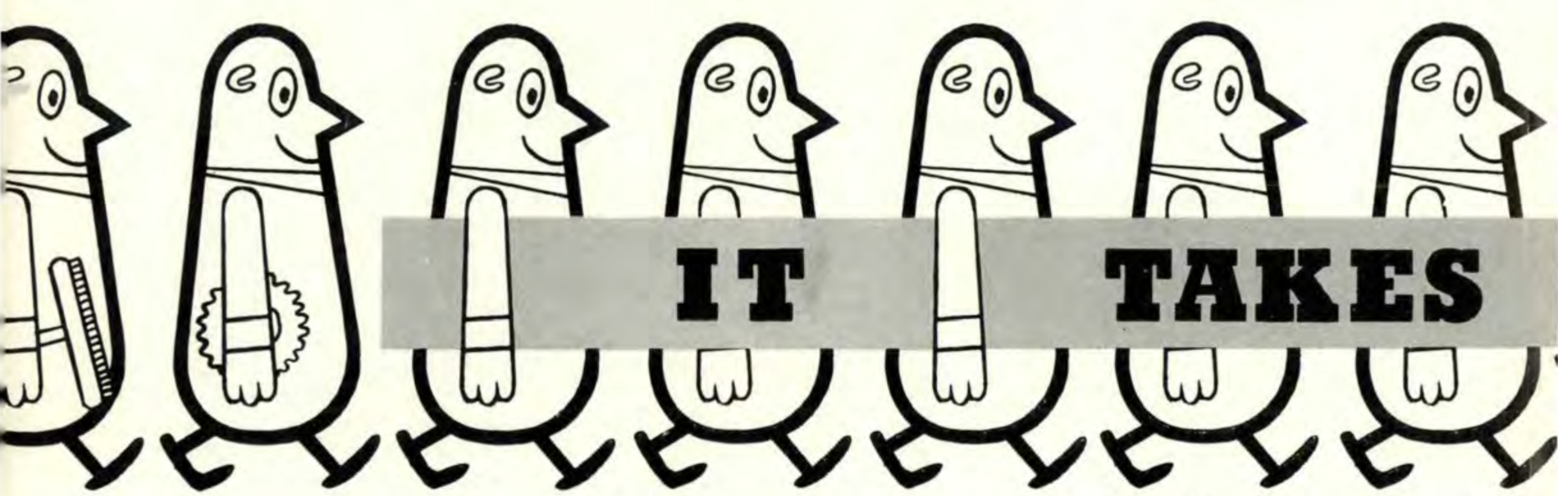
THE DESIGN ENGINEER—Deep in the jungles of integral calculus, where the smooth slip of the slide rule merges with the sharp staccato of uprooted hair, lives the Aircraft Engineer. Innately uncivilized, he dreams daily of ways to weaken the laws of physics. He slyly fingers his analog computer as he dwells on schemes for outmaneuvering the Enemy and outwitting the Competition, other fierce tribes of the same breed.

•

THE MASTER PLANNER—As children, Master Planners spend their leisure on jigsaw puzzles. As adults they do the same thing, contorting men, machinery and government requirements into neatly interlocking pieces in a four-dimensional puzzle. It is rumored that a Master Planner once slew an innocent musician because he wrote a melody entitled, "Time on My Hands." Born and reared in metronomes, they spend their leisure repairing time clocks and studying the classic uses of Procrustean beds.

•

THE MOCKUP BOARD CHAIRMAN—The Mockup Board Chairman tends to suffer from schizophrenia or split personality. During his sessions to determine with the Mockup Board and with the Contractor the best configuration for the airplane, he must compromise the conflicting views of 25 or so men, all of whom have a direct line to the source of Absolute Truth. He sometimes looks tired in the evening and one or two Mockup Board Chairmen may drink.



Keith Baker, Asst. to the Pres., Chance

THE DRAFTSMAN—If your child doodles and uses up all your blueprint paper, beware of him for he may become a Draftsman. Manufacturers of paper and pencils admire this interesting speciman whose ambition is to draw the most out of life. Engineers work from dawn to dusk to feed these little creatures who love Intricate Details and frequently leave the office to chew on Changes.

•

THE TOOLMAKER—From the great fertile area of Engineering come drawings for parts for which there are no known tools. To handle this deadlock, nature has provided the Toolmaker, an interesting type who clings to the motto, "The egg comes before the chicken." Handed a particularly juicy tool of Engineering, a Toolmaker will stand stockstill for a long time, apparently in a state of shock, and then run off to make a tool to make a tool to make a tool to make a part to make an airplane.

•

THE MATERIALS MANAGER—a born collector, the Materials Manager is the pack rat of the Aircraft Plant, constantly hoarding bits of rare metals and old jigs and fixtures against his mortal enemy, the Unexpected Contingency, which causes his tender skin to break out with a rash of Shortages. A Voracious reader, he loves to quote passages from Hemingway's novel, "To Have and to Have Not," and his favorite magazine is Time, especially lead Time.

THE QUALITY CONTROL MAN—In the Land of Hopeful Perfection lives a small group known as Quality Control Men. They are all eyes and criticism and have been known to question the formula H_2O as being inexact. They love Tensile Strength and subsist solely on Flaws and Rejected Fittings.

•

THE SALES REPRESENTATIVES—No creatures in the aircraft plant are fuller of freedom and enterprise than the Sales Representatives. Driven by their thirst for knowledge, they are great burners of midnight oil. Friendly, brave and gregarious, they fear only one thing, a Deferred Decision—a disease which sometimes attacks their appetite by causing atrophy of the Procurement Pact.

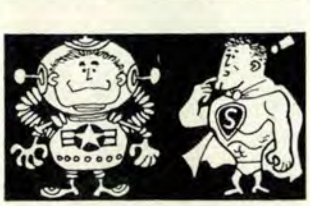
•

THE MACHINIST—A man who grinds exceedingly small, the Aircraft Machinist is easily satisfied with any old part he makes as long as it's accurate to within 1 10,000 of an inch. He is also amiable in a competitive sense. He doesn't care how good any other machinist's work is, as long as his is better. These specimens are strongly attracted to metal and are addicted to punching, stamping, milling, grinding and such things to demonstrate their mettle.

Vought Aircraft Inc., Dallas, Texas.

THE MECHANIC—Confronted with the latest scientific diseases which can affect young aircraft, such as electronic measles, small pox machs, and mumps of the armament gland, the Aircraft Mechanic peers into the intestinal tracts of these supersonic fledglings, grills the Engineering internes, and then calmly coddles the little monster into contentment.

•



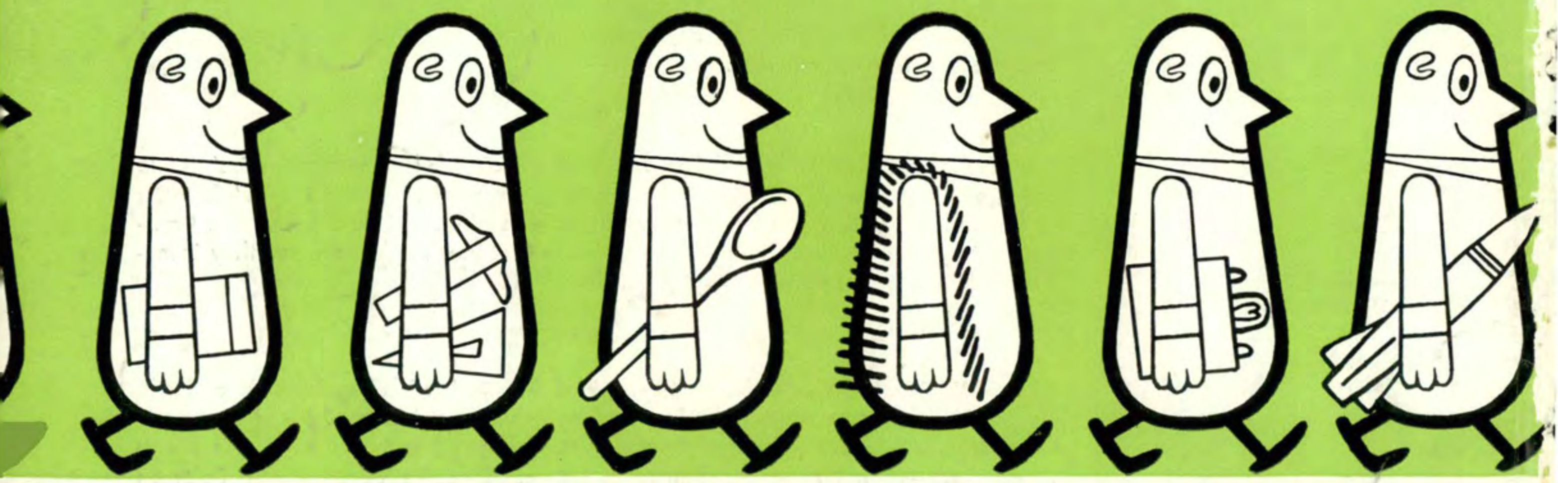
THE TEST PILOT—Often a fledgling Test Pilot will disturb his contemporaries' gentle game of "Ring Around the Rosey" by shouting, raucously, "Wring it out!" Skeptics at birth, they tend to regard aeronatical theories as airy fancies until they can transpose them into airy facts. Born without wings, a fact that maddens them, they immediately begin to fly in order to spite nature.

•

THE SQUADRON PILOT—The Squadron Pilot is a jack of all tradewinds and can fly anything, anytime, anywhere, from a barn door to a bottle of bicarbonate. He never high-hats a friend, although one pilot flat-hatted a friend once. His life is an easy one—all nature expects him to do is to combine the judgment of a Solomon with the speed of a vibration. ▲

EVERYONE

in today's Air Force is a specialist.
There is no longer a General Practitioner
of Aircraft. The Crew Chief Concept is
a thing of the past. But with this specialization
comes the danger that individuals will
not recognize the inter-relationship of team function.
EVERYONE—from Cook to Commander—
must recognize the need to coordinate,
integrate and expedite all Air Force actions
required to produce totally operational
and completely supported weapon systems. And—
EVERYONE must do his part in the overall team effort.



*U.S. GOVERNMENT PRINTING OFFICE 441797