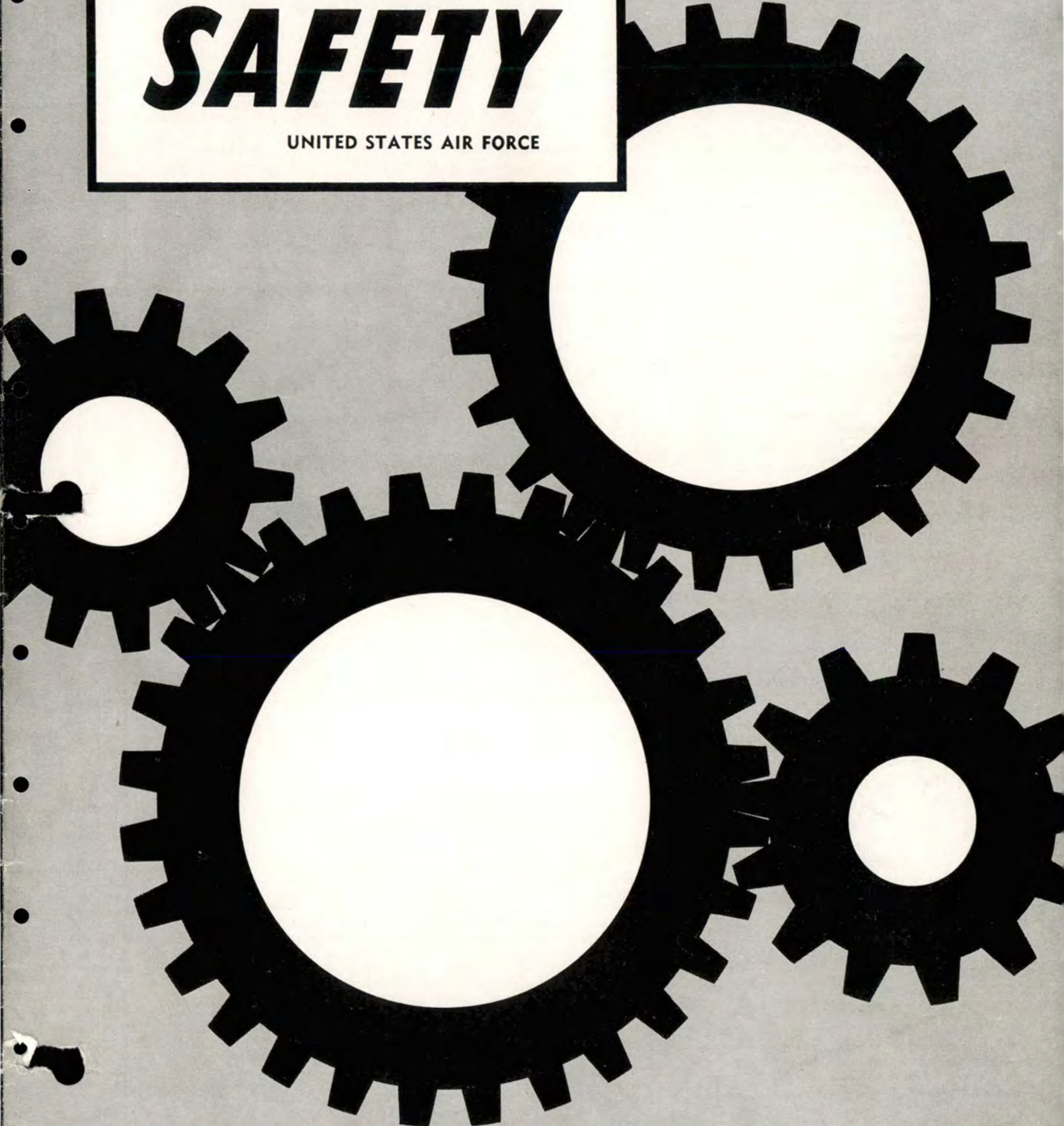
FLYING SAFETY

UNITED STATES AIR FORCE

SEPTEMBER
1957



MAINTENANCE TODAY

File Thirteen

I can hear it now: "Maintenance talk in FLYING SAFETY?" You bet. Our whole theme this month is just that—Maintenance Today. And with good reason. Time was when a pilot just sort of flew what he got, with no questions asked. He flew 'em; somebody else maintained 'em. The pendulum has swung and now the pilot finds himself a hand-to-hand partner in the matter of keeping his bird reliable and ready to go. Hence our cover design, denoting the necessity of meshing air and ground crewmen into one unit to achieve their common goal. . . . Word comes that some bases are dragging some feet on runway distance markers. Some have none and others have inadequate markers—like numbers that are too small, unlighted or in such poor state of repair that they are difficult to read. Your Flying Safety Officer received all the latest specs last month. . . . The hot weather is beginning to show up in "settled back onto runway with gear up" accidents. It's difficult to understand how a pilot who has realistically computed his takeoff distance requirement, can pull his bird off before he ever reaches his computed distance. . . . Flew with two pilots on a clear-across-country IFR flight the other day. Neither had heard of Channel 13 nor were they familiar with Pilot-to-Forecaster Service. FLYING SAFETY (Feb 57) carried the story. The stations are listed in the Radio Facility Chart as PFSV. . . . Your FSO has some good poop on the hazards of flying through Severe Weather Warning Areas. They're still around.

'til October,

Vernon R Stutts

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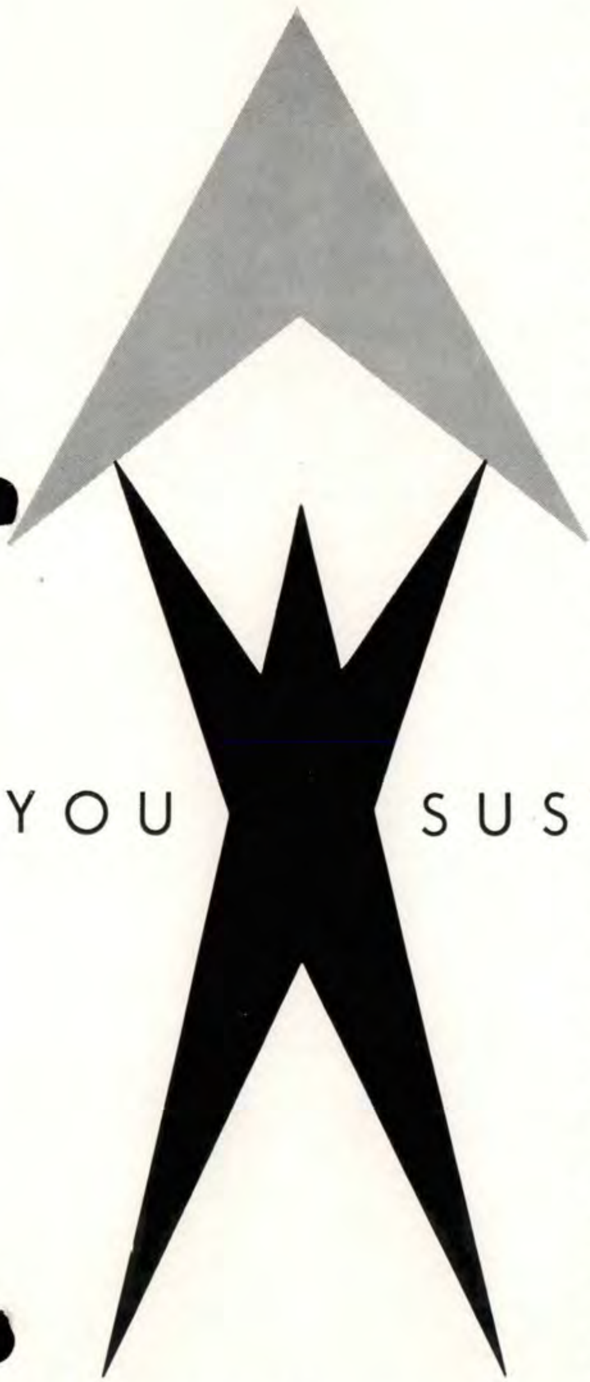
USAF PERIODICAL 62-1



YOU SUSTAIN THE WINGS

Times change, for better or for worse. The inexorable march of scientific progress makes many lovely things obsolete. The wonderful old Air Corps has taken its place in the museum of nostalgic Americana alongside the Mississippi sternwheeler and the open-top Fifth Avenue bus.

We still have a mission to accomplish—more important than ever. Our airplanes still make a loud bang when they hit the ground, but the really loud noise you hear is the terrific impact on the national debt. Also, with all our progress, we still like to stay alive. So, some things don't change and we still have the job of keeping 'em flying.

When an airplane is built in this day and age, it is capable of performance perilously close to its design limits. The old cushion against the extremes of time, speed, temperature and structural stress is not as fat as it used to be. Our new birds are finely tuned instruments that will do wonders for us if we treat them exactly right. But let's not forget, they're not the forgiving machines some of the old ones were. They don't turn the other cheek when they're abused. Is this bad? Of course not.

In the good old days, a crew chief could keep his airplane flying with a roll of piano wire, a couple of yards of fabric and a can of dope. Flying the crate was comparatively as simple.

But fifty years of progress has brought aircraft approximating missiles, with a scarcity of wing area and highly dependent upon engine thrust for safe landings. The complicated electrical and hydraulic systems place greater demands upon the pilot and the maintenance crew than ever before: for one to understand and to fly, for both of them to maintain.

It all boils down to the fact that today's pilot must be a professional. He must operate his aircraft with finesse and precision and get maximum performance out of it without abusing the airframe or engine. He affects the workload of his maintenance unit directly by his manner of operation, just as he affects the reliability of his machine. A maintenance unit continuously changing engines, brakes and tires, as a result of some pilots' thoughtless "unfair wear and tear," has less time to spend on preventive maintenance. And—the pilot winds up sitting on the powder keg. It's largely up to you.

Trend of the

"FROM PILOT to pencil-pusher—that's what this Air Force is doing for me," Lieutenant Smith grumbled, as he came in the door of his Wherry Housing apartment. He brushed past his wife while still muttering, "Charts, curves, eyelids—just give me a plane!"

She watched him disappear into the bedroom and decided, "This calls for Special Treatment B." When he returned to the living room, freshly showered and dressed for comfort, she ceremoniously led him to his favorite chair, propped his feet up, and put a very dry, very cold martini in his hand, and passed him a plate of sardines on hot buttered toast.

"Partake," she instructed, "and then tell!"

Lieutenant Smith was a new F-86D pilot. He was also relatively new to the Air Force, the Wing, and to his bride. He told.

"All my life I've wanted to fly. I have trained to fly. The Air Force says I can fly. There is a lot of trite corn about the wild blue yonder but it's trite because it has been true for so long. I come zooming in home, monarch of all that I survey—yet I don't even get out of the plane before I have to start shuffling papers . . . checking oil pressure; there are guys crawling all over the plane measuring how much oil I'd used (down to the fraction of a quart), another fellow clocking my coast-down time and measuring my eyelids."

"Did you tell them that you have 20-20 vision?"

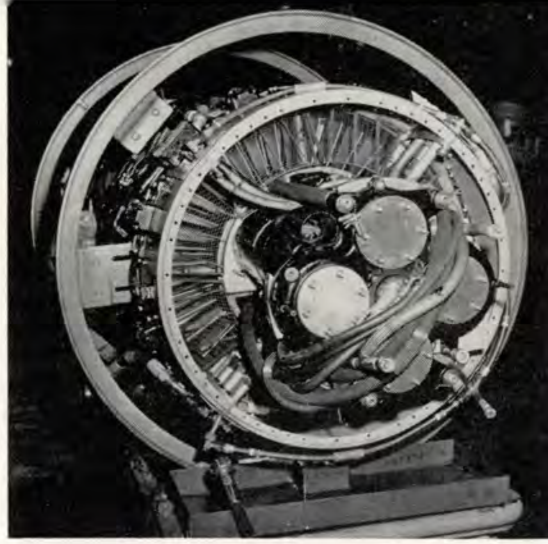
"This, pet, is a gadget in the rear of the plane known as the nozzle eyelid opening."

"Maybe they're checking its dilation to see how exciting the view has been?"

"Oh, come off it! You just don't understand . . . and I don't either. All I need is a plane that burns and turns. I'll fly it; let the other guys keep the diaries."

"There's probably a very good reason for it all," his wife suggested.

Turbine



Now, as never before, the pilot influences the type of maintenance his aircraft will receive. To the degree that he checks and reports, he will influence the reliability of his machine.

"Yeah, they said over in Ops that I'd get briefed on it, meantime I was to see that I turn in the right information. If I wanted to sluff off, the crew chief wouldn't let me. He's a stickler. We even do rechecks if something doesn't look right. Somebody made a believer out of him."

"Tactlessly changing the subject, we're eating early tonight. Our neighbors, Major and Mrs. Jones, are coming over for cards. He's a Maintenance Officer, I think. She came over this morning to see if we are getting settled all right and to invite me to a luncheon. So I asked them over tonight."

The Smiths and the Joneses were between deals at bridge later in the evening when Major Jones made a routine inquiry about the Lieutenant's job. Jones concluded an affirmative, enthusiastic reply with "The plane and I are downright congenial, but I may have trouble with my pencil."

"He came in flipping about measuring this and that; oil and eyelids, and coasting down and paper shuffling," Mrs. Smith contributed.

"Oh, that's the Engine Trend Analysis Program you're recording data for. It's a big accident-prevention deal. Going world-wide in the Air Force now. Whatever else you do when you get those figures, get them right! You are very enthusiastic about your flying," the Major continued, "and that's all to the good. That's what we want. But there are a lot of us who are equally enthusiastic about your coming back down that runway—home—too."

"Well, sir, I am at the head of that list. Besides protecting the Air Force's investment in me, I have become rather fond of my own neck. But so far, I don't see how more paper work will save me. You have a good Maintenance squadron to keep the plane in condition. Why bring pilots into the picture?"

Pilots Needed

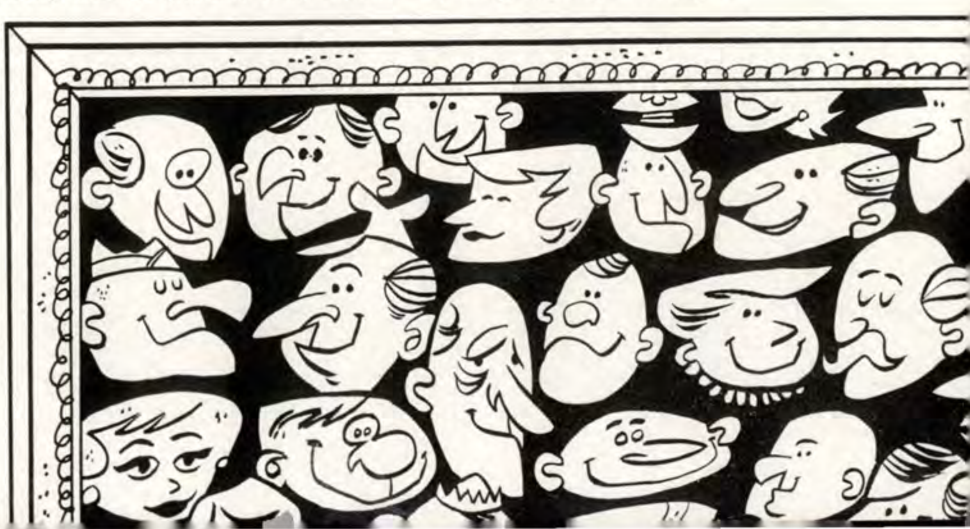
"Everybody's in this picture," was Major Jones' reply. "We have a world-wide Air Force with a primary mission of being combat ready. That means we also have long supply lines that must support operational aircraft. We need ready engines in war reserve instead of in overhaul or splashed over the terrain. We need you pilots; we don't consider you expendable. If we have all this, it comes down to one thing: We need engine reliability. One way to get this is to detect an impending engine failure before it happens, remove and service it, and put a 'well' engine back in your plane.

"That's where the Engine Trend Analysis Program comes in and where strict records of performance data take on greater importance. Major Brown, over in Records, takes all of these coast-down, oil consumption and pressure, and variable nozzle position figures and plots them on individual graphs for every engine. Each new entry that he makes on these graphs from records on every flight that you make, establishes the direction of a curve on the graph. If the curve rises or falls too much, it tells him that the engine is headed in the wrong direction. Then he tells me and we pull the engine to find out what's wrong. This statistical analysis is no crystal ball or ouija board that spells out 'You've got a bad bearing.' It does flash a warning to us and we pull the engine before it fails inflight."

"Look—are you fellows going to play bridge, or are you going to talk shop all night?" Mrs. Jones asked.

"Roger," Major Jones apologized. "I see the answer to a lot of his questions in your magazine rack. Have you read your July issue of the Maintenance REVIEW? It's required reading, you know, because it has an article in it entitled 'Dr. USAF and the Ailin' Engine' on this Trend Anal-

"Suddenly, there are guys all over my airplane—inspecting, checking, measuring. . . ."



ysis Program. You read that tonight, Smitty, and come to see me in the morning. I think I can show you how this paper work helps to keep you flying. Whose bid is it?"

The next morning, Lieutenant Smith had his Maintenance magazine with him when he called on Major Jones. "I'm still reading it," he reported. "It takes a little concentration. I can see that it's a good thing—and a big thing. I can see that my checkups, accurately made, start the ball rolling and I can see how the figures get onto a graph and how the graphs can be analyzed. I can even see where you maintenance fellows can follow a trouble-shooting chart. But it still looks like a maintenance job. Can't these things be caught in a routine crew chief checkup?"

"He can catch a lot of things. But, in the first place, it would take a guy whose mind was a cross between a camera and an encyclopedia to remember individual engine performance on all the engines and all the planes. And that's what we've got to know. The main reason he can't spot a lot of these deficiencies though is that the actual physical factors causing these pressures, times, rates and positions to vary from normal, are too well hidden for routine checks to reveal.

Coast Down

"I pulled this coast-down chart this morning to show you. I thought it might interest you because the engine was in your plane yesterday AFTER we pulled it and serviced it—then returned it to the aircraft. We pulled it for one reason alone. Analysis of this graph showed that the engine was in trouble. We didn't know exactly why, so we pulled it and found out. This graph is a record of the coast-down time. You've probably learned from the article that it should never take less than 65 seconds or more than 90, for your engine to coast down from 65 per cent rpm. As you can see, this plot shows that the engine was taking less and less coast-down time. When it reached the danger point, we pulled it."

"Yes, sir, I get all that, but how do you figure low coast-down time means trouble?"

"The time it takes a jet engine to coast to a stop from idle RPM is strictly a measure of friction. As the time goes down, the amount of friction inside goes up. This simply means that something is grinding or dragging in the engine. The parts that cause this are difficult to spot before they go completely out.

"When we pulled the engine which you flew yesterday, we found that the starter generator bearing was on the way out. It hadn't gone quite far enough, however, for the pieces to pass into the compressor.

"Do you know what would have happened if it had got there? No, I can see that you don't. The compressor would have come unglued. Now, do you know what would have happened then?"

"Yes, sir. If I had been lucky, I would have had a very flashy takeoff and odds are—on takeoff or upstairs—my flying career would take a sharp jolt, and Uncle Sam would be minus another plane . . . and I'd have had to walk home."

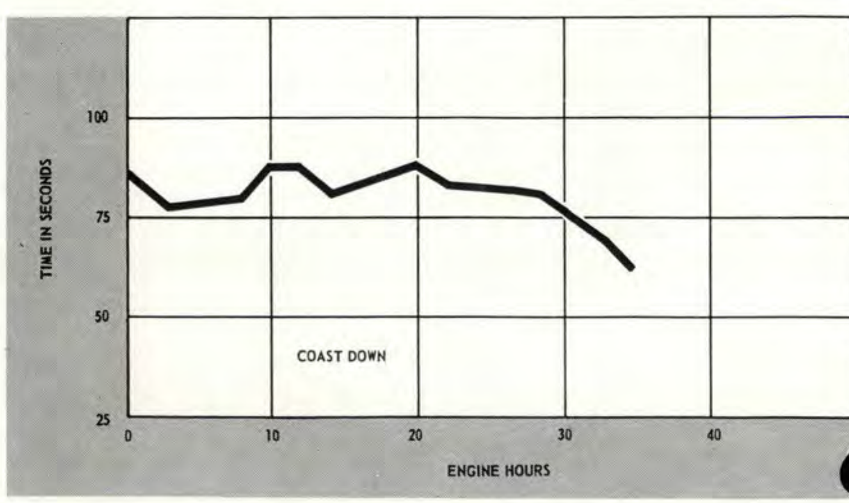
"Agreed. And to answer your first specific question, if you hadn't supplied regular, accurate figures for Major Brown to plot and analyze, we wouldn't have known that the engine was in trouble. He notified us in time to prevent an accident; without this analysis the only notification would have been to the Accident Investigation Board and possibly to the next of kin. That's the whole point of this analysis program—to learn to recognize when an engine is in the early stages of deterioration and to remove it for preventive maintenance, rather than to have it result in untimely in-flight destruction."

"I buy off. How about showing me some more? I'll join the 'briefing' team for anybody else who has any questions."

"Okay. Let's take a chart on oil consumption rates. The rate of oil

"... Another chap clocking coast down."

Is your engine headed in the wrong direction?



consumption in any engine is one criterion of its performance. When an automobile starts to drink oil, you begin to think about getting it corrected. Similarly, when the rate of oil consumption in a jet engine progressively increases or decreases, it also is significant.

"If this oil consumption on the F-86D falls below 0.10 quarts per hour, or rises above 0.75 quarts per hour, it means, again — something within the engine is wrong. Find it. Further, when an oil consumption graph shows a sharp rise or drop over the last reading, although it does not specifically indicate a trend, it announces that the engine is in trouble. This particular chart shows a progressively decreasing consumption. Now, you might say that if an engine isn't using oil, it is a real fine engine—except that isn't the way it is.

"Your engine has a certain expected consumption rate and if the consumption rate falls below that, it is a dangerous deviation and calls for maintenance investigation. As I said before, this particular engine was using less and less oil. We pulled it, and, sure enough, we found the oil jets in No. 4 bearing peened over. The support brackets were broken loose and that allowed the oil nozzle to rub on the No. 4 bearing, which, in turn, plugged off the orifice of the nozzle. That means less oil was being exposed to one of the factors that affects oil consumption.

No Guesswork

"We weren't completely shooting in the dark when we pulled this engine. We had two indications of trouble in the oil system. The pilot had been checking the oil pressure too, as you know, and we had noted a rise of 5 psi. That told us something had possibly plugged a portion of the oil system.

"You can see there in your Maintenance REVIEW that we hunt for a lot of things when the graphs show decreasing oil consumption. For instance, there is internal leakage of the oil-fuel heat exchanger. On jet aircraft, the JP-4 fuel pressure is considerably higher than the oil pressure within the heat exchanger. Therefore, if you do have an internal leak, the JP-4 will slowly flow into the oil system and—believe it or not—service the oil system to a small degree, depending upon the amount of leakage, resulting in contaminated oil. Unless this leakage is enough to run the oil tank over on the ground, and call attention to this fact, the crew chief isn't likely to remember that this engine hasn't used much oil in the past 10 to 20 hours, or to wonder why.

"With a graphic, progressive history of its oil usage in front of Major Brown, however, he can recognize the trend; we can investigate and correct the leakage. You do know what contaminated oil can do to an engine, don't you, Lieutenant?

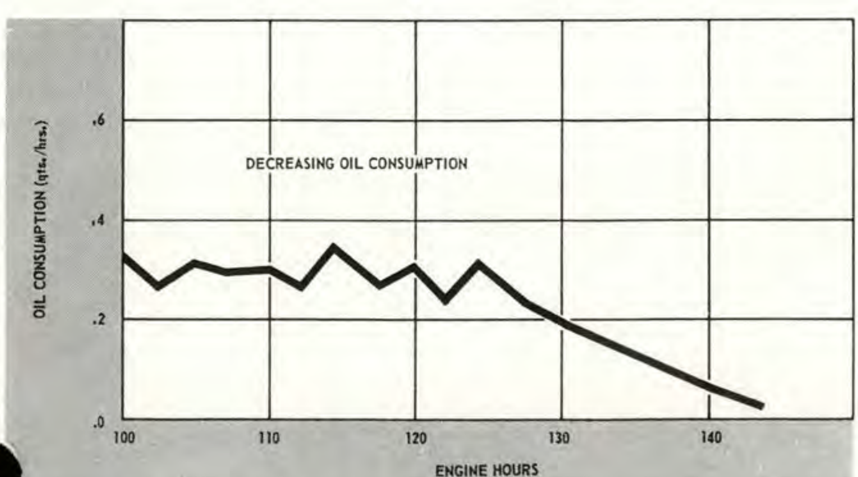
"I hardly need to add that we're also interested in spotting rising oil consumption. Here is another chart. We removed the engine the other day because this chart showed increasing oil consumption. We found excessive wear of No. 4 bearing air oil seal beyond T. O. limits. We removed the No. 4 bearing, No. 4 air oil seal, and returned the engine to service. A little thing? Sure, but if somebody hadn't been watching the consumption records on this baby, and we had not applied preventive maintenance, it would have been another statistic. The engine would have run out of oil and the aircraft would've run out of engine! Over and out.

"Now then, as to that 'eyelid' check your wife was kidding about last night, data on it are technically charted as 'exhaust nozzle lip separation,' and we usually call it the 'nozzle check.' It is basically checking the engine power output like we do when we check the torque delivered by a reciprocating engine. A wider nozzle area means simply that the engine is not putting out properly. It should not be less than 19.5″ or more than 20.5″. Those are limits.

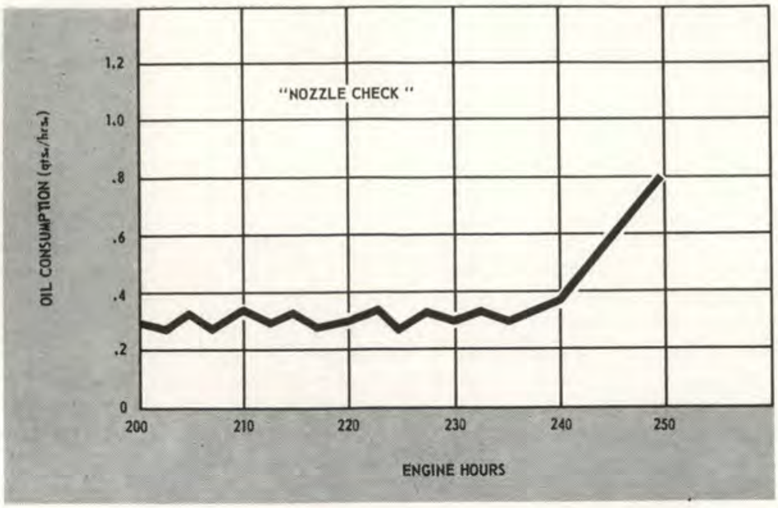
"Here's a chart on one engine which I pulled because every measurement was just a little wider than the one before. We found a bad fuel nozzle, too bad to make one more flight. You wouldn't volunteer to fly the plane with that on it, would you? Well, this brings your original inquiry right home to you because the only way that anyone would have known to look for the cause of the trouble would be to analyze this chart that showed increasing opening of the nozzle — strictly from the figures turned in by a pilot."

"Wouldn't I notice it in the cockpit if there was less than 100 per cent military power?", Lieutenant Smith asked.

"No, and if you'll think back on your MTD, you'll remember why.

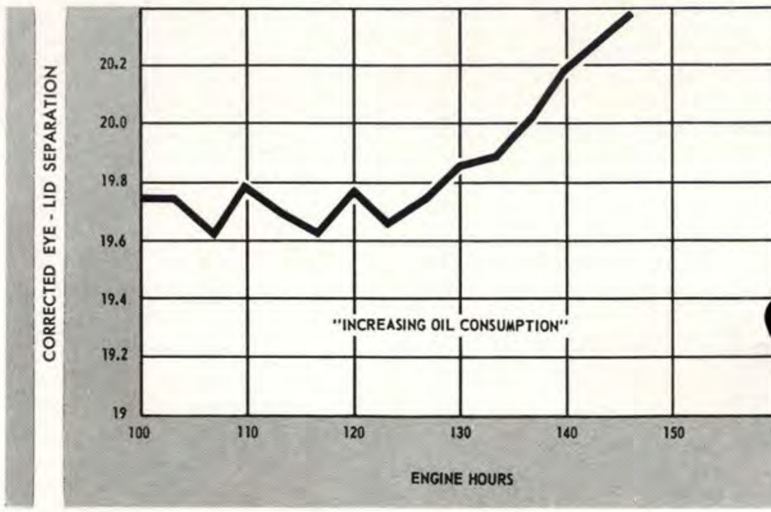


Without lubrication, something's gonna drag.



High consumption rates and fuel flow is real trouble.

It is basically checking engine power output.



"Your exhaust gas temperature indicator is stabilized at 685°C., so, in your opinion the engine is fine. That's a characteristic of the system, remember? The Integrated Electronic Control positions the nozzle to a point to maintain this EGT at 685°C. So you are sitting up there like a duck in a shooting gallery—a potentially fatal accident going somewhere to happen.

"The one thing that prevented it in this case was that we had meticulously kept records. We had a chart showing increasing width in the nozzle opening and we know that this is the signal to remove the engine and find the offending component. This exemplifies the type of accident prevention program necessary nowadays in the Air Force. Although there are still many unknown factors, we do know that nothing can be gained by postponing removal of an engine when the trends indicate trouble. Further, we know that the engine, the aircraft, and the pilot can be lost merely by waiting for something unusual to rear its head. We are losing too many and we don't have that kind of margin.

"Here's another thing. Would you care to fly a plane with an engine—standard sea level conditions—that had a nozzle opening of 21″ and 4880 pounds of fuel flow per hour? Again, you don't honestly know, do you? You see, your engine is approximately a 5500-pound thrust engine and should require at sea level, approximately 5900 pounds of fuel flow per hour. Oh, there are allowances for outside air temperature, OAT, as we call it. When it is colder, the fuel flow increases a little and when it is hot, it decreases. But if I may press home a point, the underlying purpose of this analysis program is to make everyone aware when a particular part is on the downgrade and possibly dangerous, we can tell, just by reading a chart."

"I was just wondering, sir, since the T-Bird doesn't have a variable exhaust nozzle to check, if you couldn't use EGT to read the power output?"

"You're receiving real clear, Lieutenant Smith. You change that one parameter on the graph for a T-Bird, but coast-down, oil pressure and consumption work the same way."

"EGT, nozzle position, fuel flow, RPM, OAT, pressure—all seem to be such little and even insignificant things to mean so much.

"As the man said, Smitty, life is made up of a myriad of small matters, and life—in this case, yours—is no small matter. You make these small performance checks for us, and, in return, we'll give you maximum possible engine integrity . . . and your continued flying safety. ▲

How Well Can You Remember?

July (Power Plant)

1. In the event of a compressor stall, the *first* thing a pilot should do is to:
   (a) Reduce airspeed to reduce vibration.
   (b) Retard the throttle.
   (c) Go to emergency fuel system.
2. With reference to compressor stalls, as the outside air temperature decreases, the stall margin decreases.
   (a) True.
   (b) False.
3. At a given airspeed, a heavier loaded airplane flies:
   (a) At a greater angle of attack than a lighter airplane.
   (b) At the same angle of attack as a lighter aircraft.
   (c) At a lesser angle of attack as a lighter airplane.
4. At a constant throttle setting, thrust in a jet aircraft remains relatively constant at all normal flight speeds.
   (a) True.
   (b) False.
5. In the event of a fuel leak inflight in the area of the carburetor, and the engine continues to operate normally with little or no drop in fuel pressure, the pilot should:
   (a) Shut down the engine using the normal feathering procedure.
   (b) Actuate the firewall shut-off valve.
   (c) Leave the throttle alone and cut the fuel off with the mixture control.

August (Personal Equipment)

6. Free fall time from 50,000 feet to 15,000 or in that neighborhood, the automatic parachute opening is:
   (a) Just over two minutes.
   (b) Four minutes.
   (c) Six minutes.
7. Parachute opening shock at 40,000 feet, averages:
   (a) 9G.
   (b) 14G.
   (c) 33G.
8. The CO_2 cylinders in your Mae West should be weight checked:
   (a) Every 60 days.
   (b) Every 30 days.
   (c) Every 90 days.
9. The fixed altitude for automatic parachute aneroid controlled operation is:
   (a) 12,000 feet.
   (b) 14,000 feet.
   (c) 15,000 feet.
10. In the United States, all terrain above 14,000 feet is in the form of peaks. The total area of all the peaks at or above 14,000 feet is:
   (a) 20 sq. miles.
   (b) 40 sq. miles.
   (c) 100 sq. miles.

September (Maintenance Today)

11. On some jet engines, a higher than normal oil pressure reading may indicate that:
   (a) The crew chief over-serviced the reservoir.
   (b) The engine is operating at too high an RPM for the particular throttle setting.
   (c) Lube lines or nozzles are plugged.
12. The length of time it takes a jet engine to coast down from idle RPM to a complete stop is a measurement of friction.
   (a) True.
   (b) False.
13. If the fuel flow is abnormally low (350-400 lbs.) on an engine requiring 500-600 lbs., it may light satisfactorily on the ground. However, at altitude:
   (a) The fuel flow may be too low to accomplish an airstart.
   (b) It will be impossible to get 100 per cent rpm.
   (c) The engine will flame out.
14. To cool overheated brakes, maintenance crews should:
   (a) Discharge a 20-lb. CO_2 cylinder on them.
   (b) Use a compressed airblast on the wheels and brakes.
   (c) Squirt a steady stream of water on the brakes.
15. Engine trend analysis is a process whereby:
   (a) AMAs determine what happened to an engine after an aircraft accident.
   (b) The pilot uses an engine analyzer to determine if all cylinders are firing and the desired torque is available.
   (c) Engine performance and other data are plotted and analyzed for abrupt changes in performance.

ANSWERS

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

OPERATE

DURING MY years of flying experience which includes nine years in the Air Force and more than five of experimental test flying with the General Electric Company, I have had the opportunity to see first hand the development of many new aircraft systems. With this experience and background, the words of wisdom which seem most important to me are: "Know your aircraft and equipment before you step into the cockpit for the first flight."

There was a time when, if you referred to a fighter pilot as a good stick-and-rudder man, you paid him a great compliment. Many pilots enjoyed this compliment and developed a self-confidence which prompted them to fly many airplanes with a minimum of knowledge of each. They relied primarily upon "stick-and-rudder-experience" . . . betting against the odds that nothing would happen that they couldn't handle by jockeying the throttle to enable them to fly the aircraft safely back for a landing.

It flies just like any other airplane—almost.

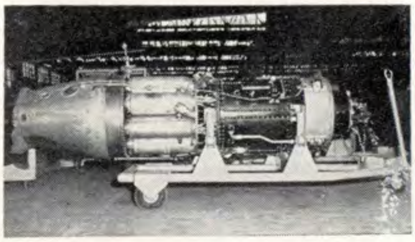
When you step into the cockpit of a Century Series aircraft (no matter which one it happens to be), you'll be in for a completely new flying experience. You will no doubt be surprised during this first experience with how familiar you feel in the cockpit and the ease with which the aircraft handles. You'll probably say to yourself, as you step out of this aircraft with "no" wings and a radical design: "What's all this 'hubba-hubba' about flying a Century Series type? It flies just like any other airplane."

True, you have had a successful flight and no doubt a few new wonderful experiences and the odds are that you will have many more such flights in the aircraft. But, have you really flown it? Would you make the right decision if you had an abnormal indication in the cockpit? Were you looking at the right instrument to tell you that everything was normal when you lit the afterburner?

Those instruments in the cockpit can give you a complete story only if you know what they are trying to tell you.

When I am scheduled for a checkout in a new aircraft, regardless of whether it is the first flight in a new configuration or a routine checkout in an operational aircraft, I first make a complete study of the Pilot's Handbook. Next, I gather from other pilots and engineers as much information as possible on the aircraft and engine characteristics in flight. From this background information I establish for myself a complete set of cards outlining operational procedures and characteristics of the particular air

Old dogs sometimes have to learn new tricks. As the sciences of warfare and aircraft change, you must be prepared to change right along with them. Despite what went before, you must now. . . .



Roy E. Pryor, Chief Test Pilot, General Electric Company

to MAINTAIN

craft and engine. With these procedures in mind it is easy to monitor all instruments in an orderly sequence in any situation.

For example, let's look at engine operating procedures from the starting sequence to shut-down to see what the instruments are trying to tell you and how you can use this information to best advantage. We are speaking of jet engines in general and no specific model.

Engine Operation

First, you can tell a great deal about the condition of an engine by the way it starts. The pilot must monitor closely the engine instruments during the starting sequence, for a maladjusted or malfunctioning fuel control or fuel regulator can cause damage or even ruin a $200,000 engine if the pilot is asleep at the switch.

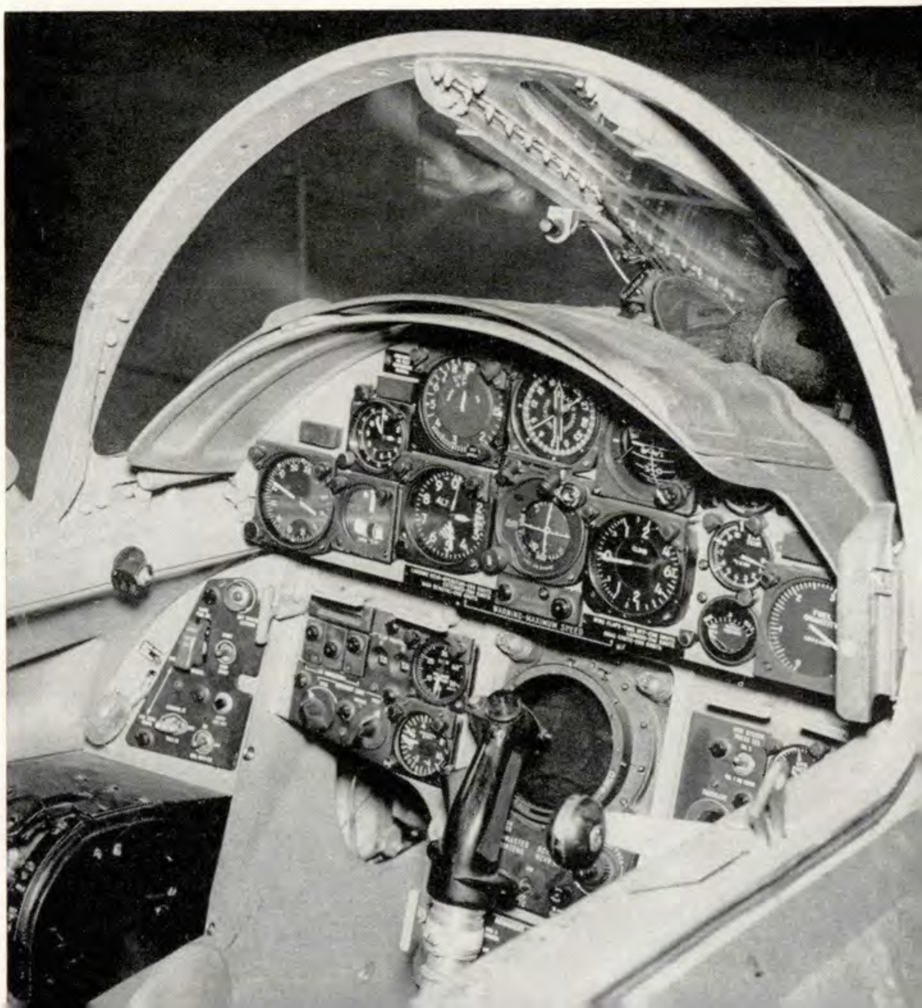
Occasionally I've seen pilots hit the start switch, then begin to adjust their harness or helmet and mask while the engine is accelerating to idle RPM. The folly of this technique should be apparent to everyone. The pilot should know the starting characteristics of his engine and monitor the instruments in a manner which will tell him that all conditions are normal, or give him advance warning of impending difficulties. The normal sequence of events that he should monitor is: Start switch ON . . . RPM increase. . . . Throttle advance. . . . Fuel flow up to proper value. . . . EGT within limits . . . then oil pressure as you reach idle RPM. If any abnormal indication should occur at any point in the start sequence, the pilot can abort the start and prevent further difficulties.

For instance, say a certain engine requires 500 to 600 pounds fuel flow for a normal start, if the fuel flow is 900 pounds, a hot start will more than likely result.

On the other hand, if the fuel flow is low—say 350 to 400 pounds—it may start satisfactorily on the ground, but at altitude it is extremely likely that the fuel flow will be too low to accomplish an airstart should there be need for one.

Also on starting, if the engine fails to light within the specified time after fuel flow (increase in EGT is a sure sign of light), shut it down! You probably have faulty ignition; also a delayed light can cause overtemperature during the light-off.

Know what they should be reading and you can make a positive check.



Responsibility has to be properly delegated even down to the most junior man on the bird—including pilots.

Each man must feel that he is part of the airplane and his efforts help to keep it flying.

If the engine instruments are not within limits during the starting sequence the pilot should refuse to accept the aircraft for flight until the trouble is corrected. And, by all means, DON'T attempt a second start when something goes wrong with the first start unless you are sure what the trouble was. Have the engine inspected and the malfunction corrected.

Further, if you are fortunate enough to fly the same airplane quite frequently, know what the normal oil pressure for that particular airplane is. On some engines, a high oil pressure indicates plugged lines or lube jets; similarly, a low pressure may indicate an oil leak.

Well, you have started and have taxied to takeoff position. As you hold the brakes and advance the throttle to military power, be sure to make a careful check of engine instruments, the EGT, the nozzle position, RPM, oil pressure, pressure ratio and fuel flow. Know what these instruments should be reading and you can make a positive check on the engine before releasing brakes.

Make it a habit to watch the nozzle position indicator and EGT when going in or out of afterburner. A nozzle which does not open after afterburner light can cause over-temperature of the engine.

Also, on engines with a fully modulating nozzle, if the situation occurs which requires you to come off after burner shortly after takeoff (say th gear failed to come up), always monitor the nozzle indicator for proper closure as you reduce the throttle.

If the nozzle is not closing do not come off afterburner but use speed brakes or climb to hold the speed down. If you come off afterburner and have a wide open nozzle, you can not maintain flight speed with the gear down. The possibilities of getting an afterburner relight under these conditions are limited.

Emergencies

I hesitate to go into inflight emergencies, for they vary so greatly with different airplanes. I can not place too much emphasis, however, on the importance of knowing the contents of those red bordered pages in your Dash One Handbook. You should not only know WHAT to do, but also WHY you are doing it.

Let's assume you have the airplane back on the ground and are ready to shut it down. This phase is important too, even if the flight is over.

Shut Down

Here at General Electric, we sh down from the minimum EGT (usu

Knowing your airplane and equipment can be the difference between success and failure.

ally a point slightly above idle). Again, before chopping the throttle, check the oil pressure. When the EGT has stabilized, chop the throttle and check the engine coast down time. Be ACCURATE on this time to the nearest second, then log it in the Form 781.

While the engine is coasting down, we have one or more individuals stationed around the aircraft to check for any unusual noises and to check for engine roll-back. Lack of engine roll-back and reduced coast down time are indications of possible engine difficulties.

These individuals also check for fuel drainage when the throttle is stop-cocked. If it doesn't drain, we are prepared to plug in an APU and motor the engine to prevent a fire in event the drain valve is malfunctioning or the drain is plugged.

Today's operations require a close-knit team.

I feel that there are many things that pilots can do to ease the maintenance load. Too many pilots often do not have enough regard for the equipment. It's one thing to get maximum performance out of an aircraft but you shouldn't abuse the aircraft and engine while doing it.

The pilot must also have an honest desire to keep the airplane in the best of condition. During accelerated service tests on an F-86H our pilots flew one aircraft and one engine over 500 hours in 16 weeks. During that time we attained an average of 62 landings on a set of tires and had practically no brake troubles, simply because the pilots handled the aircraft with care.

They wrote up discrepancies which were actually corrected as they occurred, rather than waiting until a large number of small items ganged up on the maintenance section.

One word on the relationship of the pilot-to-maintenance crew. Today's type of operations and equipment requires a close-knit team. Pilots and maintenance crews must work together and tell each other all they know about the peculiarities and characteristics of the individual airplane.

Responsibility should be properly delegated, even down to the most junior man working on the airplane. Don't look to the maintenance boys as scapegoats when things go haywire. Make each man feel that he is part of the airplane and his efforts are needed to keep it flying.

Knowing your airplane and equipment will mean the difference between success and failure of many missions, whether it be that final effort to get on the target or to make the right decision that will get you and your aircraft safely home when something doesn't work—as it always has before.

Space and time hardly permit me to relate the many experiences during my flying career that have contributed to additional gray hairs. Some have prompted me to take out additional insurance but otherwise have been completely successful I could not honestly say that the success of any one of them was the direct result of superior pilot technique.

Instead, in every case the success has been the direct result of knowing and understanding of the aircraft characteristics and its systems. I feel confident that any pilot with the same knowledge and understanding of the aircraft systems could have made the right decisions under the same adverse situations. ▲

About the Author

Roy E. Pryor is an Air Force veteran who spent six of his nine years on active duty with the 8th Fighter Group. He participated in the first F-86 flight across the Atlantic in 1951.

Since 1952 he has been at Edwards Air Force Base, as Chief Test Pilot and Supervisor of Flight Test Operation for the General Electric Company.

P ....FOR

DO YOU HAVE a pet peeve about that tin eagle that you fleigle for Uncle Samuel and all of his nice kinfolks?

Most pilots do and, with little encouragement, they will sound off about it in sulphuric terms that could frizzle a first sergeant's hair. A Jock can steam up a high psi rating when he stews and sizzles over the perverse traits of his spavined Pegasus.

Steam is valuable and it shouldn't be wasted, engineers say. If a process produces steam as a by-product, the engineers are quick to convert this extra energy into productive work. If nothing else can be done, they'll use it to tootle the factory whistle.

So, why not harness this pilot steam, and use it to "blow the whistle" on aircraft design features that displease you? It is a positive fact, easily proved by statistics, that pilots know more about what pilots don't like than any other people, including the Scandinavian.

Berating the recalcitrant bird on the flight line, in the Officers Club or in the kitchen, is not likely to produce any significant modification of the aircraft. Pilots arise. Be not as the wild jackass that brays (though unheard) in the desert wilderness. Use your USAF-given right of the UR.

No one individual ever designs a complete airplane all by himself anymore. It happens as a result of a long chain of experiences to which all of us make contributions from time to time. Most of us just fly 'em and leave the drawing board to someone else. But that doesn't mean that you can't get into the act. The kind of designing you can really get your teeth into is the kind you think of every time you are tempted to say, "Who the devil ever let 'em build it this way to begin with?"

There was a bull session just the other day. Everybody was swapping hairy tales, as pilots will. This day, about airplanes. One chap came up with a spine tingler all about the time he parked his T-Bird on the ramp after shooting a "bunch of transition." As the crew chief was replacing the pins, he suddenly discovered that he didn't have the canopy pin—only the streamer and attaching ring. The pin was still right there in place, where it had ripped out of the ring.

"Boy," says one old troop, "That's a PIP if I ever heard one."

It was a weak pun, to be sure. He finally put it across by butting in with: "How many of you guys submitted a UR as result of your near-devastation?"

Silence. And here was a bunch of good heads who had a real interest in developing good airplanes and keeping them that way. Any one of them would have offered you a ride home and driven three miles out of his way just to be nice to you. Thoughtful, sure. But did they do anything to save your neck? Or their own?

The steam was there but it just wasn't going the right way.

One said, "Well, it would have taken 45 minutes for the mechanics to find the trouble so I came on in."

Another allowed that he figured the crew chief would take care of it.

Still another didn't know just what the procedure was, and anyway you don't have to submit URs on all that sort of stuff, and how did you ever know?

From the sound of the conversation not only the problems needed a UR. So did the excuses!

But where does the pilot fit into the Product Improvement Program (PIP)? If you're like everyone else who has looked at an accident you'll agree right off that it is an accumulation of events—a chain-of—somebody said. And if you make it a chain,

Aircraft design happens as a result of a long chain of experience to which all of us make contributions.

PILOTS

which link do you want to depend on? The one that you know is weak and you haven't done anything to correct? Certainly not. Well, none of these guys did, either, but that's what they demanded—just from the fact that they knew about it but did nothing. Even as you and I.

What should have happened?

It is pretty hard on most bases to walk from an airplane to operations without passing within spitting distance of a maintenance shack of some sort. And the odds are pretty good that in every one of those shacks there is a pad of blank URs. Fill one out—in pencil—and you've contributed to the PIP program. That's all you have to do.

Contrary to popular belief, you do not have to research anything. You don't have to analyze any problem. You don't have to explain anything; just tell what happened to you. And what may happen again—only worse.

You couldn't care less about how many times this sort of thing has happened before or how many times it may have been reported. You're not even remotely bothered about whether the maintenance officer got an answer to the same type of trouble before. That's his problem. Your job is to let him know that something is wrong, right now.

Okay. You say he can read and why can't he read the Form 781 and fill out his own papers? Sure. He can and does. But *whose* papers, did you say? *Who's* flying this bird, you or the maintenance officer? These little billet-doux are just like premiums on an insurance policy (the one covering you).

The Maintenance troops will get into the act, too, but from their own end of the business. If something breaks ahead of schedule or doesn't fit their program, the way it should, they'll UR it—rest assured!

But—going back to where we started—nobody knows more about what pilots don't like, than the pilots themselves. And this includes you.

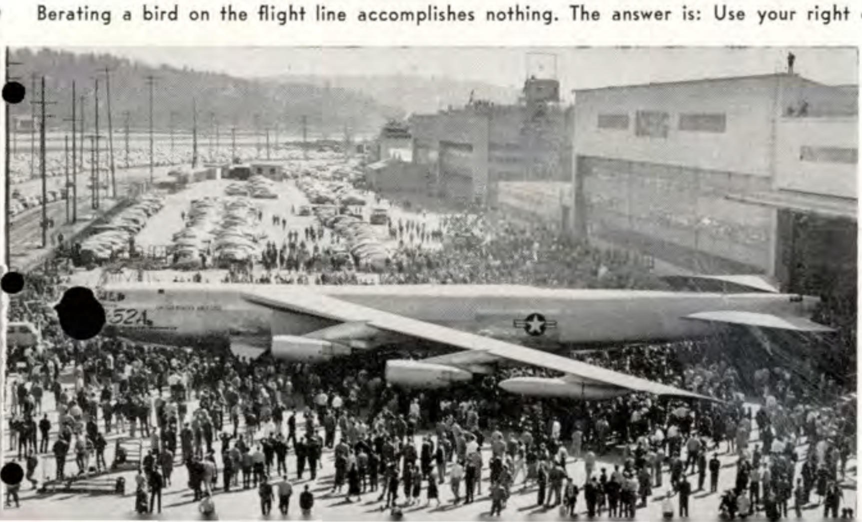
The man on the line may get too busy trying to glue it back together to take care of paper work you suggest might be a good idea, from your point of view. But even if he does have the time, he's not in the position you're in. You're the one who knows what happened, when it happened and what you had done or were doing when the whole thing came about. This makes you the star witness in the case and probably the only one who can tell the whole story.

This is often a big factor in the old discussion about no action being taken on URs submitted. The long and short of many URs that got little or no action is that there just wasn't enough information on which to base firm action. The files contain many reports that were obviously made up by persons who had too little factual data at their command to write a good report. Detailed information may assist in solving the problem for everyone concerned.

Designers, too, are human. To expect them to build a perfect bird is left-field thinking. But that doesn't mean the bird can't be improved upon and that is where you come in. The designer may never have had a chance to fly the thing, but you have. And there you have a big advantage on him.

The day you come across a perfect airplane—that's the time you'll turn in your insignia. And Old Saint Pete will be standing right next to you, ready to take it. Between now and then, don't be satisfied with blowing off steam in all directions. Put it in the pipe provided. Pipe? No—PIP—your Product Improvement Program. ▲

Berating a bird on the flight line accomplishes nothing. The answer is: Use your right of the UR.



SPLASH DEPARTMENT . . . accidents resulti

AN F-84F, SCHEDULED for an IFR round-robin navigation flight, departed its home station with full internal fuel, plus two 230-gallon outboard and one 450-gallon inboard fuel tanks. The first leg of the flight was to be flown at an assigned altitude of 15,000 feet.

After reaching altitude, the pilot checked the fuel tanks and determined that only the 230-gallon tanks were feeding. About 25 minutes later, the fuel pressure warning light began to flicker. A further check revealed that none of the external fuel tanks were feeding and that the liquidometer was malfunctioning.

The pilot advised air traffic control that he was returning to his point of departure. He began climbing to 35,000 feet, hoping to reach his home base on the remaining internal fuel. He was close when the '84 flamed out. The pilot set up a flameout landing pattern and dropped the external fuel tanks. He was unable to see the runway part of the time while in the flameout pattern because of a 2700-foot broken deck of clouds. When he penetrated the deck, he found himself in such a position that he was unable to kill off enough airspeed to avoid landing long.

The "F" touched down approximately 2000 feet from the barrier at 145 kts. The speed was estimated to be 135 kts when the barrier was engaged. The engagement was successful, however, the aircraft was damaged considerably.

Investigation revealed that the ground refuel switch for the external fuel tanks was not closed after the refueling operation. The pilot did not notice this on his walk-around preflight inspection. The pilot failed to determine the exact amount of usable fuel that he had in time to divert to an available base nearer than his home station.

■ ■ ■

IMMEDIATELY AFTER TAKEOFF, the pilot of an F-86A noticed that the aft fire warning light was on. He throttled back, checked for smoke and simultaneously declared an emergency. The aft light went out as he throttled back and, seeing no smoke, he elected to land. The landing was made without difficulty; however, as the pilot applied power, black smoke came from the tailpipe. The engine was stopcocked but there was fire in the aft section.

Investigation disclosed that the fire was caused by failure of the combustion chamber fire cross-over tube between chambers 6 and 7. The insert on No. 7 combustion chamber was not properly aligned with the cross-over tube. The forward fixed fuel drain lines between chambers 6 and 7 (located directly behind the blown cross-over tube) had been subjected to intense heat, causing the connections to melt and allowing the drain lines to separate from their fittings.

Examination of the aircraft's air intake nose duct revealed that a wooden dust cover was in the duct during flight and had lodged against the bottom of the engine intake screen.

The Form 781, Part II, indicated that a preflight had been made and the '86 had flown one previous mission on the day of the accident. The pilot who flew the previous mission had okayed the flight even though he had noticed a definite rumble sound in the engine, had experienced a hanging start (the EGT went to 690 degrees but the engine would not accelerate beyond 24 per cent on the first attempt at starting). After the second start, he had to use more runway than was normal for takeoff. The crew chief and both pilots had looked into the nose duct but did not see the dust cover.

■ ■ ■

TWO PILOTS ON AN INSTRUMENT training flight in a T-33 were cleared for a penetration and GCA. On the final approach the T-Bird was told to pull out of the pattern because of other traffic. As the pilot applied power and raised the speed brakes, he heard a rumble and the engine flamed out. The Instructor Pilot in the front cockpit took the controls and tried an airstart, but without success. He then bellied the '33 into a snow-covered field.

The Accident Investigating Board determined that the flameout was caused by ice in the low pressure fuel filter. It was further determined that the crew chief had failed to drain the tiptanks during preflight (Arctic operation) and that the pilot was not thoroughly familiar with the de-icing procedures as outlined in the Dash One.

■ ■ ■

A C-47, ON A FLIGHT TO resupply outlying radar sites, prepared to take off for the final leg to its home base. On runup, the oil pressure on the right engine dropped to zero. The engine was shut down and the crew chief checked the oil tank and found that it was full. He also checked the engine for oil leaks and could find none. On the second start and runup, oil pressure registered 15 psi. The aircraft commander decided to take off anyhow (despite the objections from the crew chief) inasmuch as a small emergency strip was only 22 miles away.

Approximately two minutes after takeoff, the oil pressure on the right engine dropped to zero. The aircraft commander instructed the copilot to feather the engine. The prop refused to feather. Power settings on the left engine were increased to 45" Hg and 2350 rpm. The C-47 would not gain altitude because of the load and the windmilling prop. The cylinder head temperature on the left engine went to 400°C. and the aircraft commander steered the Gooney toward the emergency strip at an altitude of 150-200 feet. The surrounding mountainous terrain made it impossible to return to the departure point. When it became obvious that a crash landing was imminent, the crew chief was instructed to go to the rear and strap himself into a rear seat. The C-47 crashed in a heavily wooded area approximately half a mile short of the emergency strip. The aircraft commander, co-pilot and navigator were fatally injured. A third pilot occupying the radio operator's compartment received minor

...ng from faulty maintenance or inspection

injuries. Personnel in the passenger's compartment escaped uninjured.

The Investigating Board determined that the aircraft commander erred in taking off with an apparent malfunction without determining the cause.

■ ■ ■

SHORTLY AFTER TAKEOFF and while climbing in afterburner, the pilot of an F-89H heard an explosion. He throttled back and checked his instruments but everything was in the green. Assuming that he had lost an engine door, he asked his wingman to check the Scorpion. He was advised that the left battery door was missing and that the left forward air intake duct was damaged.

The pilot returned to his base and after dumping his tips and burning up part of his internal fuel, made a normal landing.

It was determined that while the '89 was being preflighted, word had been received to tow it to the alert hangar. The two airmen who were preflighting the aircraft had partially buttoned up the battery door and notified the towing crew that the engine screen bottles needed servicing.

The pilot and radar observer arrived at the airplane some 30 minutes prior to takeoff time and began an external inspection, not knowing that the preflight had not been accomplished by the ground crew. When the pilot noticed that the preflight had not been signed off, he sent the Form 781 into the Maintenance shack and an Airman signed it, assuming it had been performed but not entered.

The pilot did not notice the loose Dzus fasteners on the battery door when he accepted the aircraft for flight.

The Accident Investigating Board decided that the pilot had failed to accomplish an adequate preflight inspection and that the maintenance crew had erred in signing off a preflight without knowledge that it had actually been performed.

■ ■ ■

IMMEDIATELY AFTER TAKEOFF the pilot of an F-100C called his element leader saying that he had an unsafe gear indication. The flight leader checked his wingman's aircraft and noticed that the nose gear door was open about two or three inches. As soon as the fuel load permitted, the wingman entered traffic for landing. He touched down at 155-160 knots IAS, approximately 1000 feet down the runway. When the nose gear was lowered, a violent shimmy occurred. The pilot applied back pressure immediately and held the nosewheel off for another 800 feet. When the nose gear contacted the runway it shimmied again, and violently. At 5500 feet down the runway, the nose gear strut collapsed.

Investigation revealed that the nose gear scissors bolt was inserted but not locked and that during taxi and takeoff, normal vibration caused the bolt to work loose and fall out. This allowed the scissors to open on takeoff and the open scissors prevented the nose gear door from closing.

CARELESSNESS . . .

CAN BE . . .

COSTLY ! !

The Accident Investigating Board determined the primary cause of this accident to be a maintenance error, since the crew chief had failed to install the scissor link locking pin, correctly. A contributing cause was the pilot's mistake of not checking the scissor's locking pin during his walk-around inspection.

■ ■ ■

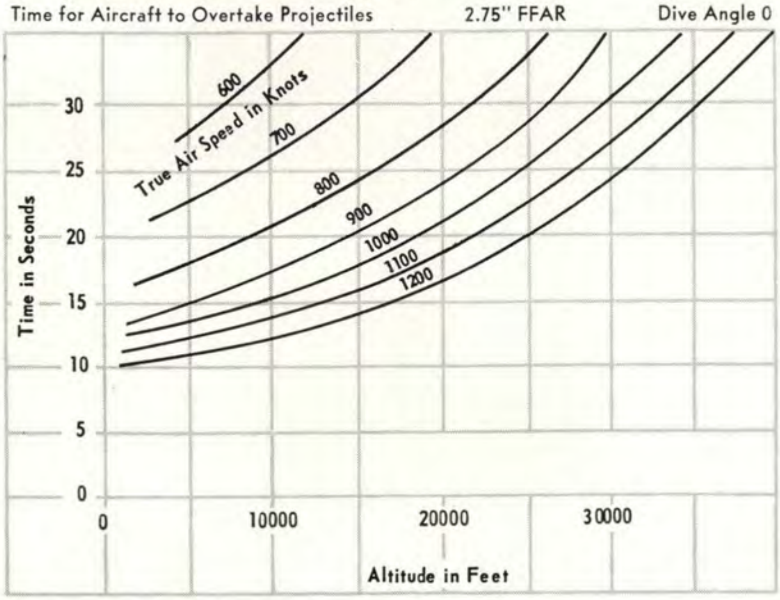
AN F-80C PILOT noticed smoke in the cockpit right after takeoff from a base other than his home station. He was not sure which surrounding areas were heavily populated and was reluctant to drop his tiptanks before landing. His first approach to the 6800-foot runway was too hot so he took it around. On his next approach, he touched down fast, about 1000 feet down the runway. The pilot was unable to stop the '80 and the nose gear collapsed as it rolled off the overrun into soft soil.

The smoke was caused by a loose oil cap which allowed oil to run over in the plenum chamber. The Alert crewman had installed the oil cap improperly and the pilot neglected to check it on his preflight inspection.

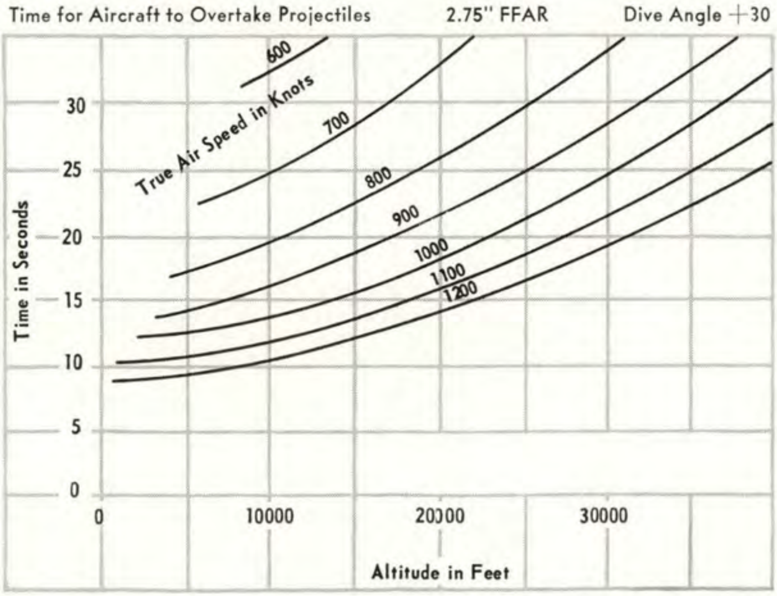
Despite what you thought when you first heard it, it is possible to. . .

...Shoot Yourself

Time for Aircraft to Overtake Projectiles 2.75" FFAR Dive Angle 0



Time for Aircraft to Overtake Projectiles 2.75" FFAR Dive Angle +30

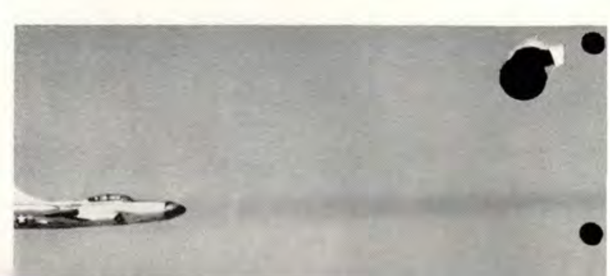


REMEMBER THE STORY about the Navy fighter that shot itself down? According to the newspaper stories that came out a few months ago, the pilot fired a projectile, then overtook and collided with it. There were a lot of the old hands who laughed and made jokes about the pilot who "shot himself down." There were a lot more who said flatly that it just couldn't happen. At least one of them asked how many times one had to do that before he became an "Ace." To wind it all up, it was generally conceded that even if it had happened once, it wouldn't happen again in a million times.

At any rate the whole affair sparked a lot of interest. Fortunately, for a lot of us, it piqued the curiosity of some people in the Air Munitions Development Laboratory, ARDC. They took the matter seriously and decided to have a real close look at the problem. Was it really a problem that we needed to do something about? Or was it, in fact, just a happenstance that might never happen again?

Surprising as it may be to some of us, they found that you can very easily shoot yourself down! Granted, you have to use the right technique. But it is, nonetheless, possible.

Here is how you, too, can do it. Using any one of several projectiles referred to in what follows, fire away! Immediately after you pull the trigger, increase your dive angle, pick up some speed and hold the same course. If your vertical drop matches that of the projectile, you'll hit your-



Down!

self. This is just one way to do it. There are a number of others as you will see by reading further.

All of this works almost exactly on the principle that you learned in basic Physics. Remember the "Monkey and Hunter Experiment?" A hunter aims his gun and fires directly at a monkey in a tree. At the instant the bullet leaves the barrel of the gun, the monkey drops. The two should collide in mid-air, regardless of the speed of the bullet. Why? Because the force of gravity is working equally upon the two.

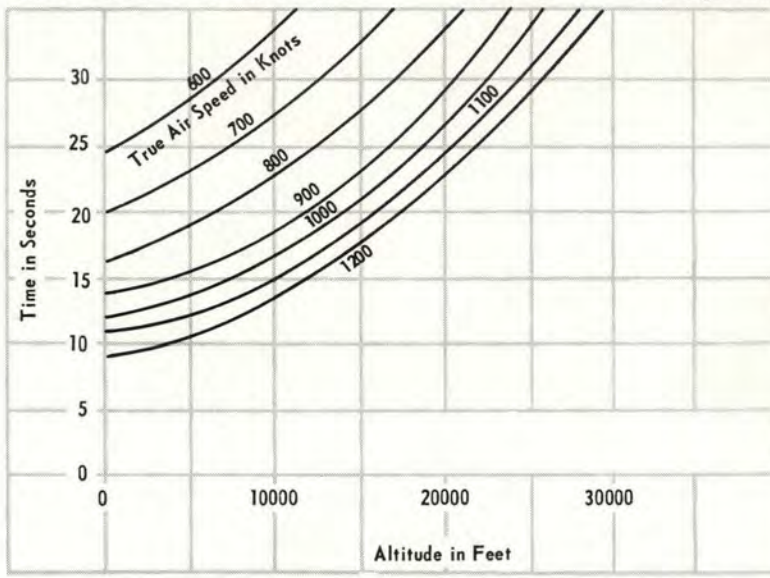
There is one more factor that you have to add in when you talk about high speed projectiles such as those you use. That is air friction. The faster you go, the more graphic this drag appears. And it is, of course, greater in the lower altitudes (and hence, denser atmosphere).

Air friction acting on the projectile results in deceleration—which, in turn, causes it to drop rapidly after leaving the aircraft.

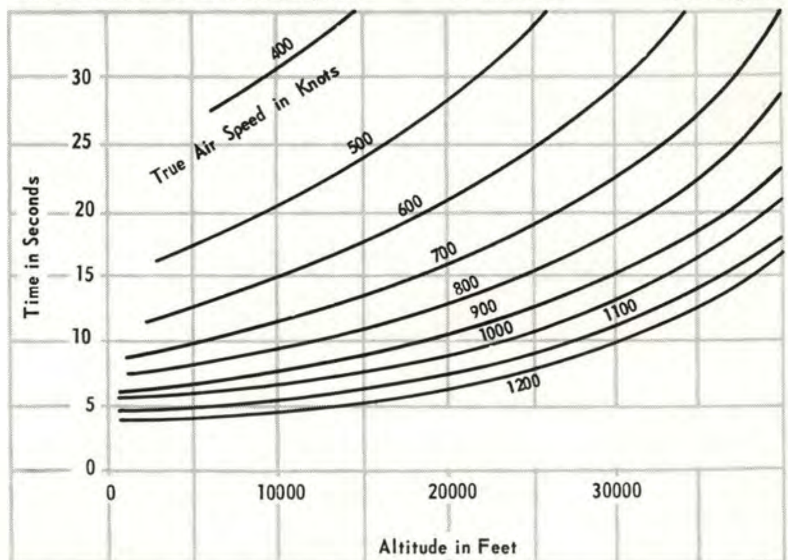
But what about you? Here is where you become the master of your fate. If, through any method, you match the drop of your projectile, you may be in trouble. After doing that, you merely have to be there at the same time. To be at the same place at the same time, is to have your leg shot off.

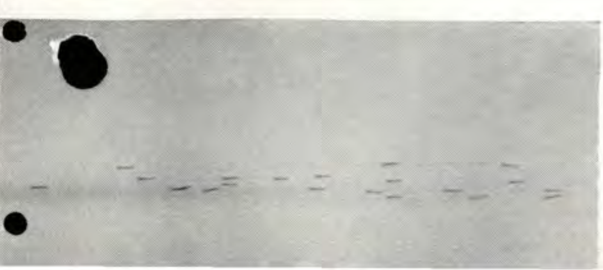
To match the drop (and be in the same place) merely drop your nose. This means that if you're in a climb when you fire, merely decrease your rate of climb, return to level flight, or put it into a dive. All amounts

Time for Aircraft to Overtake Projectiles 2.75" FFAR Dive Angle —30



Time for Aircraft to Overtake Projectiles 20 mm M-39 Dive Angle 0





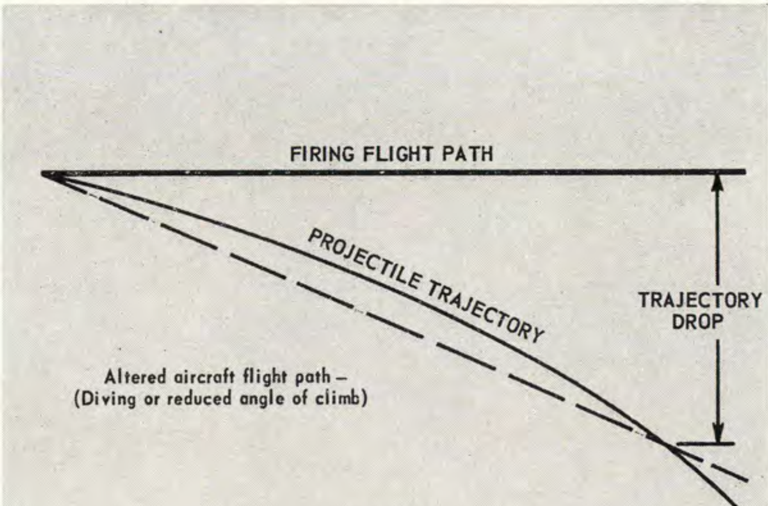
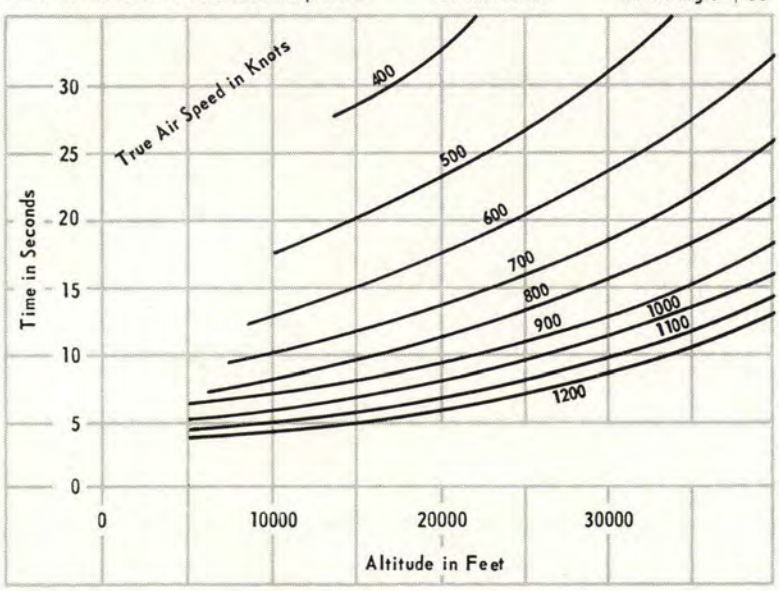
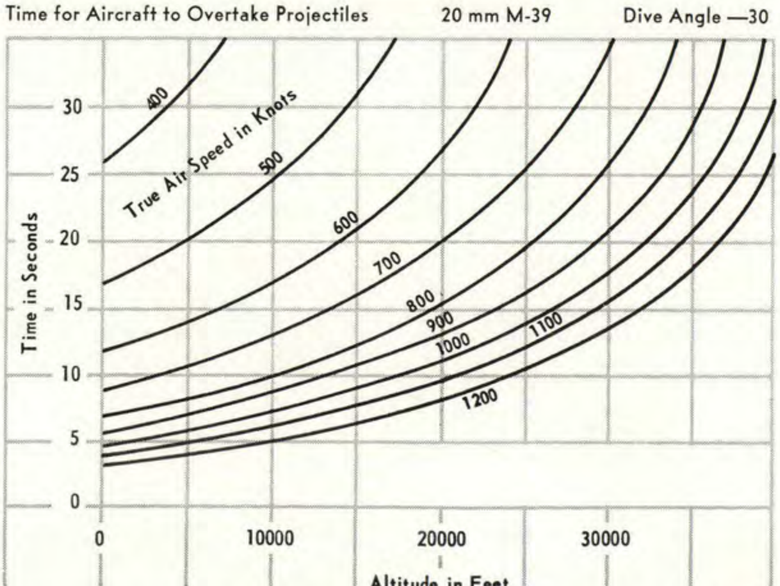


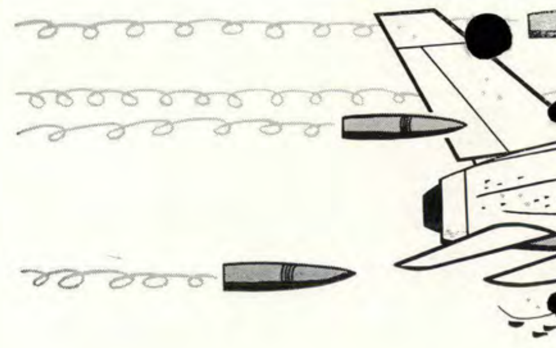
FIGURE 1

Time for Aircraft to Overtake Projectiles 20 mm M-39 Dive Angle +30



Time for Aircraft to Overtake Projectiles 20 mm M-39 Dive Angle —30





to the same thing. Just match the drop and you're there.

How to Get There

To be there at the same time is just as simple. Again, dropping the nose will gain you airspeed with which to overtake your projectile. Pushing the power stick forward will help out a little. But remember, you won't need a great deal of help because your projectile is decelerating all the time. Just holding what you've got will get you there in some cases. In the words of the experts at the Armament Center: ". . . if the aircraft remains in the same vertical plane after firing and reduces the angle of climb or increases the dive angle and increases speed, or does any combination of these, that will make the vertical drop of the aircraft match that of the projectile, the aircraft can overtake and collide with the projectile as illustrated in Figure 1." A good long look at the figure will clear up some of that.

Okay. So now that you know all this can happen, just what should you do? We've got some real handy rules of thumb for you, but first take a look at the rest of the charts. These too, were furnished by the Air Munitions Development Lab. They illustrate the time required for you to overtake your projectile for various angles of flight, airspeeds and altitudes. As you see also there are different charts for the M-39 and M-61 (T171) guns and the 2.75-inch FFAR. These were calculated on the assumption that the horizontal component of your true airspeed would remain constant after you fire and that your projectile would have a normal, stable flight.

Let's take a f'rinstance. You're on the gunnery range firing air-to-air at 15,000 feet. You're packing 2.75 Rock-

ets. Let's see how much time you have after you pull the trigger before you have to do something to avoid your own artillery. First, let's take a case where you go in level—dive angle, zero degrees. Your true airspeed (TAS) is 700 knots. According to the chart, you have 30 seconds before you will arrive just holding what you've got. Just a half a minute.

Just for kicks, let's say you missed yourself on that pass and you came around for another. You're a little low on this one but you fire anyway—in a 30-degrees climb but still at the same TAS. This cuts your odds down by a little more than two seconds, for this time you have a little over 28 seconds before you start picking up your own flak.

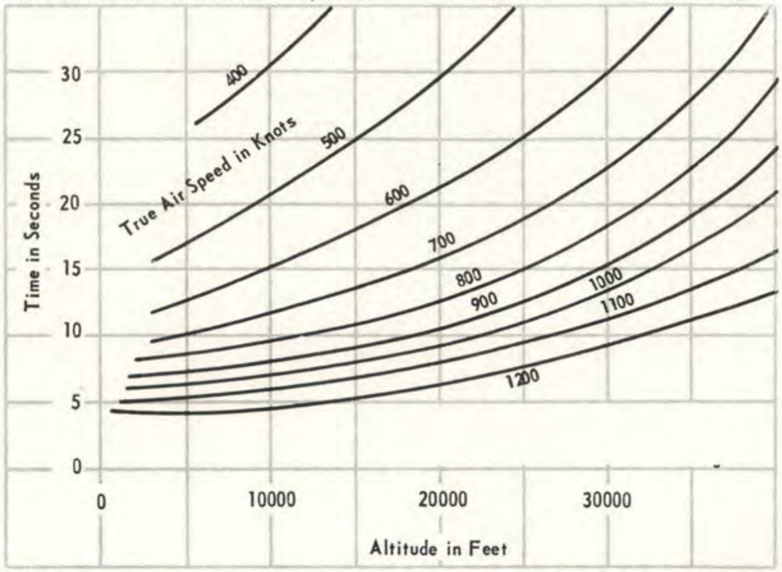
A fast look will tell you that you would have been much better off had you been in a 30-degrees dive on that pass. That way you would have had almost six additional seconds just to play around. At that speed six seconds worth is a little more than a mile.

Does that firing pattern begin to make a little more sense? That break after firing means a little more than just getting out of the way of the next guy—part of it is getting out of your own way.

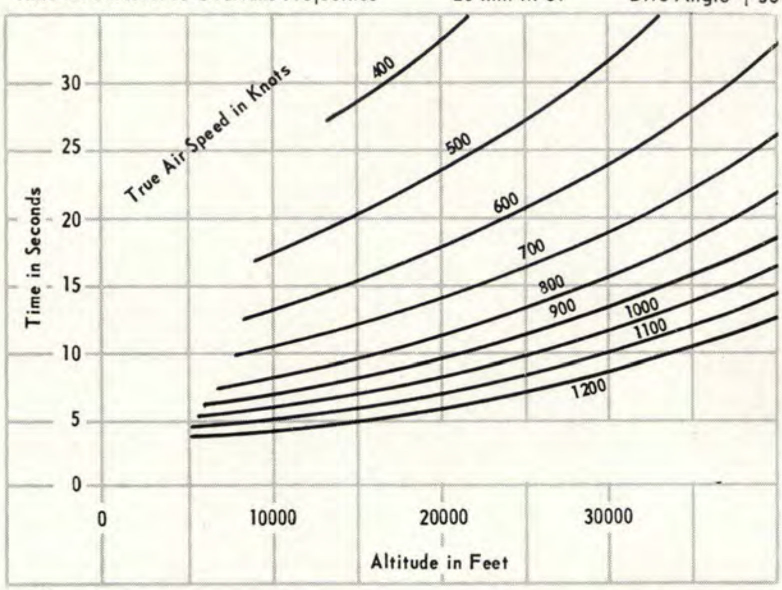
Now here are the rules:

- Whenever possible, alter your course within the time limits on the charts.
- Don't increase your dive angle immediately after firing.
- Be good to your gun barrel. This is the only way you can help insure that your projectile will go where it is predicted to go. Your Armament Officer can help by insuring that the barrel is not used beyond its rated life but only you can make it last that long. ▲

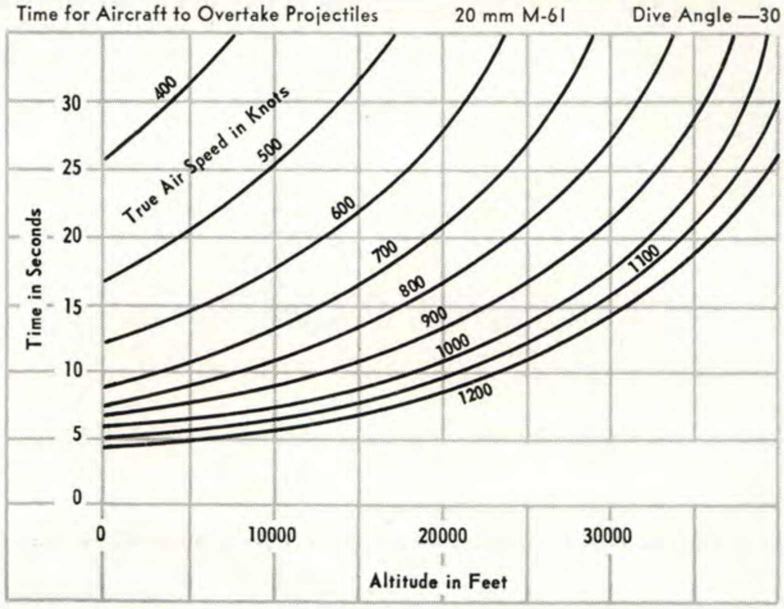
Time for Aircraft to Overtake Projectiles 20 mm M-61 Dive Angle 0



Time for Aircraft to Overtake Projectiles 20 mm M-61 Dive Angle +30



Time for Aircraft to Overtake Projectiles 20 mm M-61 Dive Angle —30



One·

THE C-124 was settled into its parking place for the night at a base far from home. Rest and quiet pervaded its vast structure. It had the look of confidence that goes with all well-kept things. "Old 711" had never aborted a mission; it always got its cargo to the South Pole, to the Orient, to Europe or somewhere Stateside. It was a crucial cog in the U. S. Air Force's operations wheel and was proud of it.

Seven-Eleven had noticed another Globemaster parked nearby, but with a caution born of indoctrination in the nature and import of their maneuvers, had refrained from hurried exchange of amenities. After a moment, however, a cordial gleam of recognition lighted its frame.

"Why, if it isn't Six-Thirteen, itself!" 711 called over.

"I saw you come in," 613 replied, "Only plane I ever saw that could strut sitting on its wheels."

"I haven't seen you since we met on that Cross-Road operation," 711 recalled, "Where've you been all this time?"

"Oh, I see the world—with sort of a jaundiced outlook."

"Are you making your trips without any trouble?"

"Oh, I fly, but I stay tired all the time," 613 explained. "More tire[d] than I should be for what I do. [I] have a lot of aches and pains and don't have much pep. I used to get excited over these jaunts but I'd just as soon stay home, now."

"Wouldn't you know it?" No. 711 thought. "You ask somebody how it is and they'll tell you every time. Oh, well, maybe she will feel better to get it off her chest." And then aloud, "Have you been in to Maintenance lately?"

"You know I have. I have regular checkups. I get the usual attention. If something breaks, they take it off and put on a new one. I'm always getting something new but the first thing you know, it breaks too."

"If I recall," 711 contributed, "you had a pretty sick engine the last time we met. Guess you got it treated."

"Was that the time my No. 2 engine was low on torque and I was laying down such a smoke job that all the planes in that end of the field went on instruments?"

"That's the time."

"Just wait 'til I tell you the rest of that story," 613 was enthusiastic. "My crew was watching No. 2 and expected to feather it before we g[ot] home. But they didn't pay any atte[ntion]

For The Record

It's the little things . . . But the little things about engines add up very quickly—unless you get in the act.

tion to No. 1, and it was drinking oil like it was going out of style. It was the sleeper that made it an odds-on bet that we'd all drop in the drink and nobody would ever know why.

"We weren't more than 800 miles out when the crew feathered No. 2," 613 continued. "Of course, that put more work on the rest of my engines and as you might expect, No. 1 couldn't take it. It clobbered, too."

"Stuff was really stirred, huh?" 711 put in.

"It takes a lot to ruffle my aircraft commander but that was one time he figured he had trouble and to spare. The crew was pitching vital cargo like it was chewing-gum wrappers."

"One trip around the world shot, I'd say."

"Yeah, and nobody knows how close I was to diving one each plane complete with crew very deep into the Pacific. It just didn't seem worth the battle. We turned around but for the next five hours I was moanin' and groanin' and the commander was sweatin' and frettin.' "

"You can't win many like that. You never should have made the trip," 711 protested. "Didn't that smoke warn your crew? Don't you use Engine Trend Analysis at your base? Had you shown any other symptoms before?"

Six-Thirteen ignored all the questions but the last one. "I'd had some sharp pains in No. 2 engine before, and after each one, I'd feel weaker and weaker. My cylinder compression checks on about half a dozen jugs were going lower and lower. Dropping 70, 60, 45—and on the last check they were barely above the minimum. You'd think that would tell them something inside my engine was dogging and not long for this world. But you know how it is—as long as we can lift a wing, up and off we go!"

The Symptoms

"Jerking, jumping, jehosophat!" 711 exclaimed. "You had a trend that even I could read. High oil consumption, smoking engine, falling cylinder compression! Those engines should have gone for preventive maintenance before you made the trip. Instead, I guess they went to the graveyard when you got back. What did the post-mortem reveal? Lots of broken piston rings?"

"In No. 1, yes," 613 answered, "and, of course, small pieces of broken rings finally broke the piston lands. From then on it came apart at the seams."

"Now let me take a guess on No. 2," 711 requested. "You had plugged tappet drains and ended up swallowing an exhaust valve."

Six-Thirteen was visibly disap-

"... it always got its cargo to the South Pole, the Orient, to Europe or someplace Stateside."

"It takes a lot to ruffle my Aircraft Commander. But he had trouble to spare."

pointed at having her story taken away, but surprised enough to ask, "How could you know that?"

"Your trend, girl, your trend!"

"You mean it's showing?"

"Every day it's showing. Your engines send a daily bulletin on their health. If someone receives information, makes a note of it and plots it on a chart, you've got a trend. Either this chart says the engines are well, which inspires confidence in the troops, or it will show up repeat occurrences of a hitch in your get-along. When these repeats occur, usually they are worse each time. That makes a rising curve on the chart, pointing out a trend of an unreliable and failure-prone engine."

"I guess you know what you're talking about," 613 stated, "but I sure don't."

Seven-Eleven was thoughtful a moment, searching for words. Then, "It's sort of like your aircraft commander saying today, 'My arm is sore.' Tomorrow, he says 'My arm feels worse than it did yesterday.' The next day he says, 'My arm is beginning to swell.' He's got a trend toward amputation. But if somebody has noticed these complaints he'll catch the trend and suggest that the commander see a doctor. The good doctor then digs out the infection, slaps some miracle drug and a band-aid on the spot, and the commander's arm gets well. On the other hand, if everyone disregards the minor ailment, the arm is apt to swell more, infect the man's entire body, and put him out of circulation. That's the message, Six, old girl, somebody has to heed the trend and do something corrective before your engines suffer inflight destruction."

Six-Thirteen was impressed but not ready to yield. "Have you included pre-med courses in your career development?"

"Nope, I'm just probably the wing's best eavesdropper, and there's a lot of conversation back in my home base on engine trend analysis. They believe in preventive maintenance and extending the lives of the engines. We've got so many old engines around they've formed a 'You're Only as Old as You Turn' club."

"Well, whizzo," 613 exclaimed, "but how is this preventive maintenance done? What's different about it?"

"We have regular post-flight checks."

"So do we."

"We have engine analyzer runs."

"So do we."

"We get our oil consumption recorded after each flight—how many quarts per hour we use per flight. Had a count just before I rolled in over here."

"That—we don't do," 613 stopped agreeing. "What difference does it make how much oil is used so long as I leave home with a full load on and still have some in the tank when I get back?"

"It isn't just measuring the oil that is important," 711 explained. "It's the individual engine performance picture that the maintenance people get after the oil consumption is measured and plotted for each and every engine."

"Sounds like a lot of trouble," 613 objected.

"Well, at first my crew figured it had enough paper work to do without taking a dipstick and measuring how much oil each engine used per flight and writing it down. Sometimes they'd forget, or sometimes they'd write in the wrong amount. But then a man from the head shed came out on the line and showed them what he did with their figures and explained how this helped everybody. He said, and I'll never forget these words as long as I fly, 'I plot the oil consumption figures on a linear graph whose parameters are quarts per hour versus engine hours.' He told the fellows that these records would help the Maintenance Squadron to spot an engine that needed minor repair and that this preventive maintenance would head off major troubles.

"Wouldn't you know I'd swallow valves?"

Keeping Records

"We went along with him after that—on keeping records. I remember that my engine oil consumption checked out about the same for two or three flights. One day, though, the chart man brought a piece of paper out and said, 'There's a rising curve on No. 4's oil consumption. Keep a close watch on it.'

"After another flight or two he came back insisting 'That the curve on No. 4 is climbing too high and too fast. The engine should come off and go to Maintenance.'

"But there was a mission scheduled and the squadron commander, Major Creasey, said he couldn't spare a plane just because somebody was jumping to conclusions. The chart fellow said, 'That engine won't last your mission and you've got another engine (No. 2) on the same plane that is beginning to smell.'

"That really sent Major Creasey! He barked, 'Here's a dollar that bets you're wrong on both counts. Now take your crystal ball and get out of here. We've got work to do.'

"That mission was a nightmare. Sure enough I came back with No. 4 feathered and creamed and No. 2 gasping. . . .

"I missed the next conversation," 711 picked up its story, "because that time the major went up on the hill to see the man with the graphs. I did hear some scuttlebutt around that the wing commander made him pay off the dollar—mounted on a piece of plexiglas — at the de-briefing critique."

"He should have been convinced that the records on oil consumption rates were worth something after that," 613 said.

"He was," 711 agreed. "He bought the program across the board. Records, strict and accurate, were kept and graphed. Maintenance men consulted these graphs and when one had a curve that said 'alert for trouble,' they pulled the engine and made a painstaking search for the specific item that was causing the trouble. They found broken piston rings, plugged pushrod tappet drains, worn exhaust valve guides, burned valves —the works! But they were able to correct all these little things before they gave the engines any grave problems.

"Just like the professor said—reliability is mighty cheap; if time is all it costs."

"About all I hear on the line now," 711 concluded, "is about what an efficient wing the 'Old Man' is running."

"I wish that our people would start an engine trend analysis program. I don't want any more of those two-engine sweat jobs."

"Give them the word when you go back."

"I wonder if I could. Now, let me see if I've got the picture. Individual records and graphs of engine oil consumption can spotlight an engine trend. If the chart indicates an engine is okay, as it ordinarily will, this assured reliability adds to the successful planning of assigned missions. When a chart shows an erratic curve, it means, 'This engine requires specialized and staff-supervised evaluation.' "

"Why, 613, you sound like the ol' professor himself. Be sure to tell 'em that it doesn't take much time to make these extra records and to correlate them. Also, that the engines that do get preventive maintenance are out only for a very short while and they come back to the plane ready to turn for many more hours. Tell them we don't want any more of these use-'em-while-they-last engines that go out to stay—and too often take one of us with 'em!"

Six-Thirteen yawned, "I've got to get my rest or I'll never make it tomorrow, but I'm very glad that we met again. I'll always say that I learned about engine trend analysis from you!"

"Carry on, 613. East is East and West is West, and one way or another we've got to tie the twain." ▲

The engines that get preventive maintenance are ones that are ready to turn for many hours.

REX SAYS

REDCAP 13, returning from a deployment mission, was nearing the end of an eight-hour flight. It had been one of those flights when a lot of little things happened that were irritating to the pilot even though none of them could be considered an emergency or as endangering the safety of the aircraft. First, an engine had to be shut down because of an overheat light, the UHF radio had been practically useless, several electrical storms had been penetrated and St. Elmo's fire was everywhere. Fortunately, there had been no difficulty in refueling, and the winds had been better than predicted.

As Redcap 13 neared its destination, the pilot contacted Approach Control for penetration instructions. The weather had been reported as 3000 scattered, 5500 broken, higher overcast and 15 miles visibility. There were several local electrical storms and radio reception still left a lot to be desired.

Approach Control acknowledged the pilot's initial call and asked if he desired to make the expedited jet penetration on the omnirange or the normal penetration on the low frequency range. The omnirange letdown had been approved locally but as yet had not been published in the Pilot's Handbook. The pilot, possibly influenced by the poor radio reception on the low frequency range, chose to make a penetration on the omnirange although he did not have a letdown chart for it. He requested and received from Approach Control the inbound and outbound headings, the penetration turn direction and altitude. When repeating the instructions, he stated: "*Right* penetration turn at 12,000 feet." Approach Control replied immediately: "Negative right penetration turn. Penetration turn to the *left* at 12,000 feet."

The next and last transmission from Redcap 13 indicated that it was leaving 4000 feet and turning to a heading of 078 degrees. Shortly thereafter, other pilots saw a brilliant flash on a nearby mountain peak. Redcap 13 had flown into the mountain and exploded.

The Investigation Board determined that the primary cause of the accident was the pilot's attempt to perform a penetration turn in the wrong direction. It was believed that the pilot was possibly influenced by his knowledge of the fact that the penetration turn on the low frequency range is to the right. Other cause factors were:

- Approach Control authorized the use of a locally approved procedure which was not published in the Pilot's Handbook and therefore not available for review, prior to penetration.
- The Controller did not obtain the pilot's acknowledgment of the correct procedure.
- Poor radio reception.
- Existing weather which required a penetration from altitude.

REX SAYS *— One of the cardinal rules for making an instrument flight*

TIPS FOR TIGERS

dream about Flying-BUT DON'T.... ....FLY ABOUT DREAMING

is to check your letdown charts for your destination and alternate, prior to taking off. In this case, there were no published charts for the OMNI penetration available to the pilot.

Air Force Regulation 60-16, requires that the base you are clearing to, under IFR conditions, be equipped with an operational navigational facility and the pilot have letdown charts in his possession. Certainly it is the intent of this regulation that the pilot have charts for the facility he is using when a base has more than one letdown procedure.

★ ★ ★

FOR THOSE of you who are still pushing the old pioneer F-80 around the pattern, here's a cool solution to a hot problem confronting a lieutenant recently.

The good lieutenant returned to his base for a landing one day with 200 gallons of JP-4 and a balky right landing gear which resisted every usual emergency lowering method known to the trade. In spite of lib-beral use of the hydraulic hand-pump, repeated recycling, skidding, rolling and judiciously applied G forces, the right gear warning light still refused to turn to that beloved green. The tower operator continued to report that the gear was most of the way down—but not in the lock position. With only 100 gallons of fuel remaining, the situation called for that 'extra something' most of us pilots hope to have when we need it.

In the pilot's own words, here's how he met the problem: "I made a rectangular pattern with about a mile long final. I cut the airspeed to 115 knots on my approach, maintaining about 70 per cent power. As I came to the runway I put the aircraft in a left skid and jumped the power to 80-90 per cent. Holding the plane in a normal landing attitude, and with its nose about 20 degrees to the right of the runway heading, I touched the gear down in a series of skips and bounces while at an airspeed of 105-110 knots. On about the third or fourth bounce, the green light came on and I performed a go-around. I made a normal landing and waited for pins before I taxied back to the ramp."

As fuel criticality is one of the most important lessons to be learned in the transition of pilots from the conventional to the jet aircraft, I feel that the point to be kept in mind is the way this pilot met his emergency. He was ready — first to go quickly through all the emergency procedures given in the Dash One and still have enough fuel left to try one more "trick" in the effort to save a costly airplane.

REX SAYS*—With this lad's heads-up pilot technique, I'd say it's good to have him aboard.*

Gridley, to be eligible for a Well Done Award you must bring back the aircraft—intact.

★ ★ ★

A FIGHTER PILOT was forced to use maximum braking action (short of blowing tires) during landing at a municipal airport. He taxied in and the alert crew parked the jet fighter in a highly congested area. The pilot was filling out the Form 781, the alert crew was standing by, when both wheels exploded. The shrapnel blew a three-foot hole in the side of a new F-101 parked next to the hot-foot fighter. Fortunately, no one was injured.

Naturally, maximum braking action should be avoided if at all possible; however, if the pilot is forced to use the brakes to the maximum, he should notify the tower and ask the alert crew to cool the brakes and tires before parking the aircraft in a congested area.

The F-100D Handbook has this to say on the subject:

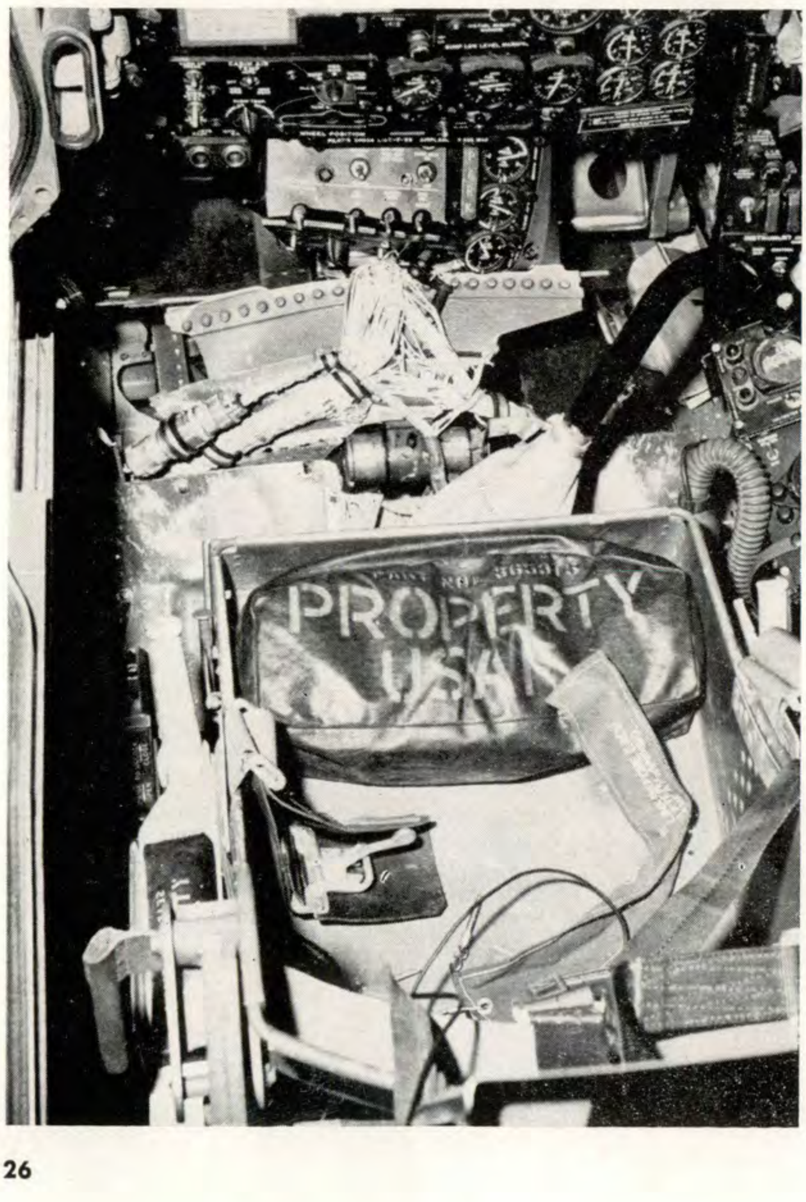
"When approaching the wheel with cooling apparatus or for inspection purposes immediately after a maximum braking operation, the approach direction should be in the plane of wheel rotation to minimize personal damage from possible explosion.

"If compressed air blast is not available to cool the wheel and tire assemblies, water spray or CO_2 in short bursts of small amounts should be applied. EXTREME CAUTION must be used because the improper use of water spray or CO_2 can cause the wheel to explode.

"If immediate cooling is impossible, warn all personnel to remain clear of the wheel area because of the danger of wheel explosion."

REX SAYS*— And I say again, DON'T park that bird in a congested area until those brakes cool.*

UP or DOWN ?



TWO YEARS AGO the Directorate published a Study on Emergency Landings on Unprepared Surfaces which recommended that jet fighter aircraft land gear-down when making forced landings. This shook many pilots, since it was 180 degrees off from what they'd been taught.

Looking back over the past year it is apparent that the recommendation was valid, as injuries have decreased since pilots have been lowering the rollers. In 1956, 82 jet fighters (and trainers) force-landed on unprepared surfaces. Of the 82 accidents, 41 pilots landed wheels-down and 41 wheels-up.

Way to Injury

From the injury standpoint, 24 of the pilots who landed wheels-up had some degree of injury. Thirteen of the 24 had spinal injuries. Only 11 pilots (out of 41) were injured landing gear-down, and just one (of the 11) suffered a spinal injury.

It's the same story on overshoots. There was a day when the recommended procedure was to "up" the gear when running out of runway. Of course, most fighter bases have runway barriers today. But take a look at the statistics on overshoots—of course not counting the barrier engagements. When the gear was retracted, 67 per cent of the pilots received some degree of injury. When the gear was left down, only 11 per cent of the pilots were injured.

On undershoots it's the same story —more pilots received injuries during gear-up landings than when the gear was down.

Left shows damage from accident below.

Getting back to the Special Study, at that time the recommendation did not apply to the F-89. It was possible for the Scorpion to trap the pilot when the bird landed off hard surfaces with the gear extended. The nose gear drag brace could be driven up into the cockpit distorting the floor whenever the nose gear strut failed.

About two years ago, an F-89 on a scramble mission aborted a takeoff because of a fire warning light. Since the remaining runway did not permit stopping, the pilot steered the aircraft into a snowbank paralleling the runway. The nose gear failed, driving the drag brace through the cockpit floor and pinning the pilot's legs to the instrument panel. Fortunately, the crash crew extinguished the resulting fire. The pilot was only slightly injured.

Damage to cockpit interior was eliminated. Compare above and below with pics on facing page.

The Straw

This accident was the one that broke the camel's back and triggered off a study of F-89 nose gear failures and subsequent cockpit floor distortion. The IBM machines started grinding out data and the results were startling.

Over a three-year period, 24 of these accidents had occurred. In each case the cockpit floor was ruptured by the drag brace. Sixteen of the accidents had happened within a nine months period.

The prime AMA at first tried reworking the cockpit floor to beef it up. This didn't prevent the drag brace from entering the cockpit, however, and — well, there just wasn't enough room in it for both the pilot and the drag brace. So, the drag brace pin was redesigned.

Technical Order 1F-89-615 required replacement of the drag link lower pin with a close tolerance shear pin. The new shear pin is a hollow pin with a weak point that will shear under abnormal loads. A machined guide and two machined slides were added to make sure the drag brace folded flat on the nose gear strut when it failed instead of being driven through the cockpit floor. The accompanying pictures show the difference between what happens in a modified F-89, as compared to one that had not been modified.

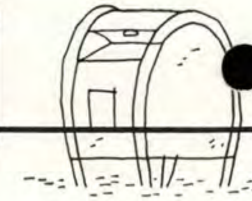
From January through June of this year, four accidents occurred which involved nose gear failure on modified F-89 aircraft. In each, the pin sheared successfully and the drag brace did not rupture the cockpit floor.

Safety of Flight Supplement Tech Order 1F-89D-1CL, published 12 Feb 57, now instructs F-89 pilots to make all landings with the gear extended, if T. O. 1F-89-615 has been complied with. ▲

Violent cases occurred prior to the modification. Your procedures are dictated by this.

CROSS FEED

LETTERS TO THE EDITOR



B-57 Flying Technique

In the June issue you published a letter from Capt. Paul R. Pitt which concerned single-engine flying technique on the B-57 aircraft.

This letter was accurate and to the point. I would like to add my endorsement to his comments and also suggest that any B-57 pilots that have not seen the film on single engine flying technique, which includes a scene of an attempted go-around on one engine with the tragic results, should see your Flight Safety Officer and ask for a showing at once.

If any of the B-57 Flight Safety Officers do not have a copy of this film I will be more than glad to send them one if they will write me directly. Obviously, we can only furnish them on a permanent basis to the units using the B-57 aircraft, although I would be glad to send them to other bases on loan, if so requested.

O. E. (Pat) Tibbs, Manager
Flight Test Dept &
Chief Test Pilot
The Martin Company

★ ★ ★

From Down Below

In your August 1957 issue, you published a letter from Major Larry Smith, USAF Exchange Officer, No. 82 Bomber Wing, Royal Australian Air Force, Australia, wherein the Major indicated a problem in obtaining and retaining copies of your magazine. The problem of retention seemed to arise from some crazy habit the Australians have of eagerly searching for and reading all world views and news, including FLYING SAFETY.

As an RAAF Officer, formerly of the 82d Bomber Wing, and now on Exchange Duty with the U. S. Air Force, allow me to do something to ease the Major's problem and to satisfy my brother officers' desire for broader knowledge. Enclosed find my check for one year's subscription to FLYING SAFETY. Copies to be forwarded direct to the Officer Commanding the 82d Bomber Wing RAAF, Amberley, Queensland, Australia.

David R. Smyth
Sqdn Ldr, RAAF
Mather AFB, Calif.

It's real nice of you to want to do something for your old outfit. All subscriptions, however, must be sent to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

★ ★ ★

10-Second Gear Warning

There has been much controversy recently concerning GCA glide path angles and threshold clearances, particularly with reference to C-124 type aircraft. I've worked a few C-124s and have observed many other (C-124) GCA approaches, and time after time and approach after approach I've seen pilots get into a hazardous situation by taking at face value the GCA 10-second gear warning prior to intercepting the glide path.

The following example is a typical and true incident. The aircraft number, the time and date are omitted, however, for obvious reasons.

The approach occurred at night during IFR conditions. The GCA final controller gave the C-124 pilot his 10-second warning approximately 10 seconds early, or 20 seconds prior to glide path interception. Ten seconds after the gear warning (the aircraft was still 10 seconds from actual glide path interception), the C-124 was observed to begin its descent and in less than a minute it was 150 feet below glide path and the final controller was turning gray-haired and blue in the face, trying to get the pilot to level off. Well, he did—finally—and the approach was completed without mishap.

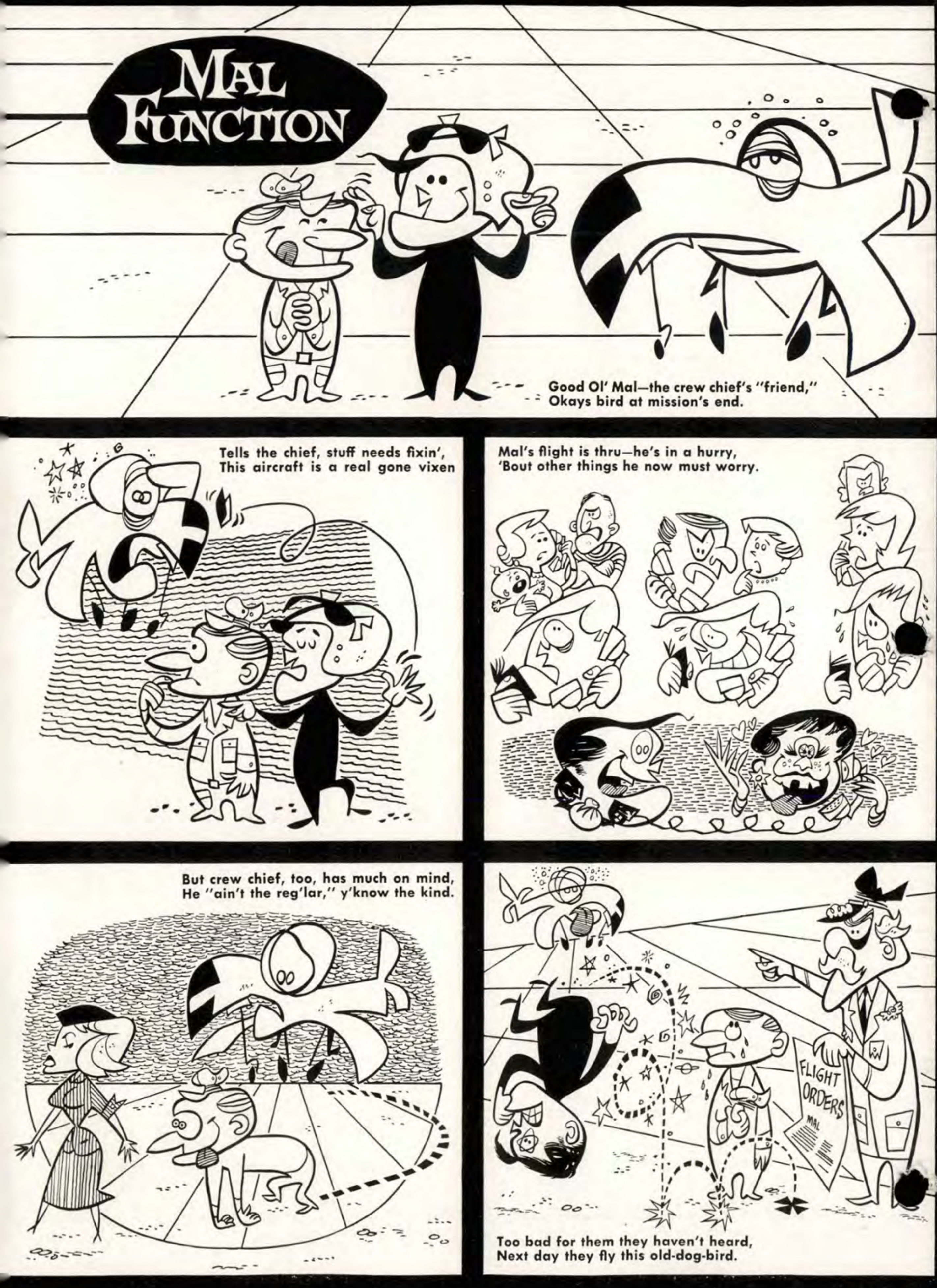
An incident of this type cannot attributed to controller error. must be understood by the pilot that a 10-second gear warning is an educated guess by the GCA final controller and may vary from five to 15 seconds. I think that pilots should be briefed that a 10-second gear warning does not necessarily mean that 10 seconds later the aircraft will be on the glide path and it is okay to commence a descent. The pilot should continue to follow GCA instructions and not try to "second-guess" the controller.

1st Lt. Eddie N. Nicholson
1961st AACS Sq, Clark AB.

Right. Doing what the man says is one thing—trying to anticipate his next transmission and over-eager action is something else. Take 'em as they come.

...*Keep it in Shape!*

Taking care of what you've got is not a matter of being all tied down. It's just plain good sense. This little doll is taking no chances. While that rope may temporarily restrict her freedom, it helps to keep her in shape. That's the way it is with good procedures. They may tend to hold you down sometimes. But you'll have what you want, when you need it — if you stay within the established limits.


MAL FUNCTION
Good Ol' Mal—the crew chief's "friend,"
Okays bird at mission's end.
Tells the chief, stuff needs fixin',
This aircraft is a real gone vixen
Mal's flight is thru—he's in a hurry,
'Bout other things he now must worry.
But crew chief, too, has much on mind,
He "ain't the reg'lar," y'know the kind.
FLIGHT ORDERS
MAL
Too bad for them they haven't heard,
Next day they fly this old-dog-bird.